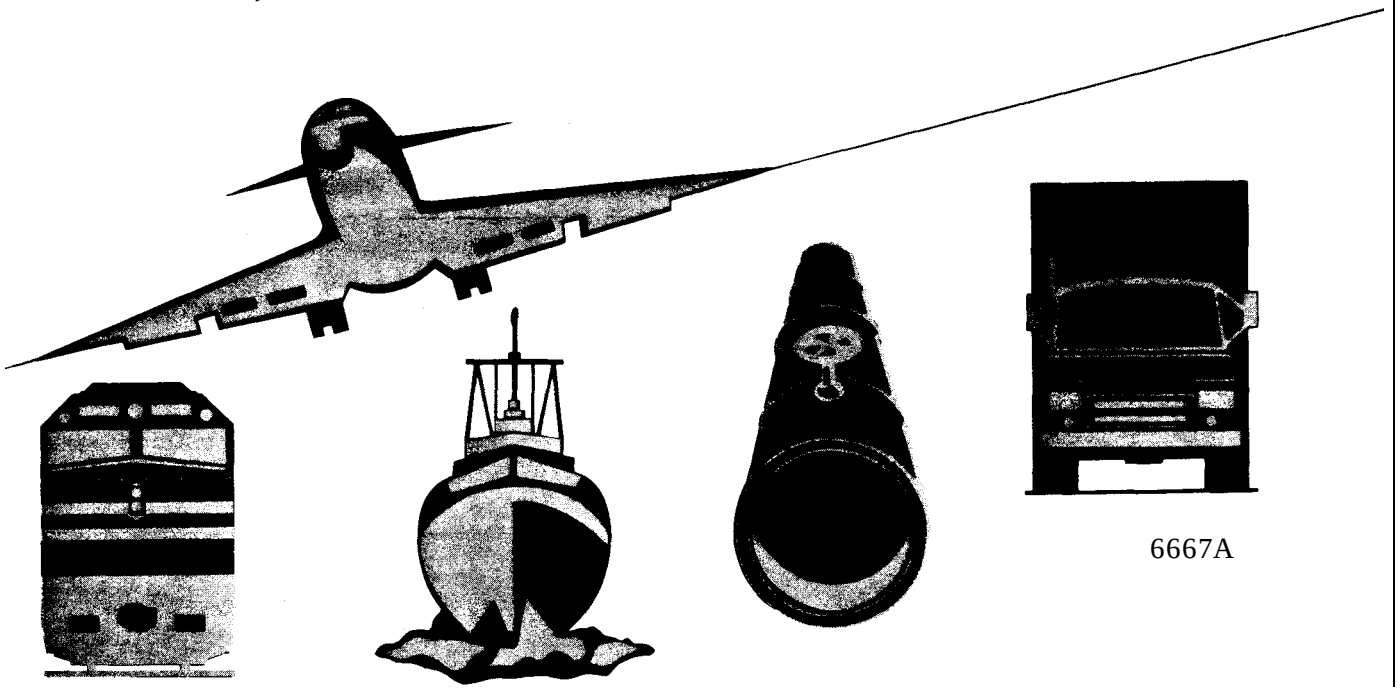
PB98-916403
NTSB/MAR-98/03

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

MARINE ACCIDENT REPORT

FIRE ABOARD THE TUG *SCANDIA* AND THE SUBSEQUENT GROUNDING OF THE TUG AND THE TANK BARGE *NORTH CAPE ON* MOONSTONE BEACH, SOUTH KINGSTON, RHODE ISLAND JANUARY 19, 1996



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Abstract: On Friday afternoon, January 19, 1996, the U.S. tug *Scandia* had an engineroom fire while towing the unmanned U.S. tank barge *North Cape*, 4.5 miles off Point Judith, Rhode Island. All six crewmembers abandoned the *Scandia* amid 10-foot waves and 25-knot winds; however, no one was injured. The crew was unsuccessful in its attempts to release the anchor of the barge, which ran aground and spilled 828,000 gallons of home heating oil, causing the largest pollution incident in Rhode Island's history, an incident that led to the closing of local fisheries.

The safety issues discussed in this report are the origin of the fire, the company management's oversight of vessel maintenance, risk assessment of oil transportation by towed barges, search and rescue, and environmental pollution and cleanup.

