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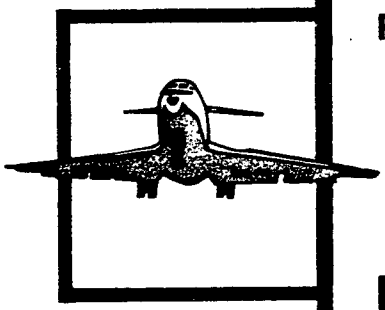

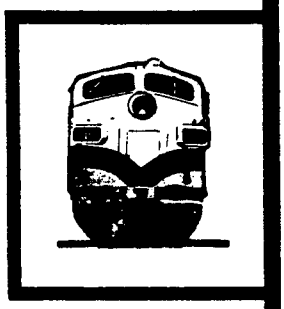

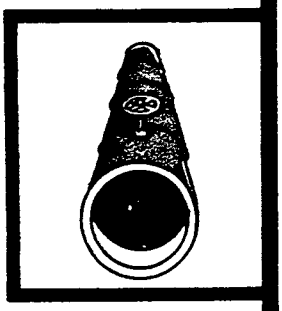

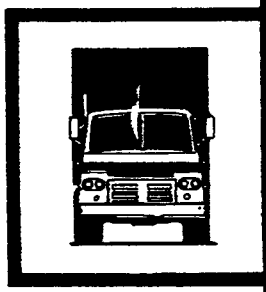

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

MARINE ACCIDENT REPORT

FIRE ON BOARD THE BAHAMIAN PASSENGER SHIP THE SCANDINAVIAN STAR IN THE GULF OF MEXICO MARCH 15, 1988

NTSB/MAR-89/04

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/MAR-89/04	2. Government Accession No. PB89-916404	3. Recipient's Catalog No.	
4. Title and Subtitle Marine Accident Report--Fire On Board the Bahamian Passenger Ship The SCANDINAVIAN STAR in the Gulf of Mexico, March 15, 1988		5. Report Date July 6, 1989	
		6. Performing Organization Code	
7. Author(s)		8. Performing Organization Report No.	
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 4857A	
		11. Contract or Grant No.	
		13. Type of Report and Period Covered Marine Accident Report March 15, 1988	
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D.C. 20594		14. Sponsoring Agency Code	
15. Supplementary Notes			

16. Abstract

About 2325 on March 15, 1988, a fire occurred in the engineroom of the Bahamian flag passenger vessel SCANDINAVIAN STAR. At the time of the fire, the ship was about 50 nmi northeast of Cancun, Mexico, en route from Cozumel, Mexico, to St. Petersburg, Florida, with 439 passengers and 268 crewmembers on board. The master broadcast a distress message and ordered the evacuation of passengers to the four muster stations on the ship. The loss of main generator and emergency generator electrical power and the malfunction of the ship's fixed CO_2 firefighting system hindered efforts to fight the fire. The inability of crewmembers to communicate with each other and with passengers created confusion during the firefighting and evacuation activities. Two crewmembers received minor injuries during the emergency. Two passengers were medivaced from the vessel and flown to a hospital in St. Petersburg, Florida, where they were treated and later released. Damage and repair costs were estimated at $3.5 million.

17. Key Words Fire; passenger ship; ventilation; SOLAS; International Maritime Organization; preventive maintenance; firefighting; Control Verification Program; fixed CO_2 system; fire drills; training; evacuation; lifejackets; emergency procedures; muster list; fuel oil		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 78	22. Price

NTSB Form 1765.2 (Rev. 5/88)

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- o engineroom emergency firefighting procedures;
- o engineroom maintenance program;
- o Coast Guard control verification examinations;
- o classification societies' vessel examinations;
- o language barriers on board ship; and
- o safety instructions to passengers.

The National Transportation Safety Board determines that the probable cause of the uncontrolled engineroom fire on board the cruise ship SCANDINAVIAN STAR was (1) the lack of a preventive maintenance program for the engineroom that resulted in the failure to replace deteriorated fuel pipe packing seals and deflector sleeves, (2) inadequate crew training, and (3) the lack of written engineroom emergency firefighting procedures. Contributing to the severity of the emergency was the malfunctioning of the ship's fixed CO_2 fire suppression system, and the inability of some crewmembers to communicate in a common language with each other and with passengers.

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EXECUTIVE SUMMARY

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As a result of its investigation, the Safety Board issued safety recommendations to the U.S. Coast Guard, SeaEscape, Lloyd's Register of Shipping, and Bureau Veritas.

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON D.C. 20594

MARINE ACCIDENT REPORT

FIRE ON BOARD THE BAHAMIAN PASSENGER SHIP THE SCANDINAVIAN STAR IN THE GULF OF MEXICO MARCH 15, 1988

INVESTIGATION

The Accident

Just after midnight on March 14, 1988, the Bahamian registered passenger vessel SCANDINAVIAN STAR departed St. Petersburg, Florida, on a voyage to Cozumel, Mexico. (See figure 1.) There were 439 passengers (over 90 percent of whom were U.S. citizens) and 268 crewmembers aboard.

About 1349,[1] that same day, the port engine of the vessel was stopped to repair a fuel oil leak to the No. 6 cylinder. The repair was completed about 1421, and the port engine was restarted and put back into service. The vessel continued the voyage to Cozumel arriving at 0900 on March 15.

Approximately 1925, on March 15, the SCANDINAVIAN STAR departed Cozumel as scheduled on the return voyage to St. Petersburg. That evening, about 2325, the watch motorman proceeded aft from the oil separator room, which is on "E" Deck, into the main engineroom. (See figure 2.) As he walked between the two main diesel engines, he noticed fuel oil leaking from the supply pipe which feeds fuel oil to the No. 7 cylinder injector pump on the inboard side of the starboard main engine. He observed the fuel oil leak develop into a spray which ignited upon contact with the hot exhaust manifold on the starboard engine. According to the motorman, the initial fire created by the fuel oil leak was about 3 feet in diameter and 6 feet high.

The motorman hurried up the starboard aft ladder to the front of the enclosed, air-conditioned engine control room, which is located on the upper engineroom level at "D" Deck, and knocked on the control room window to get the attention of the watch engineer. The watch engineer was checking the loads on the generators at the switchboards and had his back to the window. When he heard the knock, he turned and saw the motorman who began using hand signals[2] to inform him of the fire. The automatic smoke detection alarm system for the engineroom did not activate.

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[1] All times herein are eastern daylight time based on a 24-hour clock.

[2] The Honduran motorman and the Filipino watch engineer shared no common language; consequently, they communicated with each other by hand signals.

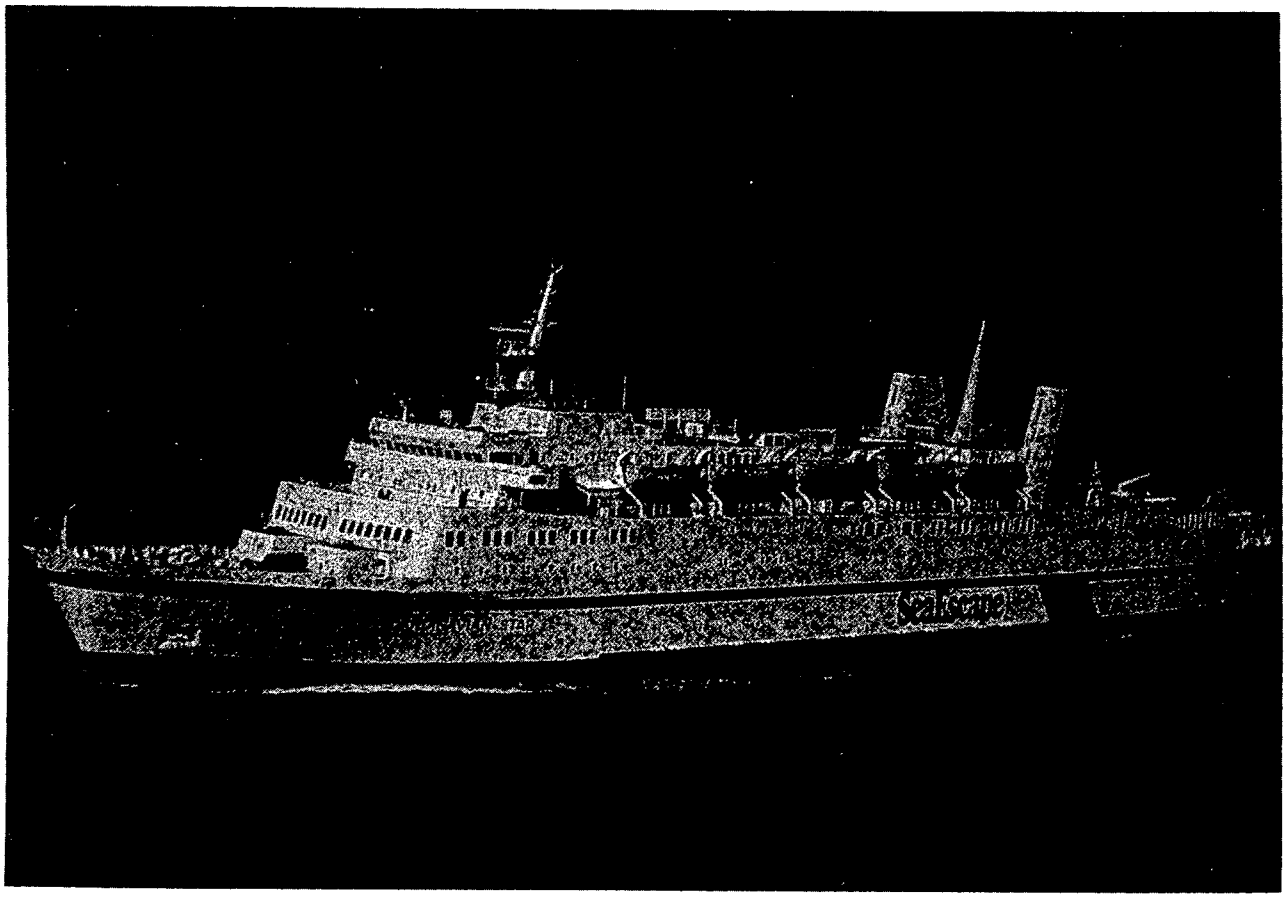
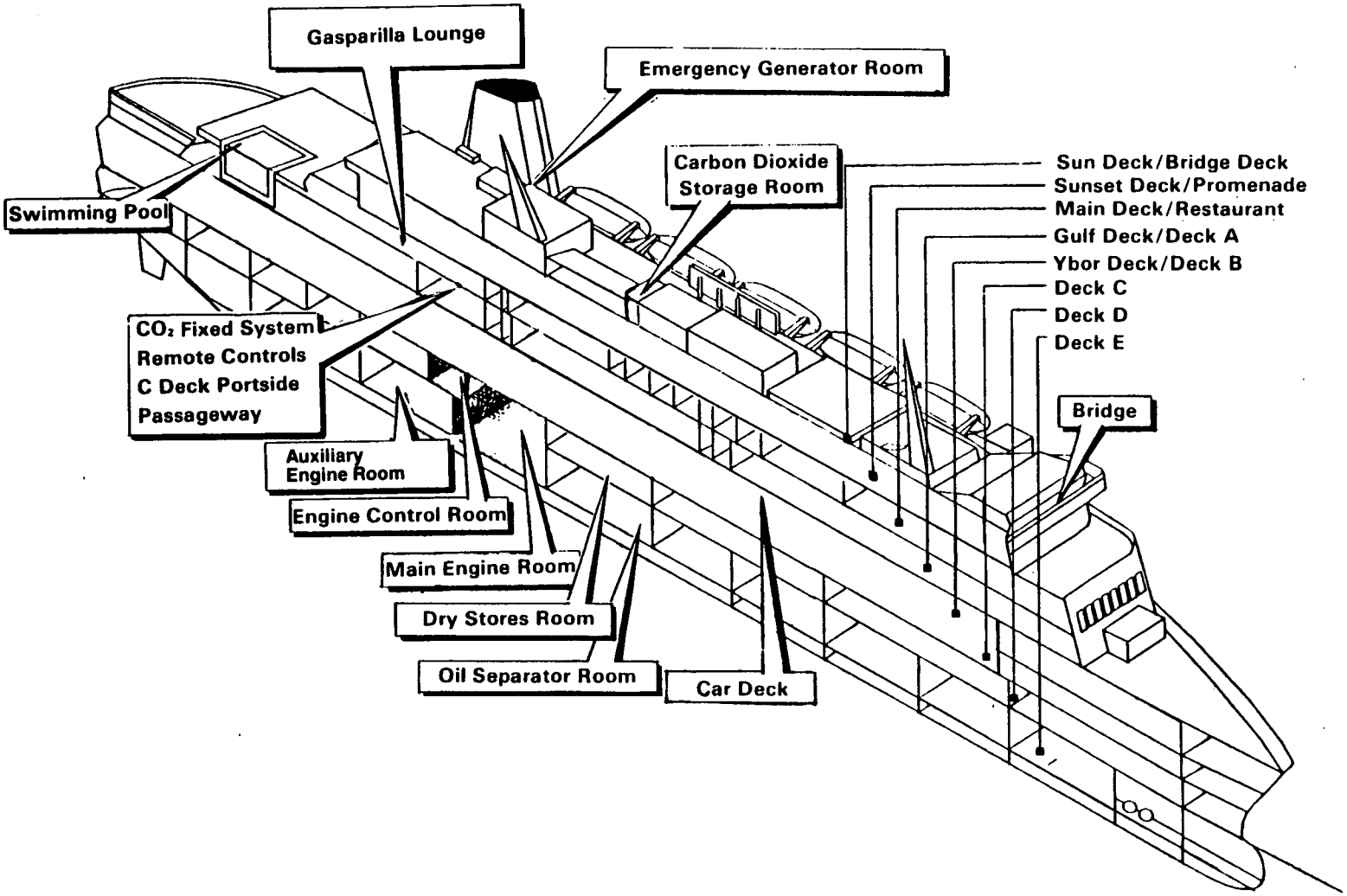


Figure 1.--The SCANDINAVIAN STAR.

The watch engineer signaled the motorman to get a portable CO_2 fire extinguisher and fight the fire. The motorman proceeded to the starboard side platform, on "D" Deck, adjacent to the outboard side of the starboard engine and attempted to fight the fire with a portable fire extinguisher stored nearby.

Meanwhile, the watch engineer activated the starboard engine emergency shutdown control on the engineroom control console. However, he did not shut down the port engine, or the engine fuel oil booster pump, which feeds both main engines. The booster pump continued to operate supplying fuel oil to both engines and the fire. The watch engineer stated that he did not stop



ROBERT E. GRAHAM / The Detroit News

Figure 2.--Three-dimensional view of SCANDINAVIAN STAR.

the fuel oil booster pump because he believed that "it could only be the starboard engine that is having fire. And I was thinking we could put out the fire as quickly as possible." The watch engineer then telephoned the navigation watch on the bridge and told the second mate to stop both engines. He did not inform the second mate of the fire. (The propulsion systems, engine speed, and propeller pitch were under the control of the navigation bridge watch at that time.) According to the watch engineer, "the fire was growing larger faster." Approximately a minute later, the engineer again called the bridge and reported the engineroom fire.

The second mate, who was in charge of the bridge watch at 2325 when the fire was reported, informed the master, by telephone, of the situation. In response to the watch engineer's request to stop both engines, the second mate then placed both of the ship's controllable pitch propellers in the zero pitch position. The master, who was in his stateroom, came to the bridge and assumed control of the bridge watch. He heard the manual fire alarm sound on the bridge and checked the manual fire alarm panel, which indicated an activated manual fire alarm at a location on the port side of "C" Deck (zones 34 & 35) and not the engineroom. The master then instructed the second mate, who was also the leader of the Fire Limitation Group,[3] to get a portable VHF radio, proceed to the location indicated on the bridge manual fire alarm control panel, close all the fire screen doors in the area, and report all important circumstances to the operational command on the bridge.

About 2328, shortly after instructing the second mate to proceed to the location of the manual alarm, the master initiated Phase I of the ship Emergency Plan by sounding the emergency fire alarm bell in all crew quarters and crew work areas and by announcing over the public address system for the Mobile Fire Group to meet in the Car Deck (see figure 2). Next, the master shut down the ventilation system to the passengers' accommodations from the emergency stop switch on the bridge.

By this time, the flames had reached the engineroom overhead, impinging on the main electrical power cables that distributed electric power from the main switchboards in the engine control room to electrical distribution panels located throughout the vessel. The watch motorman heard the Phase I emergency fire alarm bell and signaled to the watch engineer that the fire was too hot and that he was leaving the engineroom. When the watch motorman left the engineroom, he made no attempt to close the fuel oil valves to the starboard engine or stop the engine fuel oil booster pump, and he was not ordered to do so by the watch engineer.

After the motorman exited the engineroom, the watch engineer attempted to enter the engineroom through the control room starboard door to fight the fire with a portable CO_2 fire extinguisher. The fire, however, had

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[3]The ship emergency plan groups the crewmembers and officers into five main groups in the event of an emergency. The Mobile Fire Group is one of the five main groups and consists of three subgroups: the Firefighter Group, the Fire Limitation Group, and the Search & Ambulance Group. (See appendix C for an outline of each group's responsibility.)

intensified, and the heat and smoke in the engineroom forced him back into the control room. The watch engineer then left the engine control room and abandoned the engineroom by the port side door to the "C" Deck passageway. When the watch engineer left the engine control room, he again did not attempt to shut off the fuel oil booster pump at the engine control room console. The fuel oil booster pump continued to run, supplying fuel oil to the fire.

The motorman, who was followed shortly thereafter by the watch engineer, ran a few yards along the after section of the port side "C" Deck passageway and proceeded through an inboard fire door which leads to the open Car Deck area. Located in the after port side "C" Deck passageway were the emergency control cabinets that contained the remote valves to shut off the fuel oil tanks in the engineroom and the fuel pumps to the main engines and the five ship's service generator diesels, to stop the engineroom ventilation system, and to release the vessel's fixed CO_2 firefighting system. (See figure 2.) Both the motorman and the watch engineer proceeded directly to the Car Deck area without activating the emergency controls in the passageway.

In response to the master's announcement, the Firefighter Group, including the watch motorman, began assembling in the Car Deck area donning their protective fireman's clothing and preparing their equipment. The watch engineer arrived shortly thereafter.

When the fire started in the engineroom, the staff captain, staff engineer, and chief engineer were at different locations in the large Gasparilla Lounge on the main deck (see figure 2) watching a show with the passengers. The chief electrician was off watch, asleep in his room.

The staff captain was standing on the starboard side of the Gasparilla Lounge when the second mate, who was on his way from the bridge to "C" Deck, told the staff captain that smoke had been reported in the port side of "C" Deck. Upon arrival at the alarm location, the second mate reported via radio to the master that there was smoke in the port passageway of "C" Deck and in the Car Deck area and a fire in the main engineroom. The master then ordered the second mate to have his Fire Limitation Group close all the fire screen doors in that area. The staff captain, who was in charge of the Mobile Fire Group, proceeded to the Car Deck where he saw smoke but no fire. The staff captain was told by one of the crewmembers that the fire was in the engineroom but he was not told the source of the fire by either the watch engineer or motorman, who were among the firefighters in the Car Deck area, nor did the staff captain ask anyone for that information. According to statements by the staff captain, the motorman, and the watch engineer, there was no exchange of information between the two engineroom watch standers and the staff captain about the extent of the fire, the type of fire, or the fuel feeding the fire. When asked following the accident why he did not seek this information, the staff captain responded that "it is not my responsibility." The staff captain stated further that he was never told throughout the emergency that a fuel leak was the source of the fire. The staff captain also stated that he automatically assumed that the fuel supply to the engineroom had been shut off, and that it was the watch engineer's responsibility to do so.

The staff engineer was just leaving the Gasparilla Lounge through the after doors near the swimming pool when he smelled and saw smoke coming up from below. He immediately proceeded down the port side of the ship toward his emergency station in the engineroom.

When the staff engineer arrived at the port side passageway on "C" Deck, he attempted to enter the engineroom but was driven back by intense heat and dense smoke. According to the staff engineer, after closing the engineroom door, he went to the emergency control cabinet and closed the remote shutoff valves for the engineroom fuel oil tanks. Running a short distance aft in the "C" Deck passageway to the next emergency control cabinet, the staff engineer activated the remote controls to stop the engineroom ventilation fans, the fuel pumps for the main engines, the generators diesels and boilers, and the pumps for the oil separators. He then went into the Car Deck area where the staff captain, the watch engineer and motorman, and the Firefighter Group had gathered.

At this time, the firefighters could feel heat in the steel deck plating about two-thirds of the way aft on the Car Deck. Smoke was seeping through bolted steel deck covers in the Car Deck that allowed access to the engineroom equipment located below.