As a result of its investigation, the National Transportation Safety Board issued recommendations to the U.S. Coast Guard, Eklof Marine Corporation, and the American Waterways Operators, Inc.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

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Marine Accident Report

Fire Aboard the Tug *Scandia* and the Subsequent Grounding of the Tug and the Tank Barge *North Cape* on Moonstone Beach, South Kingston, Rhode Island January 19, 1996

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Adopted July 14, 1998

National Transportation Safety Board
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Executive Summary

On Friday afternoon, January 19, 1996, the U.S. tug *Scandia* had an engineroom fire while towing the unmanned U.S. tank barge *North Cape*, 4.5 miles off Point Judith, Rhode Island. All six crewmembers abandoned the *Scandia* amid 10-foot waves and 25-knot winds; however, no one was injured. The crew was unsuccessful in its attempts to release the anchor of the barge, which ran aground and spilled 828,000 gallons of home heating oil, causing the largest pollution incident in Rhode Island's history, an incident that led to the closing of local fisheries.

The National Transportation Safety Board determines that the probable cause of the fire damage aboard the tug *Scandia* and the subsequent grounding of and pollution from the barge *North Cape* was the Eklof Marine Corporation's inadequate oversight of maintenance and operations aboard those vessels, which permitted a fire of unknown origin to become catastrophic and eliminated any realistic possibility of arresting the subsequent drift and grounding of the barge. Contributing to the accident was the lack of adequate U.S. Coast Guard and industry standards addressing towing vessel safety.

In its investigation, the Safety Board identified the following safety issues:

1. Origin and cause of fire.

2. Company oversight of vessel maintenance.

3. Risk assessment:

    Weather and voyage planning.

    Barge retrieval systems.

    Anchors on unmanned barges.

    Fire safety of towing vessels.

4. Search and rescue:

    Deployment of Coast Guard rescue boat.

    Hypothermia protective clothing.

    Decision to return to barge to drop its anchor.

5. Environmental pollution and cleanup.

As a result of its investigation of this accident, the Safety Board makes recommendations to the U.S. Coast Guard, the Eklof Marine Corporation, and the American Waterways Operators, Inc.

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Factual Information

The Accident

Fire

About 5:45 p.m. on Thursday, January 18, 1996, the tug *Scandia* departed Bayonne, New Jersey, en route to Providence, Rhode Island, through Long Island Sound. (See figure 1.) The *Scandia* was pushing an unmanned barge, the *North Cape*, that was loaded with 4,074,000 gallons of home heating oil. The tug had six crewmen on board: a captain, a mate, a chief engineer, two tankermen, and a dayman.

After the tug left New York Harbor and entered Long Island Sound, it switched from pushing to towing the *North Cape*. The tug towed it at 7.5 knots, using a 1,600-foot steel towing hawser. The captain stated that he expected to reach Providence by early afternoon the following day.

About 1 1/2 hours after the departure, the captain requested and received a faxed weather forecast from FleetWeather Ocean Services, Inc., (FleetWeather).[1] [2] According to the forecast, when the *Scandia* reached Long Island Sound later that evening, it would face 3- to 6-foot seas and 15- to 25-knot winds, and it would face 4- to 8-foot seas in Block Island Sound the next day.

Just before noon on Friday, according to the captain, the visibility began to diminish because of fog. The *Scandia* was nearing Watch Hill on the Rhode Island coast. At noon, according to the usual watchstanding schedule, the mate assumed the navigation watch from the captain.

About the time the mate assumed the watch, the chief engineer finished his engineroom watch and went to his cabin. He stated that nothing unusual had occurred during his 6-hour watch and that all equipment had functioned properly. About 12:30 p.m., the on-watch tankerman completed his brief, hourly walking tour of the engineroom[3] and went to the pilothouse. He said he had found everything to be in order in the engineroom.

[1] See last page of this document for a list of all acronyms and abbreviations used in this report.

[2] A commercial organization that provides weather forecasts on demand to subscribers. The forecast faxed to the *Scandia* spanned the period from Thursday, January 18, to Sunday, January 21.

[3] The main deck of the *Scandia* inside the engineroom was called the fidley deck; the engineroom space above it was called the fidley, and the space below was the lower engineroom, where the propulsion engine was located. The fidley deck consisted of a steel grating over the engine, surrounded by steel deck plating.

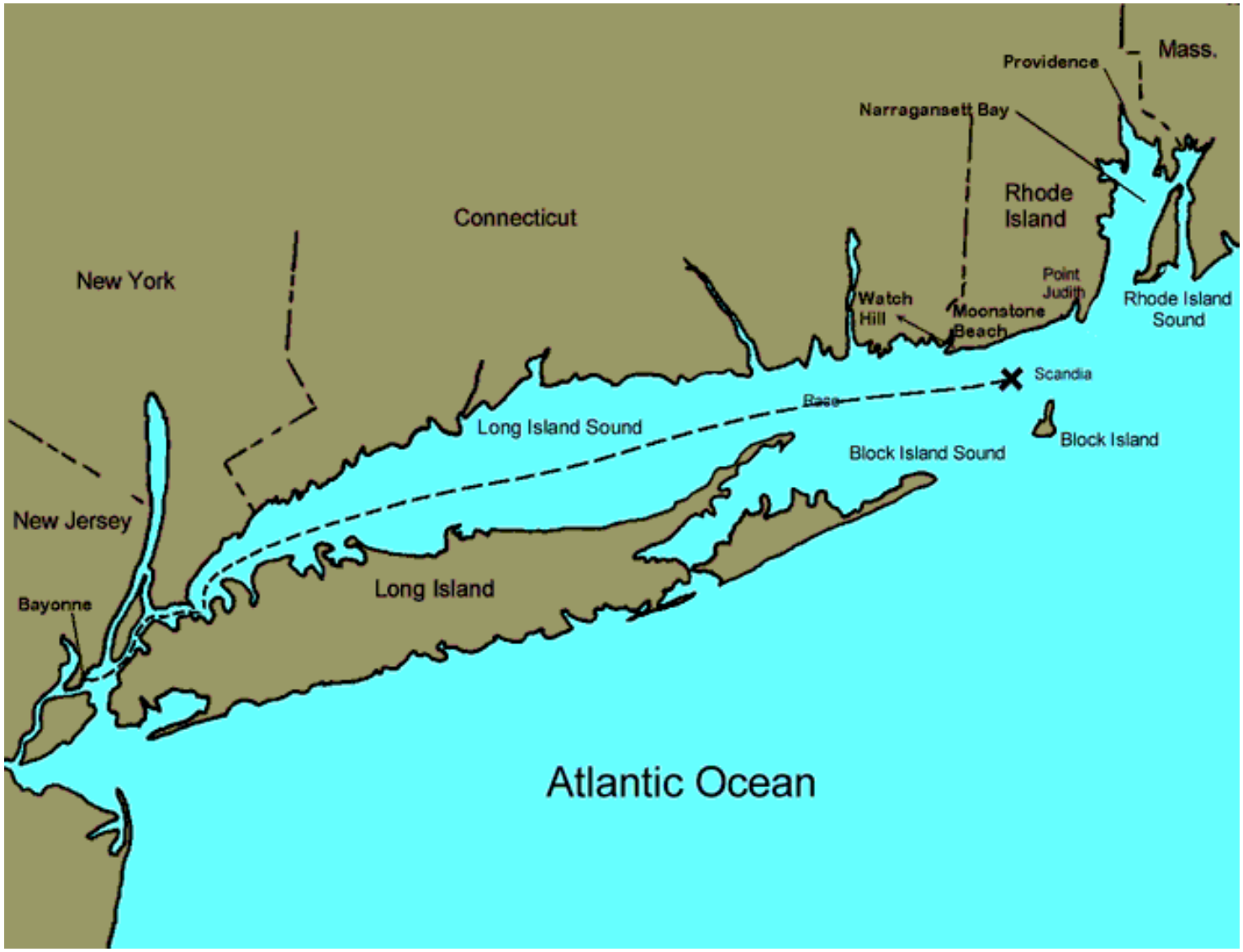


Figure 1. Route of the *Scandia*

About 1 p.m., while the tankerman remained on the bridge, the mate said he went to the galley, which was adjacent to the fidley, for a drink of water. He said he entered the fidley and looked down through the grating to the lower engineroom, because it was his normal practice to check the fidley and lower engineroom when he was near them. He noticed nothing unusual and returned to the wheelhouse.

Approximately 1:20 p.m., the dayman[4] was standing in the galley and saw smoke coming from the top of the closed door between the fidley and the galley. He ran to the wheelhouse and told the mate and the tankerman about the smoke. Meanwhile, the wheelhouse fire-alarm siren had activated, and the vessel monitoring system panel started indicating *Fire in Upper Engineroom* (fidley). The mate sounded the general fire alarm to alert the rest of the crew, and the on-watch tankerman ran from the wheelhouse to the accommodations and woke the captain, who immediately went to the wheelhouse and took command. According to the captain, the bridge equipment was functioning properly. He also stated that the weather was worsening and the seas were 8 to 10 feet. He said he had navigated the *Scandia* in similar seas and that the conditions were within the vessel's operating ability.