Meanwhile, the chief electrician, who was asleep in his cabin when the Phase I fire alarm woke him, dressed and attempted to get to his emergency station in the engine control room. He went down the forward staircase toward the Car Deck, but was unable to proceed due to dense black smoke. He started coughing and went up to the Gasparilla Lounge, but was unable to proceed because passengers, who were forced to leave the lounge because of the accumulating smoke, blocked his path. He returned to his cabin, wet a towel, wrapped it around his face, and went below again. When he arrived at the engineroom, he attempted to open the port side door but was forced back by the intense heat and smoke. He left the port side passageway on "C" Deck and went to the bridge where he reported to the master and was told there was a fire in the engineroom.

The chief engineer left the Gasparilla Lounge a few minutes after the staff engineer and was on his way to his emergency station in the engine control room when he met the staff engineer in the Car Deck area. The chief engineer and the staff engineer spoke briefly with the engineroom watch engineer and motorman. When the staff engineer confirmed that there was no one in the engineroom and decided to activate the fixed CO_2 firefighting system, he ran from "C" Deck up five decks and forward to the bridge to tell the master. When the master received word that all engine department crewmembers were accounted for, he closed the nine automatic watertight doors in the engineering spaces from the remote control switch on the bridge to contain the CO_2 and gave the staff engineer permission to activate the system.

Having received permission from the master to release the CO_2, the staff engineer returned to the Car Deck from the navigation bridge. He and the chief engineer then donned oxygen breathing apparatus (OBA) and proceeded to the CO_2 remote release cabinet in the port side passageway on "C" Deck.

According to the chief engineer, the smoke in the passageway at that time was very thick. About 2338, the staff engineer opened the cabinet and aligned the manifold distribution valves so that the CO_2 would release only into the main engineroom. The staff engineer attempted to actuate the CO_2 remote automatic release mechanism by opening the valves on the actuating system's two pilot CO_2 bottles. They heard the pilot bottles release their pressurized gas. However, by feeling the CO_2 manifold pipe and watching the pressure gauge on that line, the staff engineer determined that none of the CO_2 in the storage room had released. The staff engineer then proceeded toward the CO_2 bottle storage room, which was located about midship on the Sun Deck, five decks above "C" Deck. The chief engineer ran directly to the navigation bridge on the Sun Deck to get the key[4] for the CO_2 bottle storage room.

About 2340, when the staff engineer and chief engineer were proceeding to their respective destinations on the Sun Deck, the ship's main electrical power was lost. The emergency generator diesel started but did not generate any electrical power. The emergency battery system activated automaticaly which left the passengers, officers, and crewmembers either in the dark or with very little light. The emergency battery system furnished temporary electrical power to the navigation lights, and limited lighting at lifeboat stations, at control stations on the bridge, in the engineroom, in the steering gear room, and in passageways, stairwells and exits.[5] There was no electrical power for the public address system or any fire pumps from the emergency battery system.

The master in the meantime faced a situation of a raging fire in the main engineroom, a malfunctioning of the CO_2 firefighting system, no propulsion power, no main or emergency generator electrical power, and no fire pumps available. The ship was adrift in 10 foot seas and 27 knot winds. Based on this situation, at 2341 the master initiated Phase II of the ship Emergency Plan, which involves the evacuation of passengers to the four muster locations on the ship. Using a portable VHF radio, the master contacted the leader of the Central Squad, which was responsible for the evacuation, and initiated Phase II. (See appendix C.)

About 2346, the ship's doctor informed the operational command on the bridge that he had one passenger suffering from a possible heart attack and another passenger with a back injury. According to the ship's doctor, there was insufficient lighting in the hospital for treating any other persons who might be injured. He requested and received permission to relocate the emergency medical team to the lounge area on the Sun Deck.

Meanwhile, after obtaining the key from the bridge, the chief engineer returned to the CO_2 storage room and unlocked the door. Although the room

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[4] The CO_2 bottle storage room was kept locked to prevent anyone from tampering with the system.

[5] On the emergency battery system, about every third light is illuminated.

was dark, he could hear the hissing sound of leaking CO_2. The chief engineer had left his OBA at the emergency control cabinet in the port side "C" Deck passageway and did not want to enter the storage room without one. He searched for the staff engineer, whom he met on the stairway to the Sunset Deck. They returned to the CO_2 bottle storage room, and after the staff engineer donned his OBA, he entered the room and found that CO_2 was leaking from the pilot bottle pipe line. He then attempted to release manually the CO_2 bottles in each of four individual rows that held the 36 bottles of CO_2 designated for the main engineroom. However, the four manual releases at the end of each of the four rows malfunctioned. Finally, about 2350 in the dark, the staff engineer climbed on top of the rows of CO_2 bottles and released each bottle of CO_2 by hand, one at a time. He could hear and feel the CO2 flowing in the piping system on its way to the main engineroom.

The firefighters in the meantime had discovered a hot spot on the Car Deck at frame 75 near the centerline of the Car Deck area. Since there were no fire pumps available on the emergency battery system, the crewmembers, at 2345, connected a fire hose to the swimming pool drain line and began using the approximately 50 tons of salt water in the pool to cool the deck.

When the main generator electrical power was lost, the chief electrician headed aft on the Sun Deck from the bridge to the emergency diesel generator room. When the chief electrician reached that location and entered the room, he found the diesel end of the generator running. However, when he used his flashlight to check the gauges on the emergency switchboard, he discovered that there was no electrical power output from the emergency generator. Shortly thereafter, the staff engineer arrived and together they examined the generator and its switchboard. The two men determined that the generator had lost the excitation to the generator's magnetic field. There was no battery in the emergency generator room to provide the 24-volt DC-power supply needed to excite the generator's electromagnetic field. The chief electrician attempted to provide the power by connecting D-cell flashlight batteries to the generator field circuit, but they did not provide sufficient electrical power. Remembering that there were two spare truck batteries stowed in the Car Deck, the chief electrician hurried below and with the assistance of two crewmembers carried one of the batteries to the emergency generator room. Once the truck battery connections were made, the emergency generator was put on line, and at 0041 on March 16, it provided electricity to the emergency switchboard which distributed power to the emergency fire pump and other vital ship circuits.

Meanwhile, the firefighters discovered additional hot spots on the outside of the starboard stack trunk, which contained the starboard boiler smoke stack and the starboard main diesel engine exhaust pipe. At 0130, with the emergency fire pump operating, the firefighters removed the starboard stack interior baffles at the top of the stack and used a fire hose connection on the Sun Deck to spray water down the stack trunk.

At 0245, the starboard stack area was reported cool. But at 0320, the port stack trunk at the Sun Deck level was reported hot and the after bulkhead in the dry stores compartment on "D" Deck, which is the engineroom forward bulkhead, also was reported hot on the port side. A water stream was

directed inside the port stack trunk to cool the area. Below, on "D" Deck, insulation was removed from the dry stores aft bulkhead that was adjacent to the engineroom, and the bulkhead was cooled with water from a fire hose.

All monitored spaces were reported cool at 0645 and a fire watch was set. Phase II of the ship Emergency Plan was cancelled. At 1600, the engineroom was opened and the crew determined that the fire had been extinguished. Thereafter, the engineroom was kept closed and a fire watch checked its condition every half hour.

Search and Rescue

According to the vessel's March 15, 1988 deck log and radio log, about 2351, the master of the SCANDINAVIAN STAR ordered the broadcast of the following safety PAN[6] message on the Very High Frequency (VHF) transmitter using channel 16 (156.8 MHz), an international distress frequency:

> PAN PAN This is cruise ship SCANDINAVIAN STAR. Call sign C6BF. Adrift in position 21 degrees 38 minutes N 86 degrees 21 minutes W. Complete power [propulsion and electrical] failure after engine fire. Request shipping in vicinity to stand-by for possible passenger takeover. Master.

About 2354, the same message was transmitted again on channel 16 with the following addition: "any station please confirm receipt of this message."

About 2358, the entire PAN message was transmitted again. This time the message was broadcast over the emergency radio medium frequency (MF) transmitter using the international distress frequency of 500 kHz. A few minutes later, the cargo ship AMBASSADOR, calling on VHF channel 16, confirmed receipt of the message and replied that they were en route to the broadcast location. About the same time, the cruise ship VERACRUZ I also responded on VHF channel 16 and acknowledged receipt of the message and changed course toward the SCANDINAVIAN STAR, which was about 40 miles away at that time. At 0002, March 16, the PAN message was transmitted again on 500 kHz. The passenger ship CANADA STAR also confirmed receipt of the message about 0010, and stated that they were approximately 13 miles from the SCANDINAVIAN STAR and heading toward its position.

The radio log at the U.S. Coast Guard (Coast Guard) Communication Station at Miami, indicated that the SCANDINAVIAN STAR's MF (500 kHz) emergency message was received at 0014 on March 16. The information was forwarded to the Operations Center at the Coast Guard's 7th District headquarters in Miami. After receiving the message, the Coast Guard conducted a computer sweep of the area around the SCANDINAVIAN STAR to

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[6] PAN (Urgency) - Indicates that the calling station has a very urgent message to transmit concerning the safety of the ship or the safety of a person.

determine if there were any vessels (merchant or U.S. military) in position to aid the stricken passenger ship. The Coast Guard confirmed that the CANADA STAR, the VERACRUZ I, and the AMBASSADOR were in the area and proceeding toward the cruise ship. At 0027, the Coast Guard Cutter VIGILANT, which was approximately 80 miles away, was ordered to divert to aid the SCANDINAVIAN STAR with an estimated time of arrival of 0930.

The Coast Guard in Miami attempted to maintain radio contact with the SCANDINAVIAN STAR on the MF 500 kHz band, but due to atmospheric interference requested the cruise ship to change frequencies from MF to the high frequency Single Side Band (SSB) to improve the communications. The SCANDINAVIAN STAR responded that because it was operating on emergency radio batteries, it did not have the power to use the longer range main transmitter and could not change channels. The Coast Guard in Miami continued to communicate with the vessel on 500 kHz, requesting information about the number of injuries, the extent of the damage, and the status of the fire. In a message which began at 0031, the Coast Guard in Miami was told that:

> Ship at no immediate danger at the moment.....At present no immediate danger to persons on board. Following vessels underway to our position for possible evacuation, VERACRUZ and CANADA STAR. Please contact SeaEscape representative to arrange return of passengers and possible tug service.

At 0043, the master of the SCANDINAVIAN STAR released the cargo ship AMBASSADOR from the emergency response to continue its voyage. Other vessels which entered the area continued to offer assistance, but their assistance was declined by the SCANDINAVIAN STAR.

About 0055, the CANADA STAR arrived on scene and maneuvered alongside the SCANDINAVIAN STAR, with its port side to the SCANDINAVIAN STAR's starboard side. Shortly after the arrival of the CANADA STAR, hot spots on the outside of the starboard stack were discovered by the firefighters. The CANADA STAR attempted to direct water streams from their fire hoses to cool the stack trunk area. Due to the high winds and seas, there was risk of a collision between the two ships so the CANADA STAR could not maneuver close enough to cool the outboard starboard stack area.

Meanwhile, the Coast Guard in Miami contacted SeaEscape shoreside personnel and informed them of the master's request. The Mexican Navy contacted the Coast Guard in Miami and stated that five Mexican Navy vessels were ready to assist. The Coast Guard did not formally request Mexican Navy assistance but told them that they were free to assist if they desired.

About 0200, using a SSB transmitter, the master of the SCANDINAVIAN STAR called the Coast Guard in Miami and requested firefighting equipment. At 0214, communicating on the SSB frequencies, the master of the Coast Guard cutter VIGILANT established a communication schedule of every half hour with the SCANDINAVIAN STAR. The master of the VIGILANT, acting as the Coast Guard on-scene commander, made the following recommendations and forwarded the message to the Coast Guard in Miami:

> Suggest C-130/HU-25 [fixed wing aircraft/helicopter] be made available for possible airdrop FF [Film Forming] Foam/OBA's [Oxygen Breathing Apparatus] if necessary. Recommend inport cutters be polled as to availability and contingency plan be developed for PM delivery to VIGILANT. Suggest GOM (Government of Mexico) be contacted to render assist from Isla Mujeres Naval Base.

Unknown to the VIGILANT, about 0211, the Mexican Navy oceanographic vessel, HO-2, contacted the SCANDINAVIAN STAR on VHF channel 16 stating that it was 20 miles away and en route to the cruise ship and was accompanied by the Mexican Navy patrol boats D-11 and D-20.

About 0300, in order to determine what type of emergency equipment was needed to fight a fire that was earlier reported under control, the VIGILANT contacted the SCANDINAVIAN STAR and requested information about on-board firefighting foam, portable fire pumps, oxygen breathing equipment, the types and sizes of the fire hose pipe connection, and the vessel's present freeboard. The information was relayed to the Coast Guard in Miami. About 0334, the Coast Guard Air Station at Clearwater, Florida, loaded and launched a HC-130 (CG-1717) fixed wing aircraft to assist the SCANDINAVIAN STAR.

During the scheduled radio check at 0415 with the VIGILANT, the SCANDINAVIAN STAR transmitted information about an injured passenger who was suffering from an apparent heart attack. The master requested that medical assistance be provided and that the passenger be evacuated by helicopter. The VIGILANT requested information on vital life signs and other medical data about the heart attack victim. This information was transmitted to the Coast Guard in Miami, which in turn forwarded the information to the Rescue Coordinating Center at Scott Air Force Base and requested that a suitable medivac aircraft be readied for launch from Homestead Air Force Base in Florida.

About 0428, a communications link on VHF-channel 16 was established between the SCANDINAVIAN STAR and the CG-1717, which was en route from Clearwater, Florida. The CG-1717 was on scene above the SCANDINAVIAN STAR at 0520, prepared to drop (via parachute) firefighting equipment, and life rafts, when requested. The CG-1717 also acted as a radio relay station between the cruise ship and U.S. shoreside emergency personnel.

About 0510 with the fires apparently under control, the SCANDINAVIAN STAR queried the Mexican Naval vessel HO-2 about its ability to tow the cruise ship into a Mexican harbor. The Mexican Naval vessel agreed and preparations were initiated to make both vessels ready for the towing operation. About 0534, the HO-2 was on scene.

At 0535, the Coast Guard in Miami requested clearances from the Mexican government for the cutter VIGILANT to make a port call at Isla Mujures and for U.S. aircraft to use the airport facilities at Cancun. At 0652, an Airforce HH-3 (AF-296) helicopter, which had been standing by, was launched with a medivac team from Homestead Airforce base. At 0900, an Airforce

KC-130 (AF-824) fixed wing aircraft was launched from Homestead to refuel the medivac helicopter in flight.

At 0900, the SCANDINAVIAN STAR reported that another passenger was injured and requested that he be medivaced also. The passenger had fallen and complained of back and spinal pain. By 1030, the two injured passengers were hoisted aboard AF-296 and were transported to Cancun. Once in Cancun, the injured passengers were transferred to the refueled CG-1717 and flown to the Coast Guard Air Station in Clearwater, Florida. There the patients were taken by ground transportation to Bayfront Hospital at St. Petersburg, Florida.

The SCANDINAVIAN STAR advised the VIGILANT that the HO-2 would tow the cruise ship to Cancun. The SCANDINAVIAN STAR requested the VIGILANT to escort the cruise ship into port and to render assistance as necessary. The CANADA STAR and the VERACRUZ I were released to continue their voyages when the VIGILANT and the Mexican patrol vessels A-06 and A-05 arrived on scene at 0940. At 1310, with the assistance of the VIGILANT and using the cutter's towing hawser, the towline was passed by the VIGILANT from the SCANDINAVIAN STAR to the A-06 for the tow into Cancun. The SCANDINAVIAN STAR arrived in the protected harbor of Cancun about 1300 on March 17, 1988.

Evacuation of Passengers

When the master initiated Phase II of the ship Emergency Plan at 2341, the Central Squad assembled and began the process of evacuating passengers to the four designated muster stations: two on the Main Deck and two on the Sun Deck. The Central Squad Zone Leaders, who were responsible for the evacuation of passengers from assigned zones in the vessel, reported that in some areas of "C" and "D" Decks, they had to wear wet towels or wet shirts over their faces to prevent smoke inhalation during the evacuation. The crewmembers responsible for searching the vessel and evacuating passengers were not provided protective breathing equipment, and there were no provisions in the ship Emergency Plan for them to be used. In one main passenger stairwell, smoke was thick enough to darken the area, requiring crewmembers to station themselves at various levels with flashlights to light the way for evacuating passengers. When thick smoke entered the Gasparilla Lounge, which was one of the four muster stations, it was necessary for the Central Squad to relocate the passengers to the pool area on the Main Deck aft. According to crewmembers and passengers, smoke entered the Gasparilla Lounge through airconditioning outlet vents which were located overhead in the lounge.

Testimony from both passengers and crewmembers indicated that a list of passengers assigned to the specific muster stations was not prepared either before or after the vessel departed St. Petersburg, Florida. Further, a count of passengers was not made during the evacuation to determine if all passengers had been accounted for.

One passenger stated that she and her husband were in their cabin when the fire occurred. She stated that they left their cabin, proceeded through the smoke-filled passageway and up one deck when they realized that their lifejackets were in the cabin. Her husband then returned to their cabin to obtain the lifejackets.

Another passenger recalled that she had just left the Gasparilla Lounge and was on the stairs going down to her cabin on Gulf Deck when she saw smoke. She immediately went to her cabin, got her lifejacket, and then proceeded to her muster station on the Main Deck aft. While on her way to the Main Deck aft, she saw black smoke outside her cabin "floor to ceiling." She stated, "it was hard to breathe, and although the lighting in the passageway was fully on, the smoke was coming down the corridor which obscured the hall." She further stated that when she got to the Main Deck, "it was extremely crowded and the smoke was choking us so we went to the front of the ship. All the lights went out about 2 minutes after we had gotten outside."

Another passenger was asleep in his cabin when he heard an alarm and someone outside his cabin yelling "fire". He immediately woke his friend and gave him a lifejacket and got one for himself. He stated further that as they entered the passageway, "all the lights went out and [the] stairs had some [lights] blowing out." According to his statement, because of the smoke and their being disoriented, it took about 10 minutes for them to reach the muster station, which was located two decks above on the Main Deck. He stated further that "a lot of the crew was not sure where to go."

One passenger, who was in his stateroom at the time of the fire, said that when he woke up his cabin was filled with smoke. He opened his cabin door but could not get down the passageway because the smoke was "too thick." He went back in his cabin and put a wet towel over his face and sat on the bathroom floor waiting to be rescued or told what to do. Eventually, he decided to break the porthole window with the ladder from the bunk beds. He said that after he broke the window, he found a rope ladder hanging down from above and climbed up to the pool deck area.

An elderly female passenger was alerted to the fire when she heard an alarm. She stated that when she opened her cabin door "billows of black smoke came in the room". She grabbed two lifejackets from under the bed and woke her husband. He got wet towels and they crawled out of their cabin into the passageway. She said, "it was all dark.....couldn't see or breathe with a searing sensation in chest." She did not reach her assigned muster station at the Pirate's Cove Lounge. She further stated that "many of the crew could not speak English so were not effectively helpful."

Another passenger was in her cabin when she heard the engine shut off and she began to smell smoke. She opened her cabin door to the passageway and saw smoke. She asked a crewmember to pull the [fire] alarm and he responded, "how do you do that?" and asked, "what cabin the fire was in?" She told the crewman that she did not think the fire was in a cabin. A fellow passenger instructed the crewman how to pull the [fire] alarm. She

went back in her cabin, grabbed her purse and shoes, and went to an upper deck. She said, "I had friends begging for lifejackets from the crew and were denied until later when they said we were going out on lifeboats." She stated that "a lot of crewmembers didn't speak English, which was a problem." A number of passengers stated that they waited from 45 minutes to 2 hours to receive lifejackets and then were given childsize lifejackets.

Adequate lighting became a problem during the evacuation. Although the ship's emergency battery power system was in operation, in many areas there were no lights. Many passengers stated that no lights were on in their area and they had to feel their way up to an open deck. Some passengers stated that the overhead lights in passageways and stairwells were dim and obscured by smoke.

Injuries

Two crewmembers received minor injuries while preparing a lifeboat for launching and handling a fire hose. Two passengers who were taken to the ship hospital during the emergency were later medivaced from the vessel by a U.S. Air Force helicopter and flown to Bayfront Hospital in St. Petersburg, Florida. One of the passengers,[7] who reportedly had fallen down some stairs and complained of pain in the lower spine, was treated and released from the hospital. The other passenger, who suffered from emphysema, complained of chest pains (possible heart attack) and was held in the hospital for observation and later released.

Injuries	Crew	Passengers	Total
Fatal	0	0	0
Minor*	2	1	3
None	266	438	704
Total	268	439	707

* Although not indicated in the ship medical log, postaccident testimony indicates that many passengers and crewmembers suffered from smoke inhalation.

Damage to the Vessel

Smoke and water damage was found in various public spaces, accommodations, and compartments throughout the vessel.

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[7]After complaining of a back pain, this passenger was strapped in a wheelchair and left on deck. After waiting until daylight to be evacuated from the ship, he went to the ship hospital. The physician informed him that the medical staff had been looking for him all night.