The chief engineer said he awoke in his cabin at the sound of the general alarm and smelled smoke. He left his cabin, which adjoined the galley and fidley, and opened the fidley door. He said there were a number of small fires scattered on the grating, mainly on the center of the grating above the main engine, and that there were also some scattered fires on the port side of the grating. He stated that there was no fire in the lower engineroom.

The dayman brought a portable carbon dioxide (CO_2) fire extinguisher to the chief engineer, who sprayed the contents through the open fidley door on the fire. Both the dayman and the mate, who arrived in the galley soon after, stated that the fire was on the grating and that they did not see flames in the lower engineroom. The intensity of the heat and smoke prevented the chief engineer and dayman from entering the fidley. They discharged the contents of two more portable CO_2 extinguishers on the fire but were unable to control it.

The pull ring, or control, for the engineroom's semi-portable CO_2 fire extinguisher system was inside the fidley, about 6 feet from the door. The chief engineer said that the heat and smoke prevented him from entering the fidley to reach the pull ring. He said he also could not reach the fire pump, which was in the lower engineroom. He said the intense heat and smoke made him feel helpless in fighting the fire because he did not have a self-contained breathing apparatus (SCBA) or a fireman's outfit. (Neither the Coast Guard nor the company required the *Scandia* to carry fireman's outfits or SCBAs.)

The tankerman stated that the heat and thick smoke prevented him from closing the ventilation louvers on the engineroom stack (the louvers allowed air to enter the engineroom and feed the fire). The remote controls for the fans that ventilated the

[4]The dayman's duties were cooking, cleaning, and helping moor the vessel.

engineroom were on the vessel's exterior, outside the fidley's aft door, near the towing winch drum; however, no crewmembers attempted to stop the fans.

Meanwhile, a wooden cabinet fell over and blocked the fidley door to the galley. (The cabinet held engine spare parts and normally stood in the fidley against the forward port-side longitudinal bulkhead.) Consequently, the fidley door could not be closed, and smoke from the fidley entered the galley and flowed to other areas of the vessel. Because the rapidly increasing amount of smoke made breathing difficult, the captain told the mate to have the crewmembers retrieve their survival suits and muster on the bow. (The *Scandia* carried eight survival suits, and the cabins and watch locations were equipped with personal flotation devices.)

About 1:57 p.m., the captain broadcast a PAN PAN[5] on VHF radio channel 16 and told the Coast Guard Station Point Judith (the station) and Group Woods Hole that he had an uncontrolled fire on his vessel. (He also identified the *Scandia*'s position from the vessel's global positioning system as latitude 41.18 N and longitude 71.32 W and described his location as being off No. 2 buoy, Point Judith.) He further informed the Coast Guard that there were six crewmen on board and that all intended to abandon ship. After making the broadcast, the captain donned his survival suit and went to the vessel's bow, where the rest of the crew had assembled. The crewmembers later said that while they waited on the bow, the tug's propulsion engine and the starboard generator, which powered the interior and exterior deck lighting, were still operating.

Three commercial fishing vessels that were in the area, the *Seafarer*, the *Huntress*, and the *Nautilus*, had monitored the PAN PAN transmission. The *Seafarer* was closest to the *Scandia*. Its captain informed the Coast Guard that he was within 1.5 miles of the *Scandia* and proceeding toward it.

About 2:02 p.m., a 41-foot utility boat (UTB) left the station. The station and the tug were about 4.5 miles apart. The boat's coxswain stated that before leaving he had not checked the latest weather information posted at the station but had observed the weather from the station window. After going a short distance, however, he realized that the wind and waves were too severe for the UTB. He returned to the station, and he and his crew transferred to a 44-foot motor life boat (MLB).[6] About 2:23 p.m., the MLB left the station. About the same time, Group Woods Hole directed the 82-foot Coast Guard patrol boat *Point Turner* to proceed from Newport, Rhode Island, to the *Scandia*.

Approximately 2:30 p.m., the *Seafarer* arrived on scene, and its captain radioed the Coast Guard that he could see six crewmen wearing survival suits and personal flotation devices on the bow of the tug, which was burning and smoking. The roughness of the sea prevented the *Seafarer* from approaching the tug without risking damage to its

[5] A radio broadcast indicating that the calling station has a very urgent message to transmit concerning the safety of a ship or person.

[6] The 41-foot UTB can operate safely in seas up to 8 feet and winds up to 30 knots; whereas the 44-foot MLB can operate safely in seas up to 30 feet and winds up to 50 knots. The UTB's maximum speed is 26 knots; the MLB's maximum speed is 13 knots.

extended outrigger arms. (The arms were extended over its sides to provide stability in rough seas.)