Engineroom.--There was extensive damage to the upper and aft areas of the engineroom including structural damage as well as damage to the electrical systems. Auxiliary machinery located on the upper and lower level of the starboard side of the main engineroom was also damaged. The engineer's workshop in the starboard side of the upper main engineroom was completely destroyed. The fire inflicted minor damage to the port side upper and lower levels of the main engineroom.

Two I-beam mounted trolley hoists, one located above each of the main engines, were damaged beyond repair and the I-beam rails were severely warped. The steel plating in the overhead of the engineroom, which also forms the deck in the Car Deck space above, was heavily buckled from the heat of the fire.

The fire severely damaged the starboard engine and caused only minor damage to the port engine.

Engine Control Room.--The engine control room was damaged by the effects of the fire and showed heavy soot deposits. The engine control console was completely destroyed. The internal wiring of the main switchboards were damaged. The smoke detection sensors and alarm panel for the engine spaces were severely damaged by the fire.

Total damages and repair costs were estimated at $3.5 million.

Crew Information

General.--The manning levels of the Bahamian flag vessel SCANDINAVIAN STAR was subject to the Bahamian Shipping Act of 1976, Part III, Sections 66 and 67. (See appendix G.) The Bahamian Certificate of Registry issued to the vessel does not list specifically the required vessel manning level, which was stipulated in the Shipping Act. The multinational crew totaled 268 at the time of the accident.

All of the officers were in possession of a valid license issued by their home country and a Bahamian Certificate of Competency, which is required when serving on Bahamian flag vessels. (See appendix G.)

Of the 11 licensed officers in the deck and engineering departments, 5 (the two second officers, one second engineer, and two third engineers) were Filipino citizens. Among the remaining complement of officers was the West German master, the British staff captain, and the Danish chief engineer and Danish staff engineer. One radio officer was Swedish and the other was a U.S. citizen.

The unlicensed members of the deck and engineering departments were predominantly Filipino and Honduran citizens. The Bahamian government requires only that unlicensed crewmen have a valid passport from their country of citizenship; no other seaman's documents are required.

The deck department consisted of the master, the staff captain (first officer), two second officers, two radio officers, a bosun, a quartermaster, and nine able-bodied seamen. A routine underway navigation bridge watch consisted of a licensed deck officer and two unlicensed members of the deck department, a helmsman and a lookout. There were 9 different nationalities among the 17 deck department members.

The engineering department consisted of the chief engineer, the staff engineer (first engineer), second engineer, two third engineers, the chief electrician, two assistant electricians, three motormen, three motor repairmen, three firemen/watertenders for the boilers, and two plumbers. A routine underway engineering watch consisted of a licensed engineer and an unlicensed member of the engineering department. There were 7 different nationalities among the 19 engineering department members. (See appendix B for additional information on crewmembers.) At the time of construction, the SCANDINAVIAN STAR was built in France for a French company and managed by a French crew. All of the vessel's instruction manuals and engineering drawings were written in French.

The medical department, steward department, hotel department, and entertainers and casino personnel comprised the 232 remaining crewmembers. Twenty-two were from the United States and were employed mostly as entertainers. The remaining 210 crewmembers were citizens of the following 27 countries: Philippine Islands, Honduras, Turkey, Morocco, Spain, Portugal, Costa Rica, Guatemala, Italy, Chile, Jamaica, Canada, Colombia, United Kingdom, Korea, Nicaragua, Grenada, Haiti, Ireland, Sweden, Yugoslavia, St. Lucia, Denmark, Dominican Republic, El Salvador, Panama, and Mexico.

The Bahamian Shipping Act addresses the crew's knowledge of English and states the following:

> 76.--(1) Where in the opinion of a registrar or an inspector the crew of a Bahamian ship consists of or includes persons who may not understand orders given to them in the course of their duty because of their insufficient knowledge of English and the absence of adequate arrangements for transmitting the orders in a language of which they have sufficient knowledge, the registrar or inspector shall inform the master of his opinion and the ship shall not go to sea, and the registrar or inspector may suspend the certificate of registry of the ship until the position is rectified.
>
> (2) If a ship goes to sea or attempts to go to sea in contravention of this section both the owner and the master shall be guilty of an offence and liable on summary conviction to a fine of five hundred dollars.

<u>Firefighting Training</u>.--The motorman had been on board the SCANDINAVIAN STAR for 17 months prior to the accident and, according to the vessel's chief engineer and staff engineer, he was very familiar with the machinery and piping systems in the engine spaces.

The motorman stated that he had no firefighting training other than the fire drills conducted on board the SCANDINAVIAN STAR. The chief engineer stated that a fire drill was conducted each week in the engine spaces for the training of engine department personnel. According to the chief engineer, fire hoses were laid out and engineroom fire teams "acted out" fighting fires in different engine spaces. Crewmembers, however, were not taught about the basic components of heat, fuel and oxygen that make up a fire. They were not taught about the different methods of fighting a trash fire, an oil fire, or an electrical fire. According to a statement by the staff engineer, the motormen were not allowed to close a fuel valve or stop a fuel pump without the direct order or concurrence of the watch engineer.

IMO's Standard of Training, Certification and Watchkeeping (STCW) for Seafarers, Regulation, III/6, which pertains to the mandatory minimum requirements for ratings (unlicensed personnel) of the engineroom watch, states that every engineroom watch rating "shall have experience <u>or</u> training regarding firefighting." There is no description in the international regulations about the quantity or type of experience or training necessary for the ratings to meet the requirements of the regulation.

At the time of the accident, the watch engineer had been on board the SCANDINAVIAN STAR for the previous 8 months. The watch engineer was employed as a second engineer aboard this ship but he possessed a chief engineer's license issued by the Republic of the Philippines and a chief engineer's Certificate of Competency issued by the Commonwealth of the Bahamas. He stated that he completed a firefighting course in the Philippines.

Regulation II/4 of STCW outlines the international mandatory minimum requirements for the certification of engineer officers in charge of a watch. Paragraph 2 of the regulation requires that the watch engineer "have theoretical and practical knowledge of the operation and maintenance of marine machinery appropriate to the duties of an engineer officer."

Paragraph 3 of the regulation states that the engineer shall have knowledge of the "safety precautions to be observed during a watch and immediate actions to be taken in the event of a fire or accident with particular reference to oil systems."

Vessel Information

<u>General</u>.--The SCANDINAVIAN STAR was built in 1971 by Dubigeon-Normandie Shipyard in Prairie-au-Duc, Nantes, France, as a combination passenger/roll-on roll-off vehicle carrier. The vessel was of welded steel construction and built according to the rules and regulations of the French classification society, Bureau Veritas.

The original owner, Compagnie Maritime des Chargeurs Reunis, sold the vessel in 1984 to the Stena Cargo Line Ltd., of Hamilton, Bermuda. The name of the ship was changed three times in 1984; from the MASSALIA to the STENA BALTICA to the ISLAND FIESTA and finally to the SCANDINAVIAN STAR.

The SCANDINAVIAN STAR, official number 7048219 registered in Nassau, Bahama Islands, was 465 feet long overall, 72 feet wide, and 25.4 feet deep from "C" Deck to the keel. The SCANDINAVIAN STAR is divided horizontally into eight deck levels; the Sun Deck, the Sunset Deck, the Main Deck, the Gulf Deck ("A" Deck), the Ybor Deck ("B" Deck), the Car Deck ("C" Deck), "D" Deck, and "E" Deck. Below "E" Deck are double bottom tanks for the storage of diesel oil, fuel oil, and water ballast. (See figure 3.)

The Sun Deck is the uppermost level of the ship and contains, in addition to accommodations for some of the ship's officers, the ship's emergency battery room, the fixed CO_2 fire extinguishing system bottle storage room, the radio room, and the navigation bridge. An emergency station on the bridge contains the vessel's manual fire alarm zone indicator panel, alarm controls, the public address system, the ventilation shutoff controls for the passenger accommodations, and the automatic controls for the fire and watertight doors. (The smoke detection sensors installed throughout the engine spaces, when activated, would sound an alarm in the engineroom and in the engine control room, but not on the bridge.)

The Sunset Deck contains the emergency diesel generator room, the officer and staff mess, and officer, staff, and passenger accommodations. Ten motorized lifeboats in gravity davits and 12 inflatable liferafts are located outboard on the port and starboard sides of this deck.

The Main Deck contains the swimming pool which is located aft. Forward of the swimming pool is the Gasparilla Lounge which extends from frame 38 to frame 84.

Gulf Deck ("A" Deck) contains the largest concentration of passenger accommodations in the vessel. The ship's hospital and some officer accommodations are located forward on this deck.

The Ybor Deck ("B" Deck) is a wing deck, located outboard, port and starboard of the two-deck high open Car Deck and contains passenger accommodations. There are no transverse passageways that connect the port and starboard sides of the Ybor Deck.

The deck below the Ybor Deck is "C" Deck. Passenger and crew accommodations are located on "C" Deck, on the port and starboard outboard sides of the Car Deck. When the SCANDINAVIAN STAR was operated as a passenger/roll-on roll-off car ferry, the Car Deck was the storage location of the vehicles which were driven on board via the retractable stern ramp. The Car Deck is no longer used as a vehicle storage area; a variety of ship stores and other supplies are located there.

An engineroom emergency fire station cabinet is located in the port side passageway of "C" Deck at frame 45. The emergency fire station cabinet contains the remote controls to actuate the CO_2 fixed fire suppression system for the engineering spaces. Located just forward and adjacent to this cabinet are the emergency shutoff controls for: the boilers fuel oil pump, the oil separators, the ventilation fans for the engine spaces, the main diesel engine and diesel generator fuel pumps, and the remote manual control

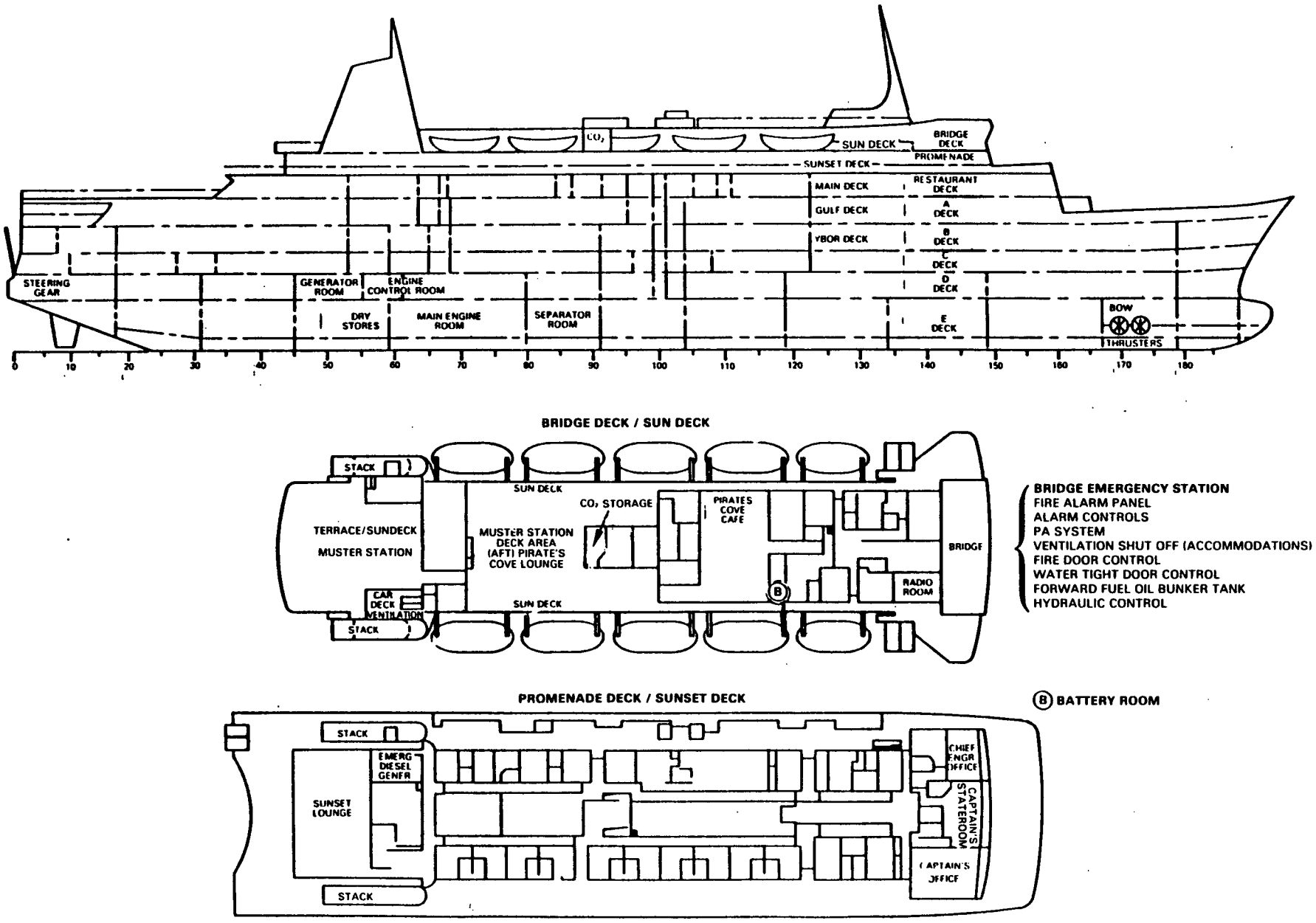

Figure 3.--General arrangement of SCANDINAVIAN STAR. (Sheet 1)

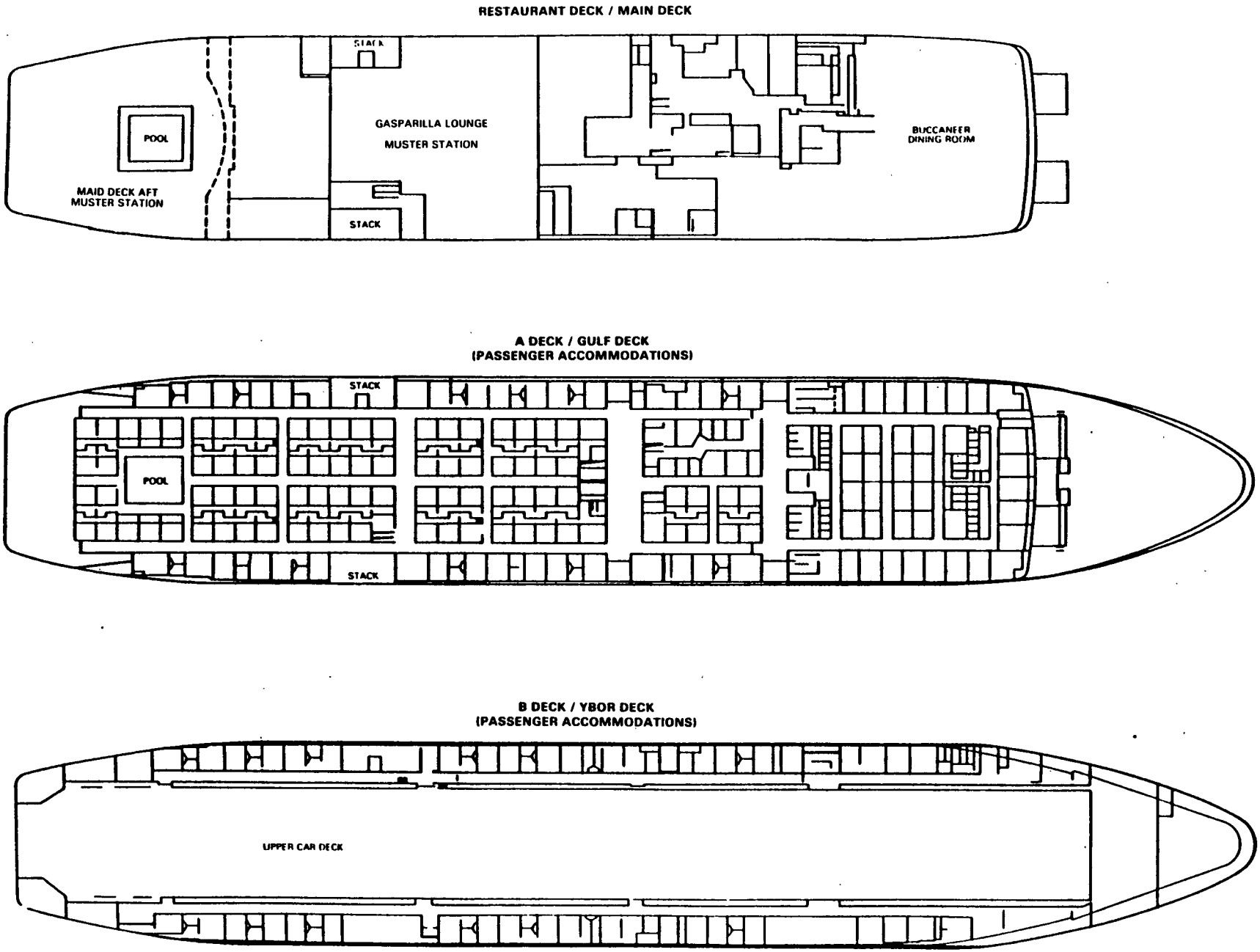

Figure 3.--General arrangement of SCANDINAVIAN STAR. (Sheet 2)

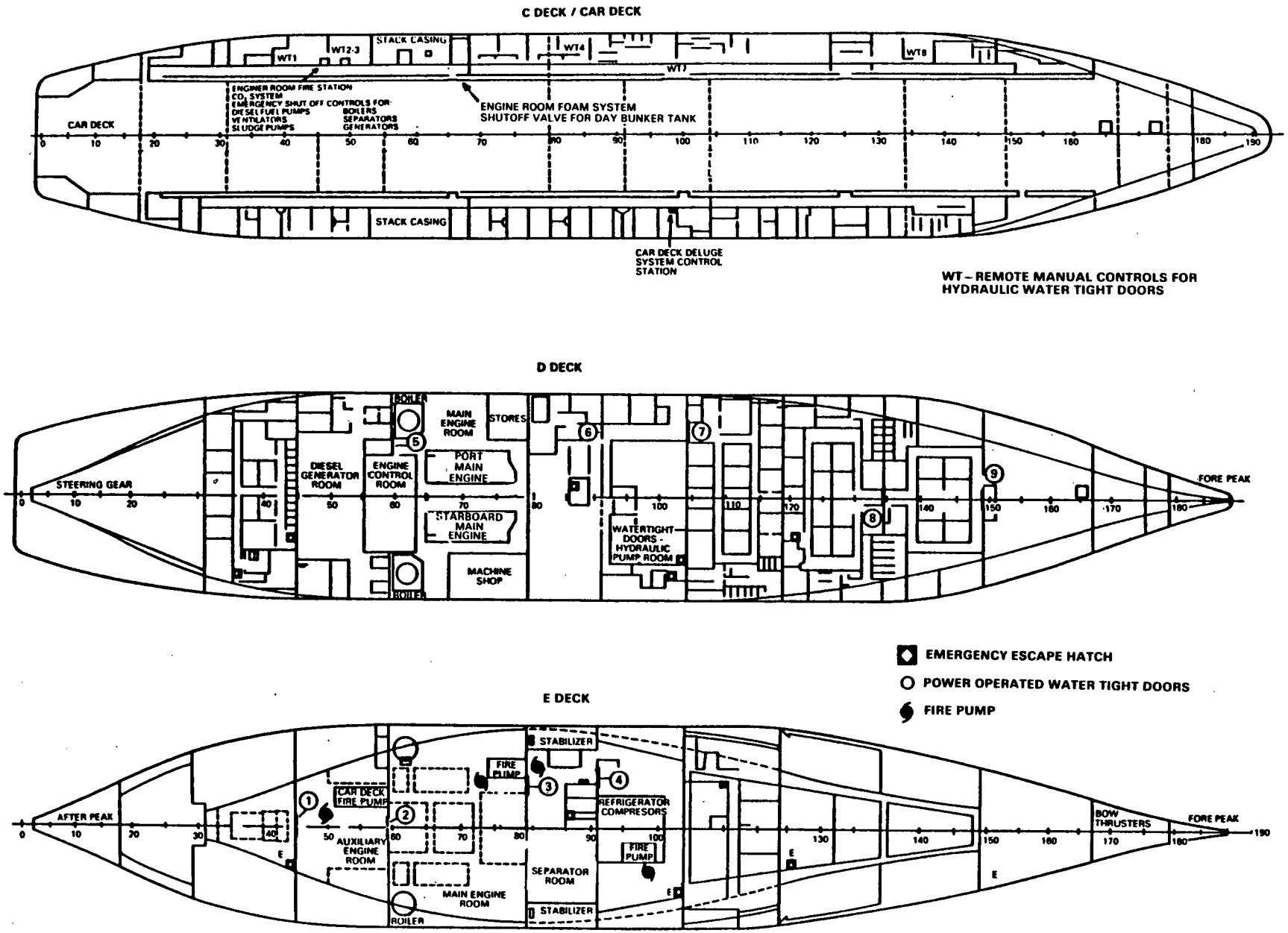

Figure 3.--General arrangement of SCANDINAVIAN STAR. (Sheet 3)

for watertight doors Nos. 2 and 3. In another emergency fire station cabinet located about frame 65 are the controls for the engineroom (boilers) foam fire extinguishing system, the remote shutoff quick acting valves for the fuel oil settling and day tanks for the generator diesels, the boilers, and the main diesel engines. Other emergency cabinets located along this passageway contain the remote manual controls for watertight doors Nos. 1, 4, 5, 6, 7, 8, and 9.

"D" Deck is located directly below "C" Deck and contains the steering gear room at its extreme aft end. Forward of the steering gear room are fresh water tanks from frame 18 to 31, port to starboard. The "C" Deck or upper level of the machinery spaces extends from frame 45 forward to frame 80.

"E" Deck is the bottom most level of the vessel and contains the water ballast tanks from frame 1 to frame 45.

Machinery Spaces.--The machinery spaces consisted of the ship's service diesel generator room, the enclosed, airconditioned engine control room, the main engineroom, the auxiliary engineroom, the oil separator room, and the refrigeration compressor room.

The ship's service diesel generator (SSDG) room is located on "D" Deck aft of the enclosed engine control room and contains five 660 KVa diesel driven generators. Electrical power generated by the SSDGs is fed to load centers in the main switchboard located in the engine control room. The generated electrical power is distributed through the main switchboard to electrical distribution panels located throughout the vessel. The cables carrying the electrical power extend from the switchboard across the overhead of the main engineroom in two large cable raceways installed directly above the two main propulsion diesel engines.

The main engineroom is located on "D" and "E" Decks between frames 59 and 80 with the steel plating of "C" Deck forming the overhead of the engineroom and the tanktops steel plating forming the bilge area. Twin, V-16 cylinder S.E.M.T-Pielstick, (Type PC-2/400), engines, each developing 7,890 horsepower, provide propulsion power for the SCANDINAVIAN STAR. The starting, stopping, and speed of each engine can be controlled from the console in the enclosed engine control room or from the control console in the wheelhouse on the navigation bridge. The direction of the vessel, either forward or astern, also can be controlled from the bridge or engineroom control stations by adjusting the controllable pitch position of the propeller blades on either or both the port and starboard propulsion propellers. For added maneuverability during docking and undocking, two 600-horsepower bow thrusters, each fitted with a controllable pitch propeller, were installed in the bow, aft of the anchor chain locker.

A central operations control system provides automatic operation and remote control of the machinery plant from the engineroom central control console. The console is installed in an enclosed, airconditioned engine control room, which is situated on the vessel's centerline between frames 55 and 63. The control room can be accessed by two doors, one on the port side

at frame 60 and the other on the starboard end of the control room forward bulkhead at frame 63. Clear windows, facing forward and located above the control console, allow watchstanders in the engine control room to observe the upper ("D" Deck) and lower ("E" Deck) levels of the main engineroom.

The control system is designed for operation by a two-man engineroom watch. While underway or at the pier with the main engines in operation, the watch engineer usually stations himself inside the enclosed engine control room where he can observe plant operating conditions and initiate certain machinery plant functions. The control system continuously monitors specific machinery pressures, temperatures, levels and flow rates and is designed to sense abnormal operating conditions and actuate alarms to warn the watchstander in a timely fashion. The motorman makes rounds through all the engine spaces and reports to the watch engineer.

The engines are fueled with a blended heavy marine diesel fuel oil known as IFO-120 (Intermediate Fuel Oil-120). The port and starboard fuel oil settling tanks and the engines' fuel oil day tank are components of the fuel oil service system which, through the system's pumps and piping, supply fuel oil to the port and starboard engines. Either one of two fuel oil booster pumps (one operating/one standby) delivers fuel oil from the fuel oil day tank to both the port and starboard engines at a pressure of 2.5 Bars (37 psi). Fuel oil discharged from the booster pump is piped to a fuel oil steam heater which heats the fuel oil to about 200 degrees F. From the fuel oil heaters, the fuel oil flows through an engine mounted supply pipeline manifold to each of 16 individual cylinder fuel oil injector pumps installed on each engine. Excess fuel oil flows through the injector pumps into an engine mounted fuel oil return manifold pipeline back to the day tank.

Each engine has 16 cylinders and an injector pump for each cylinder, for a total of 32 injector pumps. Each injector pump is fitted with a fuel oil supply and return pipeline and each pipeline has a packing gland, for a total of 64 packing glands on the two engines.

The piping connection between the fuel oil supply and return manifolds and the cylinder injector pumps consists of a two-piece telescoping pipe connection. A packing gland is fitted where the two pipe pieces interconnect.

When either the port or starboard engine control is put in the stop position, from either the bridge or the engineroom control console, there is no fuel oil discharge from the individual cylinder injector pumps; the fuel supplied to each individual cylinder is reduced to zero and the engine stops. The pressurized fuel oil passes through the cylinder injector pumps to the fuel oil return manifold pipeline back to the fuel oil tank. The fuel oil booster pump will continue to operate after the engine stops because the booster pump stop control, while located on the control console in the engine control room, is operated independently of the main engine stop controls.

Machinery Space Smoke Detection and Fire Suppression Systems.--The engine control room contains the smoke detector alarm panel which monitors all the machinery spaces. Smoke detectors are located throughout the

machinery spaces in the following areas: the engine control room, the upper and lower main engineroom (11 and 10 detectors, respectively), the ship service generator room, the auxiliary engineroom, the oil separator room, the steering gear room, and the refrigeration compressor room. When activated, the alarm for the smoke detector annunciates only in the engine control room. Smoke detectors are also located in the refrigerated stores compartment, the dry stores compartment, and the forward and aft sewage tank compartments.

There are eight manual fire alarms in the engineroom, four in the upper level and four in the lower level. Two portable CO_2 fire extinguishers and two emergency oxygen breathing apparatus are stowed in the engine control room.

The vessel's main fire pump is located in the lower main engineroom, and a combination water ballast/fire pump is located in the oil separator room. A separate fire pump supplies the car deck deluge sprinkler system and was located in the auxiliary engineroom. These fire pumps are powered by the ship's service main electrical system and provide sea water pressure to fire hose outlets located throughout the vessel's fire main system. The emergency fire pump is located in the refrigeration compressor room and can be powered from either the main or emergency generator power system. (See figure 3.)

The ventilation and airconditioning ducts were not equipped with smoke-sensitive actuating devices, nor were they required to be.

Fixed CO_2 Fire Suppression System.--During construction of the SCANDINAVIAN STAR, the ship was fitted with a fixed CO_2 fire suppression system. The CO_2 bottle storage room is located on the Sun Deck at the centerline between frames 88 and 91 and contains 36 45-kilogram (kg) bottles of CO_2. The CO_2 bottles are stored in four rows, and each bottle is fitted with a quick opening release valve. At construction, a pilot piston and cylinder was rigidly mounted in a fixed position to an I-beam at the end of each of the four rows of CO_2 bottles. The length of travel of each of the four pilot pistons inside each cylinder also was fixed. One end of a steel cable was attached to a spring mounted on the bulkhead of the CO_2 room. The cable then was attached to the control arm of each quick-opening release valve on each CO_2 bottle in that row, and the opposite end of the steel cable was attached to the bottom of the pilot piston.

The remote controls for the CO_2 system are located in an emergency control cabinet on "C" Deck in the port passageway. Activation of the suppression system from this remote control cabinet is accomplished by the release of pressurized CO_2 from two 25-kg pilot bottles. When released, CO_2 pressure in the remote control pilot system is designed to move the pilot pistons in the CO_2 bottle storage room a sufficient amount of travel (in this case 2 inches), which pulls the steel cable and opens every quick release valve on each CO_2 bottle in that row. The released CO_2 flows through piping from the bottle storage room to the CO_2 distribution manifold at the emergency control cabinet on "C" Deck. The positioning of the valves on the manifold directs the CO_2 to the desired machinery space compartment.

A local,[8] manual release mechanism was installed in the CO_2 storage room. A lever type handle was mounted on the I-beam at the end of each of the four rows of CO_2 bottles. One end of the handle was attached to the top of the pilot piston. When the handle is moved, the manual release mechanism, acting through a fulcrum, pulls the pilot piston the full length of travel in its cylinder, pulling the steel cable and opening the quick release valves, thus releasing the CO_2 bottles in that row.

In addition, the CO_2 bottles can be manually opened individually by moving the control arm on each quick opening release valve on each bottle of CO_2.

When vessel construction was completed in 1971, the CO_2 system was required to be operationally tested with the CO_2 bottles connected to the actuating pilot pistons. At that time, the test consisted of releasing CO_2 into the pilot system to demonstrate the operation of the actuating cylinder at each row of bottles. This test also proved that the piping from the storage room to the various release destinations was clear and unobstructed. The test was witnessed by national regulatory and classification society representatives to verify the satisfactory operation of the system.

Automatic Watertight Doors.--Nine sliding, hydraulically activated, automatic, watertight doors are used to control flooding and to isolate the various compartments within the machinery spaces. When closed, the watertight doors isolate the auxiliary engineroom, the main engineroom, the oil separator room, the ship service generator room, the dry stores compartment, the refrigerated stores compartment, the refrigeration compressor room, the crew's quarters, and the laundry room on "D" Deck. Sliding watertight doors No. 2 and 3 are located, respectively, aft and forward in the lower engineroom and isolate the lower main engineroom from the auxiliary engineroom aft and the oil separator room forward. Sliding watertight door No. 5 isolates the upper main engineroom from the ship service diesel generator room aft. All nine doors can be closed automatically at the same time from a remote control station on the bridge, closed manually from remote hand pump control stations in the "C" Deck port side passageway, or closed manually at each location with a hand pump.

Electrical Power Systems.--The ship's main electrical power is provided by a bank of five diesel generators located in the generator room. The generators are operated in varying numbers according to the power requirements of the vessel. In the event of the failure of the ship's main electrical power system, the vessel is fitted with a diesel-powered emergency generator. The diesel-powered emergency generator is required, by regulation, to start automatically upon the loss of the ship's main electrical power and provide emergency electrical power to the emergency switchboard for a period of at least 36 hours. According to a requirement of the International Maritime Organization's SOLAS Convention and the rules and regulations of national regulatory authorities and the classification

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[8]The term "local" refers to the valve or control handle at the location of the equipment, as compared to a remote handle or valve.

societies, the emergency generator must be independent and separated as far as practical from the main machinery spaces electrical power generating equipment and switchboards to ensure that "a fire or other casualty in spaces containing the main source of electrical power, associated transforming equipment, if any, the main switchboard....will not interfere with the supply, control and distribution of the emergency electrical power."

A postaccident examination of the emergency generator revealed that at the time of the accident a battery bank in the main engineroom supplied the power needed to excite the emergency generator's magnetic field. The engineroom fire caused the loss of this excitation voltage, which was supplied by a cable from the engineroom battery bank, to the emergency generator's magnetic field (electromagnetic) excitation circuit. Without the power supply to the generator's excitation circuit, no electrical power can be generated.

According to statements made by the vessel's chief engineer, he was not concerned by the fact that the power needed for the generator's excitation circuit was furnished by a battery bank located in the main engineroom. He said the system had been in place since he first boarded the vessel in March of 1987. He also said that he had never seen this type of emergency generator excitation circuit. The operating instructions for the diesel-powered emergency generator were written in French, and the chief engineer could not read French. None of the deck or engineering officers spoke or read French.

According to statements by the Bureau Veritas marine surveyor, who surveyed the vessel at various times from October 1984 until August 1987, the DC-battery electrical power supply to the emergency generator magnetic field excitation circuit was supplied by a battery installed and maintained in the emergency generator room. He stated that at the time of his last survey, the battery bank in the engineroom provided a back-up (secondary) power supply to the battery (primary) in the emergency generator room.

If the emergency generator electrical power should fail to be initiated or be lost, the emergency battery electrical power supply is designed to come on line and supply power to provide, for a period of 30 minutes, navigation lights and lighting at every embarkation station on deck, in all service and accommodation passageways, stairwells and exits, in the machinery spaces and main generating spaces, in all control stations, in the steering gear compartment, and at all fireman's outfit stowage locations. The emergency battery power system was not designed to supply electrical power for the smoke detection devices, the fire alarms, or the public address system.

Vessel Maintenance.--The chief engineer is responsible for the maintenance of the machinery in the engineroom spaces and other equipment and machinery spaces located outside of the engineroom. According to statements made by the chief and staff engineers, there was no planned maintenance system for the SCANDINAVIAN STAR.

A review of engine department maintenance records for a 6-month period from September 14, 1987, through February 28, 1988, revealed that

machinery maintenance on board the SCANDINAVIAN STAR occurred only after a breakdown and was not preplanned. The maintenance records indicated that on six separate occasions packing gland leaks in the engines' fuel pipes were repaired. Not included in the records was the seventh such repair, which was entered in the deck log for March 14, one day prior to the engineroom fire, and contained the entry that the port main engine was shut down from 1349 to 1421 to repair a fuel oil leak discovered while en route to Cozumel, Mexico. An engine repairman crewmember stated that the fuel lines between the manifolds and the cylinder fuel oil injector pumps leak "all the time." According to the motorman who witnessed the eighth fuel oil leak and subsequent fire on March 15, "the leak [fuel oil] is always just on the nut [packing gland] where you put the seal. This is where you have the most leaks, and the leaks only come when the oil ring [packing] is gone or something like that, broken."

In response to Safety Board inquiries, S.E.M.T. Pielstick, the French manufacturer of the SCANDINAVIAN STAR's twin engines, stated that the original packing seal installed in the engine injector pump fuel oil supply and return pipe packing glands was a one piece (25 mm outside diameter (OD) x 18 mm inside diameter (ID) x 12 mm high (H)) device made of Teflon called Viton DF 150. In 1975, Pielstick designed and marketed a new four piece packing seal as an "armored Viton seal Martin Merckel type." The 1975 design packing seal consisted of two Teflon washers with a slight V-indentation on one face of each washer and two Teflon O-rings. When installed, the two O-rings are sandwiched between the two washers with the V-shaped indentation of each washer facing each other and acting as a seat for each O-ring. Assembled, the new four piece seal measured 12 mm OD x 18 mm ID x 12 mm H. (See figure 4.)

The chief engineer of the SCANDINAVIAN STAR testified that the ship had purchased the improved variation of the original packing seal for the engine mounted fuel oil supply and return pipe packing glands. He said the new packing seals had been on the vessel since before he reported on board in March of 1987. The chief engineer further testified that he directed the crew to install the new packing seals in a fuel oil supply or return pipe packing gland only after a leak in that pipe was discovered and the engine was shut down. When asked how many of the new four piece packing seals had been installed, the chief engineer stated that he did not know but that new ones had been installed when leaks occurred. According to the chief engineer, he continued to have leak problems on the packing glands where the original packing seal was still in use. The chief engineer also stated that there had not been any leaks where the new packing seals had been installed.

In September 1975, S.E.M.T. Pielstick distributed to Pielstick engine users Service Information Bulletin No. 29 concerning the overhauling of fuel oil cylinder injector pump feed [supply] and discharge [return] pipes. The eight pages of service information cover, in detail, the cleaning, inspection, and maintenance of the fuel oil supply and return pipes and the installation of the Martin Merkel packing seal in the packing glands.

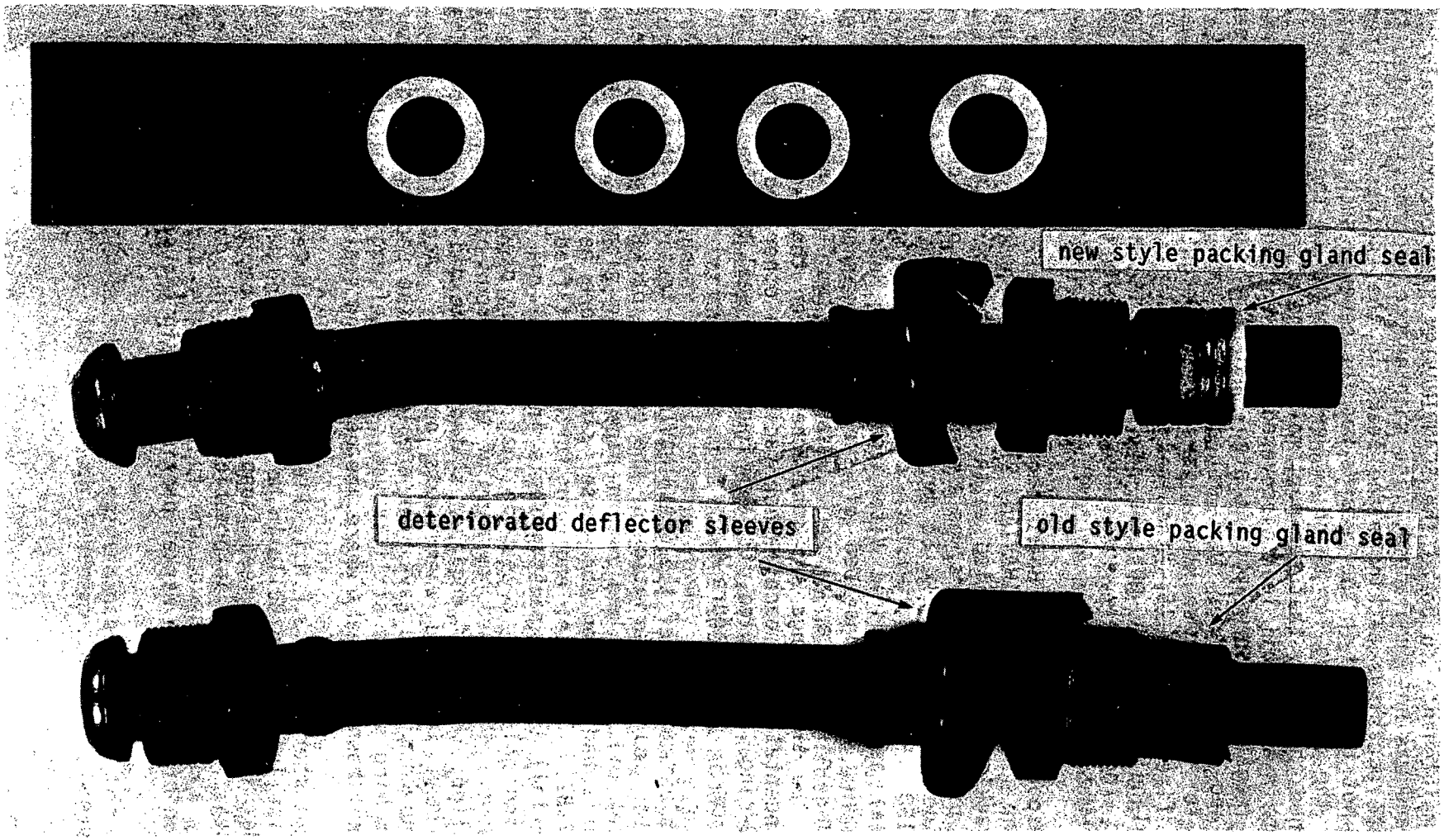

Figure 4.--Packing gland seals and deflector sleeves on engine injector pump fuel oil supply and return pipes.

S.E.M.T. Pielstick also stated that the deflector sleeve installed over the fuel oil pipelines packing gland nut will prevent pressurized fuel oil, leaking through the packing seal in the gland, from spraying onto hot engine parts. The remains of a deflector sleeve was found on the fuel oil supply pipeline to the No. 7 cylinder injector pump. About 25 deflector sleeves, on both the port and starboard main engines, were missing entirely or only a small portion of the sleeve remained. Postaccident inspection of the sleeves indicated that the sleeves had deteriorated from age and not as a result of damage from the fire. (See figure 4.) A fuel oil deflector sleeve should be installed on each of the fuel oil supply and return pipeline packing glands, for a total of 64 sleeves. Prior to the accident, Pielstick had no record of any order for this part from SCANDINAVIAN STAR or SeaEscape. The staff and chief engineer testified that they did not know the purpose of the deflector sleeves.

Classification Society Vessel Surveys.--According to the records furnished by SeaEscape Ltd., a marine surveyor from the French classification society Bureau Veritas conducted a machinery survey of the SCANDINAVIAN STAR's port and starboard engines and ship service generators during the period from March 13 to August 11, 1987. The machinery was found in satisfactory condition and in conformance with the rules and regulations of Bureau Veritas.

In September 1987, the owners of the SCANDINAVIAN STAR began the process of transferring the vessel's classification from the Bureau Veritas to the Lloyd's Register of Shipping. The vessel was drydocked, and a Lloyd's Register of Shipping surveyor conducted a drydocking and hull survey as well as a load line inspection as part of the annual classification survey. The surveyor found that the vessel met the approved plans and the society's rules, regulations, and requirements.

In addition to conducting periodic surveys for class, Lloyd's Register conducted safety certificate examinations on behalf of the Bahamian government. At the time of the accident, the SCANDINAVIAN STAR was in possession of a current Passenger Ship Safety Certificate (see appendix D), which was issued by Lloyd's Register of Shipping on January 21, 1988. The Certificate was issued under the provisions of the International Maritime Organization's (IMO), International Convention for the Safety of Life at Sea, 1974 (SOLAS '74). Lloyd's Register also issued an Oil Pollution Prevention Certificate, a Load Line Certificate, and a Bahamian Ship Radio License to the SCANDINAVIAN STAR in accordance with IMO conventions and regulations and in the name of the Bahamian government. The Bahamian government had neither the facilities nor the resources to conduct the inspections and surveys necessary for the issuance of the various national and international certificates required for the Bahamian open register (flagged) vessels. To this end, as is the case with many other "Country States" which are signatory to IMO's conventions, treaties, protocols, codes, resolutions and recommendations, the Bahamian government has authorized a ship classification society, in this case Lloyd's Register of Shipping, to act on its behalf.

Service Company Inspection and Testing of Fixed CO_2 Fire Suppression System.--The fixed CO_2 fire suppression system was tested, serviced, and a certificate, dated December 7, 1987, was issued by the service company, High Seas Safety. There is no requirement to pressure test the CO_2 pilot or distribution piping for leaks. The inspection and testing of the system consisted of the following:

1. The steel cable connecting the CO_2 bottles in each row of bottles was disconnected from the pilot pull piston. Compressed air, connected to the pilot pipeline at the remote station on "C" Deck, was released into the system to prove the free operation of the pull piston(s).

2. The quantity of CO_2 in each bottle was verified by means of a liquid detector.

3. The alarm and ventilation stop switches were tested.

4. Compressed air was blown through all the CO_2 pipelines from the bottle storage room on the Sun Deck to the designated machinery space compartments to prove the pipelines were clear and unobstructed.

5. Compressed air was blown through the pipelines in the CO_2 pilot system to prove the pipelines were clear and unobstructed.

There was no vessel or company procedure which required a crewmember to be present and verify the completeness of the testing of the fixed CO_2 fire suppression system. There is no requirement for the Coast Guard to be present during the servicing of the fixed or portable fire suppression systems.

Accident History.--According to the Code of Federal Regulations, a reportable accident for foreign flag vessels is any casualty or accident which occurs in U.S. waters, which is the navigable waters of the United States, its territories, or possessions. Accidents which occur outside of these limits are not reported to officials in the United States, nor are they required to be, even though the passenger vessel regularly operates out of a U.S. port. A record of the reported accidents which occurred to the SCANDINAVIAN STAR since the vessel began operating out of the United States was obtained from Coast Guard files. Ten reportable accidents occurred between December 1984 and June 1988. The accidents involved two groundings of the cruise ship, a collision in Tampa Bay, machinery failures of the AC generators and controllable pitch propellers, a fire in a deep fat fryer, and a fuel leak on the starboard main engine.

Survival Aspects

Emergency Plan.--An emergency plan was developed for the vessel in accordance with SOLAS '74, Chapter III, Part A, Regulation 25. The plan was printed in English in booklet form for the officers and crew and posted as a

placard in public areas for the passengers. According to the ship Emergency Plan, the Operational Command, headed by the ship's master and located on the navigation bridge, is responsible for the direction of each phase of the emergency, deploying the crew as the emergency dictates, and acting as the central information point to which all groups report. The crew is divided into five main groups and various subgroups. (See appendix C for a summary of the crews' responsibility.)

The following emergency procedures are also addressed in the ship's Emergency Plan.

EMERGENCY PROCEDURES

Anyone discovering a fire or similar grave hazard to the safety of the ship shall immediately notify the bridge by the quickest means available. Pushing the alarm button nearest the source will pinpoint its position on the bridge safety control panel.

In the case of fire do your utmost to put it out with the extinguishers nearby, and to get persons out of the danger area.

Do not open doors or hatchways which are giving off smoke until you have your extinguisher ready. Keep low and covered, be prepared for a stab of flame in the instant you open up.

If you don't succeed in putting out the fire with the equipment at hand, close up again and do your best to seal off all openings feeding air to the flames.

Remain at the scene until a Mobile Fire Fighter group arrives, tell them what has happened and whether you think anyone is trapped inside.

Go immediately to your own station if your main group is Continuous Run Ship Group, Mobile Fire Group, or Emergency Stand-by Group; if you are in Assistance Group or Evacuation Group you shall continue your duties and standby for further orders.

If you, either on work or off duty, hear the alarm, you shall prepare yourself to go to your emergency station. Listen carefully to the speaker system to follow the instructions from the Operational Command.

Not printed in the Emergency Plan booklets or on the posted placards was the division of an emergency into three separate phases that are initiated by the master.[9]

Phase I An emergency occurs. The emergency could be a fire, collision, or anything which might threaten the safety of the ship. When an alarm sounds, the Operational Command, the Mobile Fire Group, the Continuous Run Ship Group and the Emergency Stand-by Groups muster.

Note: Crewmembers in the Evacuation Group do not participate in Phase I, and should continue their normal work as if nothing had happened.

Phase II Evacuation. The emergency situation has reached a point when the ship must be evacuated. When the General Alarm, consisting of seven short rings and one long ring, sounds in the ship, then the Evacuation Group will muster and evacuate all passengers to their assigned muster stations.

Phase III Abandon Ship. When the emergency situation is no longer under control the master orders Abandon Ship. The signal to abandon ship is given only by the master and normally via the Public Address System.

The Emergency Plan contained descriptions of the various alarm signals which may be heard on board the vessel, including the fire alarm, the man-over-board alarm, the general alarm (evacuation), and the signals for lifeboat operations.

According to the Emergency Plan, the staff captain was the person responsible for the direction of the on-scene firefighting operations. However, the Emergency Plan did not contain any information concerning the locations or the operation of the various emergency shutoff control cabinets which contained the controls for the ventilation fans, the lube and fuel oil pumps operating in the engine spaces, the remote manual hydraulic watertight doors, the engineroom fuel oil tank valves, or the CO_2 fixed fire extinguishing system located near the engineroom access door in the port side passageway of "C" Deck.

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[9] This information was printed separately and handed out in English and Spanish. (See appendix E.)

According to the ship's Evacuation Plan, which is part of the overall Emergency Plan, there are four designated muster stations where passengers are directed to assemble during an emergency; two are located on the Sun Deck and two are located on the Main Deck. Passengers are instructed to report to their muster station as indicated by the color of their boarding cards; the yellow and brown boarding cards represented the two muster stations aft on the Sun Deck, and the green and orange boarding cards represented the two muster stations on the Main Deck. The boarding cards also contained brief instructions concerning the donning of lifejackets, description of the emergency alarm evacuation signal, and the location of the muster station. (See appendix F.)

The Evacuation Plan provided that zone leaders and their assigned Evacuators assemble at designated areas throughout the cruise ship to begin the evacuation of passengers to muster stations.

Emergency Drills.--The bridge log book indicated that an emergency fire and boat drill involving crewmembers and passengers was conducted on board the SCANDINAVIAN STAR about 0925 on the morning of Monday, March 14, 1988. Not all the passengers attended the drill. Some passengers who did attend the drill stated that the drill helped them understand how to don a life jacket, to know the locations of their respective muster stations, and to understand the meaning of the different alarm signals.

The hotel manager, who was the Central Squad Leader in charge of the evacuation, stated that a fire and boat drill was held for passengers every Monday morning. At these drills, passengers were instructed to go to their cabins, locate their lifejackets, and return to the deck. Also, passengers were taken to their designated muster stations and shown how to put on their lifejackets and told the name of their muster station leader.

An instruction placard, printed in English, Spanish, and Portuguese, was posted on the inside of each passenger stateroom door and contained the following information:

> If the alarm signal sounds:
>
> Dress for disembarkation.
>
> Proceed immediately to your muster station as indicated on the card you received when checking in.
>
> The crew will distribute lifejackets.
>
> Further instruction will be given over the loudspeakers.

The Foreign Flag Cruise Ship Industry in the U.S.

In 1988, 77 of a world total 90 cruise vessels in the 5,000 gross-ton-and-over capacity operated out of U.S. ports including Alaska and Hawaii. Twenty-seven cruise ships operated out of the U.S. west and northeast coasts.

Fifty of the U.S. based foreign registered cruise vessels were based in four Florida ports. They operated in the Miami-Bahamas-Caribbean region and steady growth in the size (passenger capacity) and the number of vessels operating in this region is expected in the years ahead. Miami was a loading port to 22 foreign flag cruise vessels, while 21 foreign flag cruise vessels operated out of Port Everglades, 4 out of the port of Tampa/St. Petersburg, and 3 out of Port Canaveral.

According to a survey conducted by the Norwegian Classification Society, Det norske Veritas, and published in the society's magazine, Veritas Forum, the leisure cruise ship industry is experiencing a new construction boom, with more than 20 new (non-U.S. flag) cruise ships under construction or on order. Passenger capacity of the cruise fleet is expected to increase by 25 percent between January 1988 and early 1990 with about eight new ships being delivered each year. The majority of the cruise industry growth is focused on the Caribbean and nearly all of the new ships will be put into service in that region.

According to information received from the Port Authorities in Florida, in total, about 4.5 million passengers, mostly U.S. citizens, annually board foreign flag cruise ships sailing from the ports of Miami, Port Everglades, Tampa/St. Petersburg, and Port Canaveral. Miami alone expected to handle 2.75 million passengers during 1988. Furthermore, the Miami Port Authority currently invests about $15 million per year on improving its facilities and anticipates that by the turn of the century more than 4 million passengers will be taking cruises out of Miami.

The foreign flag operations of SeaEscape began in Miami, Florida, in 1981 under the name of Scandinavian World Cruises, which was a wholly owned subsidiary of DFDS (Det Forenede Dasmkibs-Selskab) of Hamburg, West Germany. Scandinavian World Cruises operated a ferry service from New York to the Bahamas and Miami, and SeaEscape developed the idea of 1-day cruises to "nowhere," which, according to SeaEscape representatives, has become very successful. The ferry operation was not a financial success and eventually was discontinued, but the SeaEscape 1-day cruise venture was maintained.

SeaEscape discovered that the European type of passenger/car ferry vessel was ideal for their market of 1-day cruises, and all of their vessels are former passenger/car ferries. SeaEscape is operating four cruise ships out of four ports in Florida. The SCANDINAVIAN SAGA sails from Tampa, the SCANDINAVIAN SKY sails form Port Canaveral, the SCANDINAVIAN SUN sails from Port Everglades, and the SCANDINAVIAN STAR now sails from Miami.[10]

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[10] The SeaEscape operating history was printed in the January 1988 issue of 100A1 Magazine published by the British Ship Classification Society, Lloyd's Register of Shipping.

In March of 1984, a fire on board the SCANDINAVIAN SEA caused the vessel to be declared a total loss. However, there were no deaths or injuries. The SCANDINAVIAN SEA was sold and refurbished and is currently sailing out of Florida as the DISCOVERY I. In August of the same year, fire caused two deaths and nearly $3 million in damage to the SCANDINAVIAN SUN. The SUN was repaired and returned to service.

The International Maritime Organization

Marine safety on an international level is established by an agency of the United Nations, the International Maritime Organization (IMO). Cruise ships are subject to the safety standards of the IMO requirements of the International Convention for the Safety of Life at Sea (SOLAS) which includes the internationally adopted SOLAS conventions of 1929, '48, '60, and '74. In 1981 and 1983, amendments were added to SOLAS '74 in an attempt to keep that convention current with modern marine technology and safety standards. One hundred thirty two nations, known as 'Country States' in IMO parlance, are signatory to the SOLAS Conventions.

Vessels constructed prior to the adoption date of the various SOLAS conventions are required, with very few exceptions, to adhere only to the convention regulations and amendments in force at the time of their construction. Post construction upgrading of the vessel's safety systems is rarely required. The BRITTANIS, for example, the world's oldest cruise ship, was built in 1932 and is subject to the requirements of SOLAS 1929. At the time of the SCANDINAVIAN STAR accident, the BRITTANIS was still operating between Miami, the Bahamas, and Mexico.

The United States, as signatory to the conventions, is obligated to abide by the provisions of the conventions. The Coast Guard is the U.S. agency responsible for the enforcement of SOLAS regulations for U.S. ships and has the authority to ensure that foreign ships calling at U. S. ports comply with the applicable SOLAS convention requirements. To accomplish this mandate, the Coast Guard conducts Control Verification Examinations of all foreign flag vessels arriving at U.S. ports. This examination was initially authorized by SOLAS '48.

According to Coast Guard vessel inspection records, the SCANDINAVIAN STAR had been examined under the Coast Guard foreign flag vessel Control Verification Program since November 1984. At that time, the Coast Guard conducted the Initial Control Verification examination of the vessel, which is a detailed inspection of the steel structure and design of the vessel. An Initial Control Verification examination usually takes 3 or more days to complete. Since that time, one annual and three quarterly vessel examinations had been conducted each year and included fire and boat drills on nearly all occasions.

The Coast Guard conducted an annual Control Verification Examination of the SCANDINAVIAN STAR on February 3 and 4, 1988, at St. Petersburg, Florida. The vessel's various certificates, including the annual servicing certificate issued for the fixed CO_2 fire suppression system, were examined and found to be current and in proper order. Lifejackets were spot checked and found to

be satisfactory as to condition and type. A fire and boat (lifeboat) drill was satisfactorily performed and all the lifeboats were checked during the examination. The emergency diesel generator was operationally tested under load and was found to function satisfactorily. The Coast Guard inspectors also examined the bridge navigation equipment and the bridge remote operation of all automatic watertight doors and firescreen doors.

As part of the Coast Guard examination, the crew performed a simulated Phase II (passenger evacuation and muster) and Phase III (abandon ship) of the ship Emergency Plan, including lowering the five starboard lifeboats into the water and starting the motors. The five lifeboats on the port side were lowered to the embarkation deck and their motors operated. About 25 percent of the vessel's fire hoses were laid out on the Car Deck and tested under pressure. Two hoses ruptured and were replaced. The remote shutoffs for the ventilators, fire dampers, vent fans, and fuel oil pumps tested satisfactorily, as did the remote valves for the fuel oil settling and day tanks. All four fire pumps were tested and found to operate satisfactorily. The steering gear tested satisfactorily in all modes of operation. The smoke detection system in the engineroom was tested and found satisfactory. Of the 60 smoke detectors installed in the machinery space compartments, only 1 was operationally tested by the Coast Guard during its examination. At the conclusion of the Control Verification Examination, the Coast Guard found the vessel fit for the intended route and service.

There are no U.S. regulatory examinations or inspections required other than the safety and emergency equipment examinations conducted by the Coast Guard under the Control Verification Program.

The investigation revealed that the examination booklets used by the Coast Guard inspectors during their control verification examinations are manually updated by the individual inspector to reflect the amendments to SOLAS conventions. The booklet was issued in 1981 and has not been reissued since that date.

Tests and Research

Fixed CO_2 System.--A postaccident inspection of the ship's fixed CO_2 fire extinguishing system was conducted by the company that had serviced the system for years prior to the accident. The survey concluded that each of the four actuating pilot pistons, one installed at the end of each row of CO_2 bottles in the CO_2 room had insufficient travel within its cylinder to open the valve in its row.

Packing Gland.--The starboard main diesel engine fuel oil supply pipe to the No. 7 cylinder was removed from the vessel and sent to the Safety Board's laboratory in Washington. The packing found in the fuel oil supply pipe packing gland was one piece, made of a rubber-like material and measured, 25 mm OD, 18 mm ID, and 12 mm H.

ANALYSIS

The Accident

The fire aboard the SCANDINAVIAN STAR started about 2325 on March 15, 1988, when fuel oil leaking from the packing gland of the fuel oil supply pipe to the No. 7 cylinder fuel oil injector pump on the inboard side of the starboard main engine developed into a large spray that contacted the hot exhaust manifold of the starboard main engine and ignited. The engineering watch crewmen could have taken a number of immediate actions after the fire had started that would have controlled or contained the fire and, consequently, lessened the severity of the accident.

The watch motorman was in the lower engineroom and witnessed the fuel oil leaking and the subsequent ignition. The fuel oil service system was fitted with a number of valves that, when closed, would isolate either or both the port and starboard engine from the fuel oil supply. These valves were located in the lower engineroom close to where the watch motorman discovered the leak. In addition, a start/stop electrical switch for the main engine fuel oil service booster pump was within the reach of the motorman in the lower engineroom when he discovered the leak. While the prudent action would have been to eliminate immediately the source fuel to the fire, the watch motorman made no attempt to close the valves or to stop the booster pump. Instead, the motorman hurried up the starboard aft ladder to the outside front of the engine control room on "D" Deck and, by hand signals, informed the watch engineer of the fire. According to the motorman, he knew where the fuel oil shutoff valve and the switch for the fuel oil booster pump were located, but that the routine on board the SCANDINAVIAN STAR was "to inform the watch officer first before taking any action."

Once the watch engineer was alerted to the fire by the motorman, he had options, which had he exercised, could have prevented the further propagation of the fire. The watch engineer, who should have been knowledgeable of the machinery and piping systems in the engine spaces, could have instructed the watch motorman to go back to the lower engineroom and close the valves or stop the pump. More importantly, however, although the watch engineer did activate the emergency shutdown control on the main engine control console for the starboard engine and telephoned the bridge to stop the engines, he had the ability to shut off the fuel oil booster pump at the engine control room console, but failed to do so. The failure to take this action suggests that the watch engineer may not have been as familiar with the machinery and emergency procedures as he should have been. Even though the emergency shutdown control was activated and the engine stopped, the fuel oil booster pump continued to supply fuel to the engines. The watch engineer's testimony that he did not stop the fuel oil booster pump because he believed that it was only the starboard engine that was having the fire suggests that he was not sufficiently knowledgeable of the engine fuel oil system even though, according to the international minimum requirements, the watch engineer should have theoretical and practical knowledge of the operation and maintenance of marine machinery appropriate to the duties of an engineer officer.

The watch engineer's only instructions to the watch motorman was to fight the fire with a portable CO_2 fire extinguisher. The engineer also attempted to fight the fire with a portable fire extinguisher, but the fire had quickly intensified because of the constant flow of fuel, and the crewmembers were unable to use the portable fire extinguishers with any success. The Safety Board believes that had the crewmembers stopped the flow of fuel, the fire could have been extinguished shortly after it was discovered.

When both the watch motorman and the watch engineer evacuated the engineroom, they left by the port side door to the "C" Deck passageway, which was the location of the remote emergency controls to shut off the fuel oil tank, the fuel oil pumps to the engines and generators, the engineroom ventilation fans, and the remote controls to operate the fixed CO_2 system. Neither crewmember, however, used the emergency controls at this location, although the engineer, at least, should have known of the location and operation of these controls. The Safety Board believes that the failure of the watch engineer to shut off the engine fuel oil supply at either the engine control room console or at the remote emergency control cabinets in the port side "C" Deck passageway increased the severity of the fire and, consequently, the danger to passengers and crewmembers and the damage to the vessel.

Once the bridge had been notified of the fire and the master assumed control of the bridge, the master shortly thereafter initiated Phase I of the ship Emergency Plan and instructed the Mobile Fire Group over the public address system to meet in the Car Deck area. The appropriate personnel, including the watch motorman, the watch engineer, and the staff captain, who was in charge of the firefighting efforts, gathered in the Car Deck area where some of the firefighters were donning their fireman's protective clothing and preparing their equipment. Neither the watch motorman nor the watch engineer volunteered information to the staff captain concerning the source of the fire. Likewise, the staff captain, who is responsible for planning an effective firefighting attack and for instructing the firefighters as to the type of fire to be fought, did not seek the information. Furthermore, the staff captain was not aware of the various emergency shutoff control cabinets that were located nearby in the port side "C" Deck passageway. The Safety Board concludes that the staff captain's failure to aggressively seek information on the source of the fire in the engineroom and the failure of the engineroom crewmembers to provide vital information on the location of the fire contributed to the rapid spread of the fire and thus increased the danger and risk to fellow crewmembers and the passengers.

Propagation of Fire

Although the engineering spaces were equipped with an automatic smoke detection system that activated alarms on the panel in the engine control room, the alarm did not activate at the time of the fire. While the failure of the system to activate did not delay discovery of the fire, since the watch motorman was at the location of the fire when it started, the Safety Board remains concerned that an automatic detection system, particularly one

to detect a fire and/or smoke condition in an engineroom on board a passenger cruise vessel did not activate. Had there been a delay in discovering the fire as a result of the system not activating, the danger and risk to passengers and crewmembers may have been much greater and the damage to the vessel more extensive. Accordingly, there is a need for SeaEscape Ltd. to determine that all automatic fire and smoke detection and alarm systems on board its passenger cruise vessels function as designed.

Fixed CO2 Fire Suppression System.--During construction of the SCANDINAVIAN STAR, the ship was equipped with a fixed CO_2 fire suppression system which consisted of 36 45-kilogram bottles of CO_2 located on the Sun Deck. By positioning the valves on the distribution manifold at the emergency control cabinet located on the port side "C" Deck passageway, the CO_2 could be directed to the desired machinery space compartment. After the staff engineer eventually closed the fuel oil tank valves and shut down the engineroom fuel pumps and ventilation fans from the remote emergency control cabinets, the decision was made to release the CO_2 into the engineroom. However, when the staff engineer activated the automatic release from the remote control cabinet, the CO_2 did not release. Consequently, even if the watch motorman and the watch engineer had thought to utilize the emergency CO_2 release controls in the port side passageway of "C" Deck, the CO_2 would not have released. Notwithstanding the failure of the CO_2 to release from the remote controls, the Safety Board believes that all deck and engineering officers and selected crewmembers should be trained to know the location and the operation of the remote emergency shutoff valves and controls, including the remote operation of the fixed CO_2 fire suppression system.

Because the remote controls did not release the CO_2 it was necessary for the staff engineer to run up five decks to enter the CO_2 storage room on the Sun Deck. However, because the four local automatic releases at the end of each of the four rows also malfunctioned due to the limited travel allowed by the CO_2 operating cylinders, it was necessary for the staff engineer to climb on top of the rows and release each bottle manually. Valuable time was lost in the attempt to release the CO_2, and the malfunction of the remote automatic and the local automatic release mechanisms on the fixed CO_2 fire extinguishing system contributed to the duration of the fire and increased the danger to passengers and crewmembers.

The Safety Board is concerned that the primary system to fight an engineroom fire did not function as intended. The Safety Board is further concerned that the servicing and testing by a CO_2 service contractor in December 1987 detected no problems with the system and that the annual surveys conducted by the classification societies, Bureau Veritas and Lloyd's Register of Shipping, did not include a detailed inspection of the remote and manual automatic release mechanisms. Accordingly, the Safety Board believes that the classification societies should amend their procedures for inspecting fixed CO_2 fire extinguishing systems on passenger vessels to include a more detailed inspection of the remote and local automatic release mechanisms to verify their operation and the operation of the entire system.

Emergency Generator.--The fire destroyed the electrical cables overhead in the engineroom, and, according to both the bridge and engineroom log

books, about 15 minutes after the fire started, all main and emergency generator electrical power was lost. At that time, the only source of power on board the ship was from the emergency battery, which came on line as designed supplying only limited lighting to passageways, stairwells, engineroom and bridge control stations, and lifeboat embarkation stations. Since the emergency battery system did not include electrical power to the public address system, the master was unable to communicate with either the various emergency response groups or the passengers via the public address system for a 1-hour period while the emergency generator was being repaired. Also, since the battery supply system could not include electrical power to any of the four fire pumps, the only resource available to the Mobile Fire Group to cool hot spots discovered was by using the water supply from the ship's swimming pool.

The investigation revealed that the electrical power supply for the emergency generator did not comply with IMO or Coast Guard regulations that require the emergency generator be independent and separated as far as practical from the main machinery spaces to ensure that "a fire or other casualty in spaces containing the main source of electrical power...will not interfere with the supply, control, and distribution of the emergency electrical power." Testimony by the chief electrician and engineering officers revealed, however, that the battery bank which supplied power to excite the magnetic field in the emergency generator was located in the main engineroom. While the Safety Board is concerned that the power source for the emergency generator was located in the main engineroom and believes that SeaEscape should take action to correct the situation in accordance with IMO regulations, the Safety Board is equally concerned that the situation was not detected during the scheduled classification surveys conducted by Lloyd's Register of Shipping. Accordingly, the Safety Board believes that Lloyd's Register of Shipping should amend its survey procedures to require verification that the emergency generator is independent and does not rely on a power source outside of the emergency generator room.

For approximately 1 hour while the vessel was under emergency battery power, passengers received no direct communication from the master regarding the ongoing emergency. Passenger statements indicate that at times they were provided inaccurate and incomplete information by crewmembers as to what action to take during the emergency. For example, some passengers returned to their cabins through the smoke to obtain their lifejackets; they apparently did not know that lifejackets were also stowed on deck. Although fortuitously there were only minimal injuries as a result of the fire emergency on board the SCANDINAVIAN STAR, the Safety Board is concerned that with the lack of direct communication to passengers at all times during an ongoing emergency, the possibility of mass confusion, panic, and hysteria exists. Accordingly, the Safety Board believes that the Coast Guard should propose to the IMO an amendment to SOLAS '74 to provide that passenger vessels subject to SOLAS '74 have the ship's public address system powered by the emergency battery power system.

Crewmember Training and the Ship Emergency Plan

Because the actions of the various crewmembers when the fire was discovered and during the initial stages of the emergency demonstrated a lack of knowledge about basic firefighting techniques, particularly with a fuel oil fire, the Safety Board examined the adequacy of the firefighting training provided to crewmembers and the guidance provided by the ship Emergency Plan with respect to fighting fires.

Crewmember Training.--The IMO regulations require that unlicensed personnel of the engineroom watch have experience or training regarding firefighting. There is, however, no description of the quantity or type of experience or training necessary to meet the requirement. According to the motorman, he had received no firefighting training other than what he learned during the fire drills conducted weekly on board the SCANDINAVIAN STAR. According to the chief engineer, these drills consisted of laying out hoses and teams "acting out" fighting fires in different engine spaces. While these fire drills may have been considered sufficient in terms of meeting the IMO requirements for firefighting training of unlicensed personnel, the Safety Board is concerned that crewmembers were not taught about the basic components of fire (heat, fuel, and oxygen) and were not taught the various methods of fighting different types of fires, including trash fires, oil fires, and electrical fires, and the importance in fuel fires of eliminating the supply of fuel.

The IMO regulations state that the engineer shall have knowledge of the "safety precautions to be taken in the event of a fire or accident with particular reference to oil systems." The engineer's failure to shut down the main engine fuel oil booster pump, his instructions to the watch motorman to fight the fuel oil fire with a portable CO_2 fire extinguisher, and his own attempt to do so suggest that he did not have a clear understanding of how to combat a fuel oil fire. In this case, removal of the fire's fuel source would have been the first and most effective response in combating the engineroom fire. A fire at sea can be one of the most dangerous hazards confronting the crew and passengers of a ship, especially a large passenger ship. Assistance may not be immediately available, and the crew with the on-board firefighting equipment must be able to provide timely and effective fire protection. On-board training in the use of firefighting equipment, the components of fire, the various types of fire, and the most effective methods to fight the various types of fire is the basis of shipboard fire protection. The Safety Board concludes that the training provided crewmembers on board the SCANDINAVIAN STAR was inadequate and did not prepare them for making the proper decisions in fighting a fuel oil fire.

Ship Emergency Plan.--An emergency plan had been developed for the SCANDINAVIAN STAR, in accordance with SOLAS 74, Chapter III, Part A Regulation 25. While the plan outlined in general terms the responsibility of the various groups that were to be formed in the event of an emergency and provided general guidance in the event of a fire on board ship, there were no specific procedures regarding the types of fires that might occur or the various methods to be employed to fight the fires. Furthermore, information about the location, operation, and function of the various emergency shutoff

control cabinets was not included in the plan. The Safety Board believes that the lack of detailed written engineroom emergency firefighting procedures contributed to the delay in shutting off the fuel oil booster pump and, consequently, to the propagation of the fire. The Safety Board, therefore, urges SeaEscape Ltd. to develop written engineroom emergency firefighting procedures that include, at a minimum, instructions on the initial actions to take for the various types of engine and oil system fires, the methods for fighting fires, and the location and operation of critical shutoff and control valves for the engine and fuel oil systems. While the Safety Board does not believe that the engineroom firefighting procedures need to be a part of the ship Emergency Plan that receives shipwide distribution, the procedures should be posted in the engine control room and distributed to all engineroom and firefighting personnel. More importantly, SeaEscape should determine that these procedures are understood by the appropriate personnel through training.

Vessel Maintenance

Leaks, similar to the one which occurred at the packing gland in the fuel oil supply pipe to the No. 7 cylinder fuel oil injector pump, had occurred before on the SCANDINAVIAN STAR. According to the engineroom log book, engine maintenance records, and testimony of the watch motorman, fuel oil leaks at the packing glands were a recurrent problem and the leaks were at times severe enough to require stopping the engine to make repairs at sea. In fact, on March 14, 1988, one day before the accident, while the vessel was en route from Tampa/St. Petersburg to Cozumel, the port engine was stopped to repair a packing gland fuel oil leak to the No. 6 cylinder on the port engine.

The investigation revealed further that in 1975 the engine manufacturer had designed a new packing seal for the packing glands in the fuel oil supply and return pipes and that the ship had recently purchased a number of the new packing seals. According to the chief engineer, who testified that there was no planned maintenance program on board the SCANDINAVIAN STAR, he would install the new seals only after a fuel oil leak was discovered. He made no attempt to replace or schedule the replacement of all the old packing seals even though he knew that leaks continued to occur at those locations where the old seals were still in place and that he experienced no new leaks at those locations where the new seals had been installed.

The foregoing indicates that the SCANDINAVIAN STAR lacked any type of preplanned maintenance program since the obvious and prudent course of action would have been to replace all of the old packing seals with the new style which were in stock aboard the ship. The Safety Board believes that had all the old packing seals been replaced, as would be accomplished in a preventive maintenance program, the fuel oil leak at the packing gland may not have occurred.

The engine maintenance program that existed on the SCANDINAVIAN STAR only dealt with a defect or problem after it was discovered. The Safety Board believes that a preventive maintenance program, the objective of which is to prevent the breakdown, deterioration, and malfunction of equipment, is

necessary to ensure passenger safety. Consequently, the Safety Board urges SeaEscape Ltd. to develop a preventive engineering maintenance program for the vessels in the SeaEscape fleet so that main engines and auxiliary equipment and safety equipment are properly maintained.

The post-fire survey of the engineroom revealed the remnants of a deflector sleeve on the packing gland of the fuel oil supply pipe to the No. 7 cylinder injector pump. The survey revealed further that of the 64 deflector sleeves that should have been installed on both main engines about 40 percent were either missing entirely or only had small portions remaining. Furthermore, examination of these sleeves revealed that they had deteriorated from age and not as a result of fire damage. Although the designed purpose of the deflector sleeve is to divert a fuel leak in the packing gland away from hot engine ignition sources, the staff and chief engineer testified that they did not know the purpose of the deflector sleeve. The Safety Board concludes that engineering department personnel were not sufficiently knowledgeable of the engineroom machinery and its function to carry out their responsibility to maintain the vessel in a safe condition. Had the engineering staff known the purpose of the deflector sleeves and taken action to replace those missing or deteriorated, the accident may not have occurred.

Survival Aspects

Passenger Evacuation.--There were no procedures in the Emergency Plan developed by SeaEscape to account for all the passengers at the muster stations and at the lifeboat stations. The hotel manager confirmed that the only way the crew would become aware of a missing person was if someone informed the crew. The crewmembers in charge of the muster stations did not have passenger manifests or any other method of determining if passengers were at their assigned muster stations.

The Safety Board's investigation into the fire and explosion on board the passenger ship EMERALD SEAS[11] revealed that two passengers were found unconscious in their cabins and they were not rescued until another passenger, who was trapped in a passageway, informed crewmembers. As a result of that investigation, the Safety Board recommended to Admiral Cruises, Inc. that:

> M-87-20
>
> Before a ship leaves port, provide the crewmember in charge of each lifeboat with a list of passengers assigned to his/her lifeboat.

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[11] Marine Accident Report--"Fire and Explosion Onboard the Panamanian Passenger Ship EMERALD SEAS in the Atlantic Ocean Near Little Stirrup Cay, Bahamas, on July 30, 1986" (NTSB/MAR-87/04).

Although the Safety Board has requested information on two occasions concerning the company's efforts to implement this recommendation, Admiral Cruises, Inc. has failed to respond. Consequently, Safety Recommendation M-87-20 has been placed in a "Closed--Unacceptable Action" status.

The Safety Board believes that this accident investigation again illustrates the need for passenger cruise vessels to account for all passengers during evacuation to muster and lifeboat stations. Accordingly, the Safety Board urges that SeaEscape Ltd. provide to each crewmember in charge of each muster and lifeboat station a list of those passengers assigned to those stations before vessels depart from port.

A number of factors hampered the successful evacuation of passengers to the muster stations. Although the master was able to stop only the ventilation system to the passenger accommodations, all of the ship's ventilation fans and vent dampers were not closed immediately after the fire was discovered and, as a result, smoke quickly spread to the public spaces such as the lounge, passageways and stairwells, and to the two aft muster locations. Passengers stated that the Gasparilla Lounge quickly filled with smoke through the airconditioning ducts. Had the ventilation systems been stopped when the fire was initially discovered, the migration of smoke would not have been as extensive as it was, and some of the problems of reduced visibility and breathing difficulties while searching for and evacuating passengers could have been avoided.

The Safety Board has previously addressed the need to stop ventilation immediately upon detection of a fire. As a result of its investigation of the fire aboard the SCANDINAVIAN SUN, the Safety Board recommended that the Coast Guard:

> M-85-57
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> Direct inspectors conducting control verification examinations to stress to the ship's officers the need to close fire doors and to stop ventilation immediately upon detection of a fire.

In response, the Coast Guard indicated that the marine safety manual had been revised to instruct marine inspectors to question the crew about their emergency duties. According to the Coast Guard, this should ensure that the crew is aware of what prompt and effective action needs to be taken in the event of fire. Although this safety recommendation was placed in a "Closed--Acceptable Action" status, the Safety Board believes that this accident illustrates that further guidance to crewmembers is needed on this issue. The Safety Board believes that at a minimum the need to stop ventilation in the event of a fire should be stressed in the ship Emergency Plan and in the emergency firefighting procedures for the machinery spaces.

Notwithstanding the Board's belief that crewmembers should be aware of the need to shut down ventilation systems in the event of an emergency, the Safety Board believes that with the state-of-the-art technology, ventilation

systems could be automatically stopped, thus preventing the migration of smoke as occurred during the evacuation of passengers in this accident. Smoke-sensitive actuating devices that would automatically shut down the ventilation system when the smoke sensing device is actuated could be made a part of each local ventilation system.

The Safety Board has recognized previously that the automatic shutdown of the ventilation system would reduce the amount of smoke spread through the ship. As a result of the Safety Board's investigation of the fire and explosion on board the passenger ship EMERALD SEAS in the Atlantic Ocean near Little Stirrup Cay, Bahamas, on July 20, 1986, the Safety Board made the following safety recommendation to the Coast Guard:

> M-87-18
>
> Propose that the International Maritime Organization amend SOLAS 74 to require that smoke detectors be made a part of each local ventilation system to shut down the ventilation system automatically when the detector is activated to prevent the spread of smoke.

The Coast Guard forwarded this recommendation to the IMO's Maritime Safety Committee as a United States agenda item and in the 33rd session of the Subcommittee on Fire Protection it was introduced. The United States stated in this document that in the past, smoke detectors were not technically advanced. Today, cost, reliability, and accuracy have improved to the point that dampers and fans can be successfully controlled through local smoke detectors; therefore, the United States proposed that the Subcommittee consider amending SOLAS 74 regulation II-1/16 and 32 by adding the following sentences:

> .1 To the end of paragraph 1.6 added the following sentence:
>
> "Smoke detectors shall be installed in ventilation ducts, and shall be connected to the power ventilation controls so as to automatically stop all fans in case of fire."
>
> .2 Add a new paragraph 1.7:
>
> "1.7 All automatic fire dampers shall be equipped with smoke detectors arranged to close the damper in case of fire."

Discussion was held at the 34th session and the issue of amending SOLAS 74 to require automatic ventilation system shutdown was supported in the working group on passenger vessel safety by Japan, Finland and the United States. However, a larger number of Administrations, most notably the United Kingdom, Canada, Russia, Liberia, Sweden, Norway and the Netherlands, opposed the amendment citing the fact that human failure led to delays in ventilation systems shutdown and that there may be cases such where shutdown may be dangerous, i.e., if passengers are trapped in a smoked situation.

The Safety Board, however, continues to be concerned that automatic ventilation system shutdown is not a requirement for foreign flag passenger vessels entering the U.S. cruise industry market. In view of the fact that the safety recommendation met with little success through the IMO process, the safety recommendation has now been placed in a "Closed--Superseded" status. As an alternative approach, the Safety Board believes that the Coast Guard should seek legislation that directs U.S. and foreign flag passenger vessels operating out of ports in the U.S. to have automatic ventilation system shutdowns.

Since the Evacuation Group was not provided with protective breathing equipment, the smoke greatly hampered their efforts to search passenger accommodation areas. The Safety Board is concerned that a group designated in the ship Emergency Plan and charged with the responsibility to search for passengers during an emergency situation that could involve smoke conditions are not provided with adequate equipment to accomplish their task. The Safety Board urges SeaEscape Ltd. to provide protective breathing equipment to all members of emergency groups who may be exposed to smoke while involved in the search and evacuation of passengers from staterooms and public spaces.

Location of Lifejackets.--During the emergency, some passengers were given conflicting instructions regarding the location of their lifejackets. The placards posted on the back of each stateroom door instructed passengers to obtain lifejackets from a crewmember when they reached their respective muster stations. However, during the fire and boat drill that was conducted on March 14, those passengers who attended were instructed to bring the lifejackets that were stored in their cabins under the beds. As a result of this conflicting information, some passengers, who were on the upper decks near their muster stations when Phase II of the emergency plan was initiated, attempted to return to their cabins through the smoke and little light to obtain their lifejackets. The passengers who remained at the muster station found that there was an insufficient number of lifejackets in the storage lockers on the Sun and Sunset Decks to accommodate all of the passengers at those locations. Furthermore, some passengers stated that they had to wait for nearly an hour or more before crewmembers obtained lifejackets for them. The Safety Board is concerned that the conflicting instructions about obtaining lifejackets needlessly endangered the lives of some passengers and believes that SeaEscape Ltd. should take action to correct this situation and provide consistent information to passengers concerning the location of lifejackets.

The Safety Board is also concerned that there was an insufficient number of lifejackets at the muster stations and that some passengers either had to return to their cabins or wait an unacceptable length of time before receiving a lifejacket. Had the fixed CO_2 system never released and, consequently, had the fire on board become far more critical, some passengers could have been faced with the situation of abandoning ship with no lifejacket available. Given the sea conditions at the time of the accident, and the insufficient number of lifejackets on deck, the Safety Board believes that the situation could have been catastrophic had Phase III of the ship Emergency Plan been initiated.

As a result of its investigation of the grounding of the U.S. passenger vessel PILGRIM BELLE near Vineyard Sound, Massachusetts, on July 28, 1985, the Safety Board issued the following safety recommendation to the Coast Guard:

> M-86-62
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> Conduct research to determine the best location for stowing life preservers on all passenger vessels; in the interim, require that life preservers be stowed outside of passenger and crew berthing rooms and closer to or at emergency stations.

The Coast Guard did not concur in this recommendation and concluded that "although life preserver stowage was not ideal for this particular casualty, it was appropriate considering the various possible casualty scenarios." Based on the Coast Guard's position, this safety recommendation was placed in a "Closed--Unacceptable Action" status. The Safety Board believes that this accident illustrates the need to have a sufficient number of lifejackets at the muster stations for all passengers in addition to the lifejackets stowed in the cabins and urges SeaEscape to take action toward this end for each vessel in its fleet.

Language Barrier Problems

During the accident, there was evidence of language barrier problems on board the SCANDINAVIAN STAR. The Honduran watch motorman communicated by hand signals to the Filipino watch engineer that there was a fire in the engineroom. Since the two crewmen did not share a common language, the use of hand signals was the only means available for communicating. While there is no evidence to suggest that the watch engineer had difficulty deciphering the hand signals of the motorman, the Safety Board remains concerned that the watch crewmen, who are responsible for monitoring the machinery spaces and initiating a timely response to any emergency situation, did not share a common language. Had a situation developed that required the exchange of more complex information, any delay in communicating this information could become critical and further endanger the lives of passengers and other crewmembers. The Safety Board believes that watchstanders should be able to communicate in a common language during normal and emergency situations and that requirements to reduce language barriers should be established.

The investigation revealed further that neither the Filipino engineer or any other engineering or deck officer read French, but that nearly all of the machinery and equipment operating manuals and engineering drawings were written in French. Both the chief engineer and the staff engineer testified that they did not know that the purpose of the deflector sleeve on the packing gland was to prevent leaking fuel oil from contacting hot ignition surfaces. Even though the manuals did state in French the purpose of the deflectors, it is unknown if the crewmen would have replaced them had the manuals been written in a language they could read and understand. Nevertheless, the Safety Board questions the usefulness of having manuals

written in a language that is not understood by the ship's operating and maintenance personnel. More importantly, the Safety Board is concerned that SeaEscape Ltd. was probably aware that engineering instructions and drawings were written in a language not understood by the ship's officers. Accordingly, the Safety Board believes that SeaEscape Ltd. should provide operating instructions and engineering drawings for vital ship machinery and emergency equipment written in a language readily understood by the ship's officers. Furthermore, the Coast Guard should propose that the IMO amend SOLAS '74 to require that operating instructions and engineering drawings for vital ship machinery and emergency equipment be written in a language which is readily understood by the ship's officers.

Postaccident statements by passengers, the majority of whom spoke English, indicated that there were numerous problems during the emergency communicating with the crew, which consisted of 27 different nationalities, many of whom could not speak or understand English. Passenger statements also indicate that crewmembers did not understand each other and, as a result, firefighting and evacuation activities were at times confusing and instructions were given through gestures. The Safety Board is concerned that acceptable levels of safety for passengers and crewmembers may be compromised if passengers and crewmembers are unable to communicate without difficulty, particularly during an emergency situation. The Safety Board believes that crewmembers in charge of muster and lifeboat stations and the evacuation group should have the ability to communicate in a common language with the majority of the passengers.

Although the Bahamian Shipping Act stipulates language requirements for crews of Bahamian flag vessels, there apparently are no provisions to determine that the requirements are adhered to. Lloyd's Register of Shipping does not inspect crews to determine their competency in the English language and has not been charged to do so by the Bahamian government. Likewise, the Coast Guard does not inspect crews to determine their ability to communicate with each other. Consequently, the Safety Board believes there is a need for the ship's officers and crew to be able to communicate with each other and with passengers.

Search and Rescue

The search and rescue efforts by the U.S. Coast Guard, U.S. Air Force, Mexican Navy, and merchant vessels that responded to the distress message of the SCANDINAVIAN STAR and stood by offering assistance were timely and effective. Firefighting equipment was transported and made available to the SCANDINAVIAN STAR, although ultimately the equipment was not needed to extinguish the fire. Because of the timely response of the U.S. Coast Guard and the U.S. Air Force, the two injured passengers aboard the SCANDINAVIAN STAR were flown from the vessel to St. Petersburg, Florida, where they were admitted to a hospital and later released.

Coast Guard Control Verification Examinations

The investigation revealed that under SOLAS regulations, the Coast Guard's examination of foreign flag vessels is limited in scope and not

comparable to the Coast Guard inspections of U.S. passenger vessels. Regulation 19 of SOLAS '48 permits the Coast Guard to board the passenger vessel and "verify that a valid Passenger Ship Safety Certificate is on board;" except for cause, it does not specifically allow the U.S. or any other "country state" to examine in detail a vessel's safety and life saving systems and equipment. Because of the limited scope of the Coast Guard Control Verification Examinations of foreign flag passenger vessels, the Coast Guard examination did not detect the problems with the SCANDINAVIAN STAR's fixed CO_2 firefighting system or with the emergency generator. The Safety Board has expressed concern previously that the Coast Guard examination program for foreign flag passenger vessels that board U.S. citizens at U.S. ports does not measure adequately the level of safety on board foreign passenger vessels.

As a result of its investigation of a fire aboard the SCANDINAVIAN SEA on March 9, 1984, the Safety Board issued the following safety recommendation to the Coast Guard:

> M-85-31
>
> Under the Control Verification Program for foreign passenger ships calling at United States ports and embarking U.S. citizens as passengers, conduct more comprehensive examinations of the fire and emergency equipment and safety procedures aboard vessels.

The Coast Guard in response to this recommendation stated that it had taken a number of actions to emphasize its posture on foreign vessel inspections including reinstituting its quarterly reexamination program. The Coast Guard also published a navigation and inspection circular which "provides plan review and inspection guidance for operators of foreign passenger vessels calling at U.S. ports for the first time." Based on this information, the safety recommendation was placed in a "Closed--Acceptable Action" status. The Safety Board believes that this accident illustrates that additional action by the Coast Guard is needed in this area. In particular, the Safety Board believes that the testing of only 1 out of 60 smoke detectors in the machinery spaces is unacceptable. In view of the number of foreign flag passenger vessels now calling at U.S. ports and with the expected increase in the number of passenger cruise ships, the Safety Board believes that the Coast Guard should be conducting more detailed inspections of these vessels. Accordingly, the Safety Board urges the Coast Guard to expand the scope of Control Verification Examinations to include a more detailed examination of fixed fire detection and extinguishing systems and emergency power systems.

The examination booklet used by Coast Guard inspectors during their control verification examinations was issued in 1981 and has not been revised since that date. The Coast Guard apparently depends on its inspectors to take the initiative to update their booklets manually to reflect amendments to SOLAS conventions that have been adopted since 1981. The Safety Board is concerned that the Coast Guard cannot be assured that all of its inspectors have manually updated their booklets to reflect accurately and consistently

all amendments to SOLAS conventions. Accordingly, the Safety Board believes that the Coast Guard should revise and reissue the foreign vessel control verification examination booklet to reflect current SOLAS conventions and amendments.

Accident Reporting Criteria for Foreign Flag Vessels

The Safety Board is concerned that there are no accident reporting criteria for foreign flag vessels in the event of an accident outside of U.S. navigable waters even though the vessel regularly operates out of U.S. ports and carries a large majority of U.S. passengers. The Coast Guard became aware of and involved in this accident only by monitoring radio communications. There was no requirement that the fire on board the SCANDINAVIAN STAR be reported to the Coast Guard. Because of the number of foreign flag passenger vessels operating from U.S. ports with U.S. passengers, the Safety Board believes that corrective action in this area is needed and the Safety Board is addressing this issue in more detail in its ongoing Passenger Vessel Safety Study.

CONCLUSIONS

Findings

1. The watch engineer did not shut off the engine fuel oil supply, at either the engineroom control console or the emergency fuel pump shut-off location in the "C" Deck passageway, resulting in an increase in the severity of the fire and, consequently, the danger to passengers and crewmembers and the damage to the vessel.

2. Had the watch engineer immediately stopped the flow of fuel or instructed the motorman to stop the flow of fuel, the fire could have been successfully extinguished during the initial stages.

3. The watch engineer did not have adequate theoretical and practical knowledge of the machinery and fuel oil systems.

4. Although it did not delay discovery of the fire, the engineroom automatic smoke detection system did not activate at the time of the fire.

5. The watchstanders did not inform the staff captain, who was in charge of the firefighting, of the source of the fire and the staff captain did not seek that information, all of which contributed to the propagation of the fire and increased the danger and risk to fellow crewmembers and the passengers.

6. On-board firefighting training provided to crewmembers on the SCANDINAVIAN STAR was inadequate and did not prepare the crew for making the proper decisions in fighting a fuel oil fire.

7. The lack of detailed written engineroom emergency firefighting procedures contributed to the delay in shutting off the fuel oil booster pumps and, consequently, to the severity of the fire.

8. Had the local ventilation systems been equipped with smoke-sensitive actuating devices that would automatically shut down the ventilation system when smoke is detected, the spread of smoke would have been minimal and the risk and danger to passengers and crewmembers reduced.

9. The malfunction of the remote automatic and manual release mechanisms on the fixed CO_2 fire extinguishing system increased the duration of the fire and increased the danger to passengers and crewmembers.

10. Classification surveys by Bureau Veritas for 15 years from 1972 until 1987 and by Lloyd's Register of Shipping for 6 months from September 1987 until March 15, 1988, did not detect the problems in the ship's fixed CO_2 fire extinguishing system.

11. The firefighting efforts and the evacuation of passengers was greatly hampered by the lack of electrical power for the public address system and the emergency fire pump.

12. The location of the power supply for the emergency generator did not comply with International Maritime Organization regulations that require the emergency generator to be independent of the main machinery spaces.

13. The scheduled classification surveys conducted by Lloyd's Register of Shipping did not detect that the field excitation power source for the emergency generator was located in the main engineroom in violation of International Maritime Organization regulations.

14. There was no preventive maintenance program for the engineering equipment on the SCANDINAVIAN STAR.

15. Had the old seals for the packing glands in the fuel oil supply and return pipes been replaced when the new ones were purchased, the accident probably would not have occurred.

16. Had the engineering staff known the purpose of the deflector sleeves and taken action to replace missing or deteriorated sleeves, an intact deflector sleeve would have directed the fuel oil leak away from the hot exhaust manifold and the accident may have been avoided.

17. There were no procedures in the Emergency Plan developed by SeaEscape to account for all the passengers at the muster stations or lifeboat stations.

18. The Evacuation Group was hampered in their search of the passenger spaces because the members of the group were not provided with protective breathing equipment.

19. Written instructions on the placard in passenger staterooms and verbal instructions given to passengers during the fire and boat drill conflicted as to where passengers were to obtain lifejackets during an emergency and, as a result, caused confusion during the evacuation.

20. The watch motorman and the watch engineer were forced to communicate with each other through hand signals, because they did not share a common language.

21. Operating instructions and engineering drawings for the ship machinery and emergency equipment were written in French, a language not understood or spoken by any of the engineering or deck officers.

22. The inability of crewmembers to communicate with each other and with passengers created confusion and hindered the evacuation process.

23. The search and rescue efforts by the U.S. Coast Guard, the U.S. Air Force, the merchant vessels, and the Mexican Navy were timely and effective.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the uncontrolled engineroom fire on board the cruise ship SCANDINAVIAN STAR was (1) the lack of a preventive maintenance program for the engineroom that resulted in the failure to replace deteriorated fuel pipe packing seals and deflector sleeves, (2) inadequate crew training, and (3) the lack of written engineroom emergency firefighting procedures. Contributing to the severity of the emergency was the malfunctioning of the ship's fixed CO_2 fire suppression system and the inability of some crewmembers to communicate in a common language with each other and with passengers.

RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board made the following recommendations:

--to the U.S. Coast Guard:

> Seek legislative authority to regulate and directly surveil the safety of foreign passenger vessels as a condition for operating from U.S. ports. (Class II, Priority Action) (M-89-43)
>
> Seek legislative authority to require that all passenger vessels operating from U.S. ports embarking U.S. passengers integrate smoke detectors into local ventilation systems to shut down the ventilation system automatically when the detector is activated to prevent the spread of smoke. (Class II, Priority Action) (M-89-44)

Propose that the International Maritime Organization amend SOLAS '74 requirements for passengers vessels to:

Specify the procedures necessary to perform a functional test of fixed CO_2 fire extinguishing systems annually to verify their operation. (Class II, Priority Action) (M-89-45)

Require that operating instructions and engineering drawings for vital ship machinery and emergency equipment be written in a language which is readily understood by the ship's officers. (Class II, Priority Action) (M-89-46)

Require that the emergency battery system supply power for the smoke detection devices, the fire alarms, and the public address system. (Class II, Priority Action) (M-89-47)

Expand the scope of Control Verification Examinations of foreign flag passenger vessels to include a more detailed examination of fire detection and fixed fire extinguishing systems and emergency power systems. (Class II, Priority Action) (M-89-48)

Direct U.S. Coast Guard inspectors conducting Control Verification Program examinations of foreign flag passenger vessels to verify that the emergency generator is independent and not reliant on a power source from the main engineroom. (Class II, Priority Action) (M-89-49)

Revise the Foreign Vessel Control Verification Examination booklet (CG-840F) to be current with the SOLAS Conventions and Amendments. (Class II, Priority Action) (M-89-50)

Inform the masters and operators of all passenger vessels operating under the Coast Guard's Control Verification Program, by appropriate published means, of the circumstances and deficiencies in this accident. (Class II, Priority Action) (M-89-51)

--to SeaEscape:

For each vessel in your fleet provide lifejackets at each muster station for passengers in addition to those lifejackets stowed in the cabins. (Class II, Priority Action) (M-89-52)

Develop written emergency firefighting procedures for the machinery spaces for use on all SeaEscape operated passenger vessels. (Class II, Priority Action) (M-89-53)

Conduct regularly scheduled emergency firefighting drills and training for simulated engineroom fires. (Class II, Priority Action) (M-89-54)

Emphasize in the ship Emergency Plan, in the emergency firefighting procedures for the machinery spaces, and during the regularly scheduled emergency fire drills the need to shut down ventilation systems immediately upon detection of a fire. (Class II, Priority Action) (M-89-55)

Determine that all automatic fire and smoke detection and alarm systems on board your passenger cruise vessels function as designed. (Class II, Priority Action) (M-89-56)

Survey your fleet of passenger cruise vessels to determine that the power source for the emergency generator is independent of the main machinery spaces, as required by International Maritime Organization regulations. (Class II, Priority Action) (M-89-57)

Provide operating instructions and engineering drawings for vital ship machinery and emergency equipment written in a language understood by the ship's officers. (Class II, Priority Action) (M-89-58)

Require that the officers and crew of passenger ships are able to communicate with each other and with a majority of the passengers. (Class II, Priority Action) (M-89-59)

Prior to departure from port, provide the crewmember in charge of each muster station and lifeboat station with a list of passengers assigned to those stations. (Class II, Priority Action) (M-89-60)

Provide passengers consistent instructions during fire and boat drills and on the placards posted in passenger staterooms about obtaining lifejackets in the event of an emergency. (Class II, Priority Action) (M-89-61)

Provide protective breathing equipment to all members of emergency groups who may be exposed to smoke while involved in the search and evacuation of passengers. (Class II, Priority Action) (M-89-62)

Initiate a training program for all deck and engineering officers and selected crewmembers of all vessels in the SeaEscape fleet concerning the location and operation of the remote emergency shutoff valves and controls, including the remote operation of the fixed CO_2 fire suppression system. (Class II, Priority Action) (M-89-63)

Amend the Emergency Plan booklet distributed to the officers and crewmembers to include information about the location and operation of the various emergency control cabinets. (Class II, Priority Action) (M-89-64)

Develop a preventive maintenance program for the vessels in the SeaEscape fleet so that the main engine and auxiliary equipment and safety equipment are properly maintained. (Class II, Priority Action) (M-89-65)

-- to Lloyd's Register of Shipping:

Amend survey procedures for the fixed CO_2 fire extinguishing systems on passenger vessels to include a more detailed inspection of the remote and local automatic release mechanisms to verify their operation and the operation of the entire system. (Class II, Priority Action) (M-89-66)

Amend survey procedures for the emergency generator on passenger vessels to require verification that the emergency generator is independent and not reliant on a power source from the main engineroom. (Class II, Priority Action) (M-89-67)

-- to Bureau Veritas:

Amend survey procedures for the fixed CO_2 fire extinguishing systems on passenger vessels to include a more detailed inspection of the remote and local automatic release mechanisms to verify their operation and the operation of the entire system. (Class II, Priority Action) (M-89-68)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

s/s James L. Kolstad
Acting Chairman

s/s Jim Burnett
Member

s/s John K. Lauber
Member

s/s Joseph T. Nall
Member

s/s Lemoine V. Dickinson, Jr.
Member

July 6, 1989

APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

Investigation

The National Transportation Safety Board was notified of the accident on March 16, 1988. Because this accident occurred in connection with public transportation carrying primarily U.S. citizens and involved problems of a recurring nature, the Safety Board investigated the accident under the provisions of Section 304 (a)(1)(F) of the Independent Safety Board Act of 1974. The Safety Board conducted an on-scene investigation from March 17 through 27, 1988.

Hearing

Hearings were conducted in Miami, Florida, on June 22, 23, and 24, 1988, and on October 4, 1988. Sworn testimony regarding this accident was taken at these times. SeaEscape Inc., the operator of the SCANDINAVIAN STAR, Lloyd's Register of Shipping, the society which classed the vessel at the time of the accident, and the U.S. Coast Guard were designated parties to the investigation.

APPENDIX B

PERSONNEL INFORMATION

Master Peter Hemerich Godfrey Schaab

Captain Peter Schaab, 38, was assigned as master of the SCANDINAVIAN STAR in September 1987. He received his masters license unlimited for oceangoing vessels from the Government Shipping Agency of West Germany and a masters certificate of competency issued by the Commonwealth of the Bahamas in August of 1976. His maritime education was conducted in accordance with the German Training Standards for ship officers which included a 3-year period as an apprentice officer and training at a German Naval Officer's training facility. Mr. Schaab received his first license as a watch standing third officer in July 1974. He was relief master on the SCANDINAVIAN SUN from February to September, 1987.

Staff Captain William Granville Phillips

Staff Captain William Phillips began going to sea in 1948 and trained for 4 years as a cadet midshipman. He received his first license as third officer in 1952 and continued working his way up through second officer, first officer, and master. Mr. Phillips completed firefighting training as a cadet in the British Merchant Service and completed comprehensive firefighting courses in 1981, 82, and 83 while working as a marine pilot with a Bahamian oil refining company. He was initially employed on board the SCANDINAVIAN STAR from March 1984 to June 30, 1986. From July 1986 to March 1988, Mr. Phillips was employed on vessels other than SeaEscape vessels. Mr. Phillips rejoined the SCANDINAVIAN STAR as staff captain 13 days prior to the fire on March 2, 1988.

Chief Engineer Anker Nissen

Mr. Nissen, 39, was in possession of a Danish chief engineer's license and a Bahamian chief engineer's certificate of competency. He was first licensed as a third engineer in 1970. He received his license as second engineer in 1972 and his license as first engineer in 1974. He received his chief engineer's license in 1976. Mr. Nissen began employment with SeaEscape on June 2, 1986, on board the SCANDINAVIAN SKY. On March 24, 1987, he was assigned to the SCANDINAVIAN STAR.

Staff Engineer Sten Jorgensen

Mr. Jorgensen was in possession of a Danish chief engineer's license and a Bahamian chief engineer's certificate of competency, both issued in January 1988. His maritime training was as a midshipman in a Danish Marine Academy. He began his engineering career at sea in 1968, followed by 10 years in the Danish Navy. After a period of employment on shore he returned to sea in 1982. From mid-1984 until mid-1985, he was hired as a second engineer working on board the SCANDINAVIAN SKY. He was assigned to the SCANDINAVIAN STAR in June 1985 as second engineer.

APPENDIX B

Second Engineer Modesto Cacatian

Mr. Cacatian, 47, was in possession of a valid Philippine chief engineer's license and a Bahamian chief engineer's certificate of competency. He began his career at sea as an apprentice working his way up in the engine department of various vessels as a wiper, boiler fireman, and 4 years as an oiler. During his time as oiler, he completed seminars and courses to prepare for the fourth engineer's examination. In 1975, he received a fourth engineer's license from the Republic of the Philippines. After nearly a year ashore, his first employment as fourth engineer was with Holland American Lines, where he remained for over 2 years while upgrading his license and position to third engineer. He continued working on cruise ships until 1983 when he returned to the Philippines and found employment as a chief engineer on a small passenger boat (less than 1,000 HP) until September 1984. He then sailed for 5 months as third engineer on the cruise ship BERMUDA STAR, before returning to the Philippines working ashore from March 1985 until July 1987. On July 11, 1987, he was hired as second engineer on board the SCANDINAVIAN STAR and remained with that vessel until April 1988.

APPENDIX C

SCANDINAVIAN STAR'S EMERGENCY PLAN

The five main groups and the various subgroups of the ship emergency plan is outlined below.

Continuous Run Ship Group is a main group and consists of the following subgroups:

Navigation and Stability -- This subgroup is headed by the second officer No. 1 and located on the navigation bridge. It is responsible for the safe navigation and stability control of the vessel.

Power and Propulsion -- This subgroup is headed by the staff engineer (first engineer) and located in the engine control room. Its responsibility is to maintain electrical and propulsion power and to respond to bridge maneuvering orders and to transfer fluids in response to bridge trim and stability orders.

Document and Valuables Control -- This subgroup is headed by the chief purser and located in the purser's office. It is responsible for the control of open paydesks, cash boxes, documents and other passenger and vessel valuables.

Food Group -- This subgroup is headed by the first cook and located in the main galley. It is responsible for cooking in progress and the safety of the galley and adjacent spaces.

Mobile Fire Group is a main group and consists of the following subgroups:

Fire Fighters -- This subgroup is headed by the staff captain and located at the announced fire area. It is responsible for the initial firefighting attack in areas as directed by the operational command.

Fire Limitation Group -- This subgroup is headed by the second officer No.2 and located at the announced fire area. It reports to the staff captain and the operational command. Its responsibility is to limit the spreading of the fire and to control areas adjacent to the scene of the fire as directed by the operational command.

Search and Ambulance Group -- This subgroup is headed by the chief steward and located at the announced fire area. It reports to the staff captain and operational command. It is responsible for the searching of zones adjoining the fire for weak or injured persons, to administer first aid, and to transport the injured to the ship's hospital.

Emergency Standby Group is a main group and consists of the following subgroups:

Technical Department -- This subgroup is headed by the chief engineer and located in the engine spaces. Its responsibility is to maintain the operation of mechanical and electrical devices in support of the emergency.

Boat and Raft Preparation -- This subgroup is headed by the second officer No. 1 and located on the starboard bridge wing. It is responsible for the readying of all lifeboats and liferafts.

Radio -- This subgroup is headed by the radio electronics officer No. 1 and located at the ship's radio station. It is responsible for the operation of the emergency radio transmitter, and the supply of communication aids to group and zone leaders if necessary.

Hospital -- This subgroup is headed by the medical officer and located at the ship's hospital. It is responsible for the readiness of the hospital and the medical treatment required for the injured.

Evacuation Group is a main group and consists of the following subgroups:

Central Squad -- This subgroup is headed by the hotel manager and located at the information desk on Gulf Deck. It is responsible for the safe evacuation of all decks in accordance with the Evacuation Plan. All zone leaders report their progress to the Central Squad.

Zone Leaders -- Each of the 11 zone leaders meet with their zone evacuators at the locations designated for them in the Ship's Evacuation Plan. They are responsible for the safe evacuation of the zone to which they are assigned. They make their reports to the Central Squad.

APPENDIX C

Evacuators -- Under the direction of individual zone leaders, the evacuators are responsible for the evacuation of all persons in their assigned areas according to the Ship's Evacuation Plan. They are to bring all lifejackets up to the muster stations and to avoid any trend toward panic in the passengers.

Assistance Group is a main group with no subgroups and is headed by the Asst. Maitre D' Hotel and the Asst. Food Manager. Those crewmembers not assigned to any group or subgroup are to meet on the Observation Deck of the ship and await orders from the operational command to assist any group as required.

APPENDIX D

PASSENGER SHIP SAFETY CERTIFICATE

No.

Lloyd's Register of Shipping

COMMONWEALTH OF THE BAHAMAS

PASSENGER SHIP SAFETY CERTIFICATE

for an ~~Malaysk~~ international voyage.

Issued under the provisions of the

INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974

Name of Ship	Distinctive Number or Letters	Port of Registry	Gross Tonnage	Date on which keel was laid *See NOTE below*
SCANDINAVIAN STAR	C6BF	NASSAU	10,531	1970
Particulars of voyages, if any, sanctioned under Regulation 27 (c) (vii) of Chapter III				

I, the undersigned, ARTHUR M. KNIGHT certify

I. That the above-mentioned ship has been duly surveyed in accordance with the provisions of the Convention referred to above.

II. That the survey showed that the ship complied with the requirements of the Regulations annexed to the said Convention as regards:

(1) the structure, main and auxiliary boilers and other pressure vessels and machinery;

(2) the watertight subdivision arrangements and details,

(3) the following subdivision loadlines:

Subdivision loadlines assigned and marked on the ship's side at amidships (Regulation 11 of Chapter II-1)	Freeboard	To apply when the spaces in which passengers are carried include the following alternative spaces
C.1	1757mm	
C.2		
C.3		

III. That the life-saving appliances provide for a total number of 1188 persons and no more, viz.:

10 lifeboats (including 10 motor lifeboats) capable of accommodating 958 persons, and 1 motor lifeboats fitted with radiotelegraph installation and searchlight (included in the total lifeboats shown above), and – motor lifeboats fitted with searchlight only (also included in the total lifeboats shown above), requiring 48 certificated lifeboatmen;

10 liferafts, for which approved launching devices are required, capable of accommodating 250 persons; and

12 liferafts, for which approved launching devices are not required, capable of accommodating 300 persons;

4 buoyant apparatus capable of supporting 40 persons;

20 lifebuoys;

1248 life-jackets. Plus 119 lifejackets for children

IV. That the lifeboats and liferafts were equipped in accordance with the provisions of the Regulations.

V. That the ship was provided with a line-throwing appliance and portable radio apparatus for survival craft in accordance with the provisions of the Regulations.

FORM 1622 (7/68)

APPENDIX D

VI That the ship complied with the requirements of the Regulations as regards radiotelegraph installations, viz

	Requirements of Regulations	Actual provision
Hours of listening by operator	16	16
Number of operators	2	2
Whether auto-alarm fitted	REQUIRED	FITTED
Whether main installation fitted	REQUIRED	FITTED
Whether reserve installation fitted	REQUIRED	FITTED
Whether main and reserve transmitters electrically separated or combined	ELEC. SEPARATION REQUIRED	ELECTRICALLY SEPARATED
Whether direction-finder fitted	REQUIRED	FITTED
Whether radio equipment for homing on the radiotelephone distress frequency fitted	NOT REQUIRED	FITTED
Whether radar fitted	REQUIRED	FITTED
Number of passengers for which certificated	MORE THAN 250	963

VII. That the functioning of the radiotelegraph installation for motor lifeboats and/or the portable radio apparatus for survival craft, if provided, complied with the provisions of the Regulations.

VIII. That the ship complied with the requirements of the Regulations as regards fire-detecting and fire-extinguishing appliances, echo-sounding device and gyro-compass and was provided with navigation lights and shapes, pilot ladder, and means of making sound signals and distress signals, in accordance with the provisions of the Regulations and also the International Regulations for Preventing Collisions at Sea in force

IX. That in all other respects the ship complied with the requirements of the Regulations, so far as these requirements apply thereto.

X. The above country has accepted the amendments to the 1974 Convention which entered into force on 1st September 1984/1st July 1986 and this ship complies with the applicable requirements of those recommendations.

This Certificate is issued under the authority of the Government of the Bahamas

It will remain in force until 20th of January 1989

Issued at NEW YORK **on** 21st of January 1988

The undersigned declares that Lloyd's Register of Shipping is duly authorised by the said Government to issue this Certificate

Arthur M. Knight

CHAIRMAN OF THE AMERICAN COMMITTEE

NOTE: – It will be sufficient to indicate the year in which the keel was laid or when the ship was at a similar stage of construction except for 1952, 1965 and 1980, in which cases the actual date should be given.

In the case of a ship which is converted as provided in Regulation 1 (b) (i) of Chapter II-1 or Regulation 1 (a) (i) of Chapter II-2 of the Convention, the date on which the work of conversion is as begun should be given.

FORM 1622-1 (7/86)

APPENDIX E

EMERGENCY AND BOAT DRILL PROCEDURES

EMERGENCY AND BOAT DRILL PROCEDURE FOR "SCANDINAVIAN STAR"

Read these two pages carefully

Check and note your crew number on the back of your crew card and compare with your position in "the emergency plan" on the following page.

Find the fastest, and an alternative route from your cabin and work area, to your muster - and rescue station.

An emergency drill is normally divided into 3 phases as follows:

Phase 1: An emergency situation occurs (e.g. fire) and the "fire alarm" consisting of one long ring (_____) sound in the crew quarters. When this alarm sounds, only the following groups muster:

PHASE 1

	Operational Command	(Nos. 0100 - 0104)
MFG=	Mobil Fire Groups	(Nos. 0200 - 0410)
CRS=	Continuous Run Ship (groups)	(Nos. 0500 - 0815)
ESB=	Emergency Stand By (groups)	(Nos. 0900 - 1203)

Listen for announcement of where to meet.

CREWMEMBERS WITH NUMBERS FROM 1300 AND UPWARDS - DO NOT PARTICIPATE IN PHASE 1, and should continue their normal work as if nothing had happened.

PHASE 2

Phase 2: Evacuation. The emergency situation (e.g. the fire) has now reached an extent that the ship must be evacuated. The "general alarm" consisting of seven short rings and one long ring (-------_____) will sound in the whole ship. Only now do the evacuation groups take action. REPEAT: ONLY, WHEN THE "GENERAL ALARM" (-------_____) SOUNDS, DO THE CREWMEMBERS WITH NUMBERS HIGHER THAN 1300 GO TO THEIR MUSTER STATIONS.

PHASE 3

Phase 3: Abandon Ship. The emergency situation (e.g. the fire) is no longer under control, and the Captain orders abandon ship. The signal or abandon ship is a voice command given only by the Captain (normally via P.A. system). Only now, AND NOT BEFORE, do the crewmembers proceed to their rescue stations wearing their personal lifejackets from their cabin. LIFEJACKETS ON DECK ARE FOR PASSENGERS ONLY.

Finally, 8 reminders concerning emergency drills in general:

1. NO LIFEJACKETS to be worn or carried during Phase 1 and Phase 2, except for crewmembers in "Boat and Raft Preparation Group".
2. Smoking, eating, newspaper reading, use of "Walk-Man" etc. during the drill is strictly forbidden.
3. Be absolutely sure to check with your group leader, and follow his/her instructions.
4. Check that your cabin is equiped with your personal lifejacket ready for use. After the drill is over, do not leave you lifejacket in any other place than in your cabin.
5. Show interest in the drills. They may save lives - one day.
6. Wear suitable enclosed shoes (no high heels or slippers).
7. Officers shall check, that their cabin is also equiped with a flashlight of the open handle type.
8. If you are in doubt of anything concerning emergency drills and safety on board, do not hesitate to ask your Groupleader or the Staff Captain.

APPENDIX F

PASSENGER BOARDING PASS

SeaEscape

Nº 0670

ROUND TRIP CRUISE

BOARDING PASS

VOYAGE NUMBER

1082

SEE REVERSE FOR
DINING AND SAFETY INFORMATION

DO NOT MISPLACE THIS PASS

This pass entitles holder to board the vessel and must be presented to reboard at ports of call.

BON VOYAGE

ROUND TRIP CRUISE
1082 Nº 0670

ROUND TRIP CRUISE
1082 Nº 0670

SeaEscape

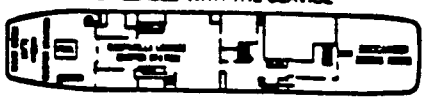
M/S SCANDINAVIAN STAR

DINING INFORMATION

Suggested Dining Hours
For your convenience:
Lunch — 12:00 p.m. / Dinner — 6:00 p.m.

Dining Room Located on Main Deck
IT IS CUSTOMARY TO TIP YOUR WAITER
IF YOU ARE PLEASED WITH THE SERVICE

Main Deck



m/s Scandinavian Star

There is little likelihood we will encounter a situation requiring emergency preparation, but it is good practice to be acquainted with the safety features we have provided for you on this vessel.

—IN THE EVENT OF AN EMERGENCY—

An alarm will be given over the ship's public address system. This alarm signal will consist of 7 short and 1 long blast.

● ● ● ● ● ● ●

When you hear this signal you are required to proceed immediately to your muster station.

Do Not Use Elevators!

Your muster station is.

GASPARILLA LOUNGE
MAIN DECK

In case of an emergency remember, your ship's officers are highly trained experts, follow their instructions carefully and most important:

STAY CALM

HOW TO PUT ON THE LIFE JACKET:

1. Put jacket on.
2. Tighten tapes well in front.
3. Tie tapes.

MAIN DECK

APPENDIX G

EXCERPTS FROM BAHAMIAN SHIPPING ACT

No. 16 of 1976

An Act to make provision for the registration of ships; for the control, regulation and orderly development of merchant shipping; to make provision for the proper qualification of persons employed in the sea service; to regulate the terms and conditions of service of persons so employed; and for matters connected with and incidental to the foregoing.

(Assented to: 29 November 1976)

BE it enacted by The Queen's Most Excellent Majesty, by and with the advice and consent of the Senate and the House of Assembly of the Commonwealth of The Bahamas, and by the authority of the same, as follows:—

PART I

Preliminary

Short title and commencement

1. This Act may be cited as the Merchant Shipping Act, 1976, and shall come into operation on such date as the Minister may appoint by notice in the Gazette, and the Minister may so appoint different dates for different Parts or sections of this Act.

Interpretation.

2. In this Act, unless the context otherwise requires —

"allotment note" means a note mentioned in section 95;

"apprentice" means an apprentice to the sea service;

"approved" means approved by the Director;

"Bahamian ship" means a ship for the time being registered as a Bahamian ship under section 4;

"Bahamian waters" means all areas of water subject to the jurisdiction of The Bahamas, and includes territorial waters, internal waters and archipelagic waters;

APPENDIX G

PART III

MASTER AND SEAMEN

Certificates of Competency

Ship to be provided with certificated officers.

66.—(1) Every Bahamian foreign-going ship, every Bahamian home-trade ship carrying passengers and every Bahamian home-trade ship of not less than 500 tons register tonnage when going to sea from a place in The Bahamas, and every foreign ship carrying passengers to or from a place in The Bahamas which is not provided with certificated officers in accordance with the national laws of the country of registry, shall be provided with officers duly certificated under this Act according to the following scale —

(a) in every case, a duly certificated master,

(b) if the ship is over 100 tons but not over 500 tons register tonnage, at least one officer besides the master holding a certificate not lower than —

(i) mate in the case of a home-trade ship;

(ii) second mate in the case of a foreign going ship;

(c) if the ship is over 500 tons but not over 1600 tons register tonnage and is engaged on voyages where the distance between the ports visited —

(i) does not exceed 500 nautical miles, at least one officer besides the master holding a certificate not lower than second mate;

(ii) exceeds 500 nautical miles, at least two officers besides the master, one holding a certificate not lower than second mate and the other a certificate not lower than third mate;

(d) if the ship is over 1600 tons register tonnage and is engaged on voyages where the distance between the ports visited — .

(i) does not exceed 500 nautical miles, at least two officers besides the master, one holding a certificate not lower than first mate and the other a certificate not lower than second mate;

(ii) exceeds 500 nautical miles, at least three officers, besides the master, namely a first mate, a second mate and a third mate, all of whom shall be duly certificated;

(e) if any seaman officer is carried in addition to those required by paragraphs (b), (c) and (d) of this subsection for the purpose of keeping a watch at sea, he shall hold a certificate not lower than —

(i) mate in case of a home-trade ship;

(ii) third mate in the case of a foreign-going ship;

(f) if the ship is a motor ship of under 500 shaft horse power, at least one engineer holding a certificate not lower than third class engineer;

(g) if the ship is a motor ship of over 500 but not over 2500 shaft horse power and is engaged on voyages where the distance between the ports visited —

(i) does not exceed 500 nautical miles, at least two engineers, one holding a certificate not lower than second class engineer and the other a certificate not lower than third class engineer;

(ii) exceeds 500 miles, at least two engineers, one a first class engineer and the other a first class engineer or a second class engineer, all duly certificated;

(h) if the ship is a motor ship of over 2500 but not over 5000 shaft horse power she shall be provided with at least three engineers, one a first class engineer, one a second class engineer and one a third class engineer, all of whom shall be duly certificated;

(i) if the ship is a motor ship of over 5000 shaft horse power, she shall be provided with at least one third class engineer duly certificated in addition to those engineers required under paragraph (h) of this subsection;

(j) if any engineers are carried in addition to those required by paragraphs (f), (g), (h) and (i) of this subsection for the purpose of keeping a watch in the engine room at sea, they shall hold a certificate not lower than third class engineer.

(2) No person other than a seaman officer or engineer officer holding a certificate or licence under this Act may take charge of a watch on deck or in the engine-room of a Bahamian ship at sea, and no person other than a duly certificated engineer shall be left in charge of the boiler room of a Bahamian ship in port if the boilers are under steam.

APPENDIX G

(3) Any person who —

(a) having been engaged as one of the above-mentioned officers goes to sea as such an officer without being duly certificated; or

(b) employs a person as one of the above-mentioned officers without ascertaining that the person so employed is duly certificated,

shall be guilty of an offence.

(4) An officer is not duly certificated within the meaning of this section, unless he is the holder for the time being of a valid certificate of competency under this Act, or a licence under section 68, of a grade appropriate to his rank and status in the ship and to the tonnage or shaft horse power or the type of engine of the ship or to the trade in which the ship is engaged or of a higher grade.

(5) Where it appears to the Minister that a ship may be unreasonably delayed because the owner is unable to provide officers in accordance with the foregoing scales, and the Minister is satisfied that —

(a) the owner has exercised due diligence to provide such officers; and

(b) the ship is properly and efficiently manned for the voyage she is about to undertake,

the Minister may on the written application of the owner exempt that ship from any of the provisions of this section.

Grades of certificates of competency

67.—(1) Certificates of competency shall be granted in accordance with this Act in each of the following grades —

(a) Master of a foreign-going ship;

(b) First mate of a foreign-going ship;

(c) Second mate of a foreign-going ship;

(d) Third mate of a foreign-going ship;

(e) Master of a home-trade ship;

(f) Mate of a home-trade ship;

(g) First class engineer;

(h) Second class engineer; and

(i) Third class engineer.

(2) A certificate of competency as master or first mate of a foreign-going ship is superior to a certificate of competency as master of a home-trade ship, and entitles the holder to go to sea in that capacity, but a certificate of competency as master of a home-trade ship does not entitle the holder to go to sea in any capacity in a foreign-going ship.

(3) A certificate of competency as second mate or third mate of a foreign-going ship is superior to a certificate of competency as mate of a home-trade ship and entitles the holder to go to sea in that capacity, but a certificate of competency as mate of a home-trade ship does not entitle the holder to go to sea in any capacity in a foreign-going ship.

Examinations for certificates of competency and foreign certificates

68.—(1) For the purpose of granting certificates of competency the Minister may —

(a) cause examinations to be held at such times and at such places as he may direct;

(b) appoint examiners to conduct the examinations;

(c) make regulations for the conduct of the examinations and the qualifications of candidates and do all such acts and things as he thinks expedient for the purpose of the examinations, and may fix fees therefor;

(d) cause to be delivered to every candidate who is duly reported by the examiners to have passed his examination, and to have given satisfactory evidence of his experience, ability and good character, the appropriate certificate of competency;

(e) prescribe the rights and obligations of holders of certificates of competency and offences for which certificates may be forfeited or suspended.

(2) Where the laws of any other country provide for the examination for, and grant of, certificates to persons intending to act as masters, seamen officers and engineers on board ships, and —

(a) the Minister is satisfied that all examinations are so conducted as to be equally effective as the examinations for the same purpose in The Bahamas under this Act; and

(b) the certificates are granted on such principles as to show the like qualifications and competency as those granted under this Act,

the Minister may in the case of persons holding such certificates, who desire to go as master, seaman officer or engineer in Bahamian ships, direct that —

(i) if the person is a citizen of The Bahamas he shall surrender such certificate and be granted a certificate of equivalent grade under this Act;

(ii) if the person is not a citizen of The Bahamas he shall, on payment of the prescribed fee and subject to such conditions as the Minister may impose, be issued with a licence

authorizing him to go to sea in a Bahamian ship in the same rank or station as if his certificate had been granted under this Act.

(3) A licence issued under subsection (2) of this section shall —

(a) during its currency have the same force as a certificate of competency granted under this Act and may be cancelled or suspended for like reason; and

(b) be valid for a period of five years from the date of issue, and may be renewed on payment of the prescribed fee.

(4) The Minister shall by notice in the *Gazette* from time to time declare the names of the countries to which subsection (2) of this section has application.

Offences relating to certificates of competency

69. Any person who —

(a) makes any false representation for the purpose of obtaining for himself or for any other person any certificate of competency or of service as a deck officer or engineer;

(b) forges or fraudulently alters any such certificate or any official copy thereof;

(c) fraudulently makes use of any such certificate which is forged, altered, cancelled or suspended or to which he is not justly entitled; or

(d) fraudulently lends such a certificate or licence to or allows the same to be used by any other person,

shall be guilty of an offence and liable on summary conviction to a fine of one thousand dollars or to imprisonment for eighteen months.

Record of certificates of competency.

70. A record of certificates of competency and the suspending, cancelling, or altering of such certificates and any other matter affecting them shall be kept in such manner as the Minister may direct.

Loss of certificate.

71. If a master, mate or engineer proves to the satisfaction of a registrar that he has, without fault on his part, lost or been deprived of a certificate of competency already granted to him, that registrar shall, and in any other case may, upon payment of the prescribed fee, certify and deliver to him a copy of the certificate to which, by the record kept in pursuance of this Act, he appears to be entitled, and a copy purporting to be so certified shall have all the effect of the original.

Master to inform registrar of officers on board ship.

72.—(1) Upon the signing of the crew agreement, the master of every Bahamian ship shall forthwith inform the Director in writing

of the name, grade and number of the certificate and licence of each officer (including the master himself) employed on the ship.

(2) Whenever a certificated officer ceases to be employed on the ship, or a new certificated officer becomes employed on the ship, the name, grade and number of the certificate and licence of that officer shall forthwith be despatched in writing to the Director by the master of that ship.

Prohibition of going to sea under-manned

73. Subject to subsection (5) of section 66, if a Bahamian ship goes to sea or attempts to go to sea without carrying such officers as it is required to carry under section 66, both the owner and the master shall be guilty of an offence and liable on summary conviction to a fine of one thousand dollars, and a registrar may suspend the certificate of registry of the ship until she is properly manned.

Production of certificates and documents of qualification

74. Any person serving or engaged to serve in any Bahamian ship and holding any certificate or other document which is evidence that he is qualified for the purposes of section 66, shall on demand produce it to any registrar, inspector or proper officer and (if he is not himself the master) to the master of the ship, and if he fails to do so without reasonable cause he shall be guilty of an offence and liable on summary conviction to a fine of one hundred dollars.

Use of English language

75.—(1) Except where otherwise provided in this Act, all correspondence, documents, forms or other writings shall be in the English language, and in the case of the crew agreement, official log-book and muster lists, in a prescribed form:

Provided that a foreign language version of any document may be appended to the English language version thereof.

(2) All written signs displayed on board Bahamian ships shall be in the English language with, if it is considered necessary by the master, a foreign language version appended thereto.

Crew's knowledge of English

76.—(1) Where in the opinion of a registrar or an inspector the crew of a Bahamian ship consists of or includes persons who may not understand orders given to them in the course of their duty because of their insufficient knowledge of English and the absence of adequate arrangements for transmitting the orders in a language of which they have sufficient knowledge, the registrar or inspector shall inform the master of his opinion and the ship shall not go to sea, and the registrar or inspector may suspend the certificate of registry of the ship until the position is rectified.

(2) If a ship goes to sea or attempts to go to sea in contravention of this section both the owner and the master shall be guilty of an offence and liable on summary conviction to a fine of five hundred dollars.