About 2:55 p.m., the MLB arrived on scene. As the person in charge of the first Coast Guard resource to reach the scene, the coxswain assumed the role of on-scene commander.[7] He observed that visibility was severely restricted by the thick fog and smoke.

After the coxswain maneuvered the MLB in front of the tug, the chief engineer of the tug jumped onto the MLB. The pilothouse windows then suddenly blew out as if there had been an explosion. The coxswain said that when the "explosion" occurred and he saw flames come out of the pilothouse windows, he told the remaining crewmembers on the *Scandia* to hold hands and jump into the water.

The coxswain then directed the surface swimmer on the MLB to jump in and retrieve the tug crewmembers. The swimmer was not wearing any thermal protection other than his anti-exposure coveralls. The temperature of the water was about 32° F.

Wearing a rescue harness and tethered to the MLB, the swimmer encircled the crewmen in the water with his tether line and brought them alongside the MLB. The other MLB crewmen lifted them aboard. By 3:13 p.m., everyone had been retrieved from the water.

While the MLB's crewmembers were assessing the physical condition of the tug crewmen, the captain of the *Scandia* asked the coxswain to take him to the barge so that he could board it and drop its anchor to prevent the barge from drifting ashore. But by then, the crew had discovered that the swimmer was hypothermic; consequently, the coxswain immediately returned to the station so the swimmer could have medical treatment.

While the tug crewmen were being rescued, a Coast Guard helicopter had arrived and monitored the rescue. The coxswain later stated that given the rough sea, the poor visibility, and the smoke, the helicopter would not have been able to rescue the crew from the tug or hoist the swimmer from the MLB.

At 3:35 p.m., the MLB arrived safely at the station. The swimmer was taken to a local hospital, where he was treated and released.

Attempt to Deploy North Cape*'s Anchor*

When they arrived at the station, the chief engineer and the mate of the *Scandia* asked the coxswain to return them to the barge so that they could drop its anchor. The

[7] As on-scene commander, he reported to the commander of Coast Guard Group Woods Hole, who acted as the search and rescue (SAR) mission coordinator for this accident. The mission coordinator reported to the First Coast Guard District Office in Boston, Massachusetts. For SAR operations that involve salvage, the mission coordinator is required to obtain formal approval for salvage from the District.

coxswain and the officer in charge of the station discussed the request and conveyed the information to the group commander at Group Woods Hole. Meanwhile, Coast Guard Air Station Cape Cod (the air station) told the group commander that the air station would not provide a helicopter to deliver anyone to the barge because the risk associated with dropping the barge's anchor did not meet the aviation risk assessment guidelines in the Coast Guard's *Air Operations Manual*.[8] The Coast Guard's First District search and rescue (SAR) plan did not have similar restrictions or risk assessment guidelines for the group commander to use in evaluating the risks the mission posed to surface craft. The general Coast Guard salvage policy for the group commander did not specify the conditions under which Coast Guard and civilian personnel could be placed at risk for salvage operations.

The group commander said that he decided to let the coxswain take the tug crewmen to the barge because he thought that the mission was reasonably likely to succeed. He stated that he based his decision on the following factors: the operator of the barge had assured him that the crew had the knowledge and experience to drop the anchor, the coxswain had agreed to deliver the crewmen to the barge, and the crewmen were confident that they could drop the anchor within 5 minutes of boarding the barge.

The group commander did not include the air station in his decisionmaking process and did not tell the air station that he had authorized the coxswain to return to the scene.

About 4 p.m., the coxswain and two other crewmen left the station in the MLB with the chief engineer and the mate of the *Scandia*, both of whom were wearing survival suits. The MLB reached the barge about 4:45 p.m., and the two tug crewmen boarded it at 4:56 p.m. The barge was still drifting toward the Rhode Island shore and was less than 2 miles offshore.

The crewmen repeatedly attempted to release the anchor but failed. They stated that rain, fog, and smoke from the burning tug had reduced visibility and that waves breaking over the barge's deck made their task increasingly difficult and dangerous.

The coxswain motioned to the crewmen to re-board the MLB when it became clear to him that the anchor could not be released; he said he feared that the MLB might capsize in the high surf as the vessels drifted into progressively shallower water. About 5:35 p.m., the chief engineer jumped from the barge to the MLB. The mate remained on the barge; he stated that he did not jump because he was afraid of landing on top of the chief engineer. The coxswain said that he did not tell the mate to escape by jumping into the water because the surf was so rough that the mate might have been swept away or run over by the MLB. The coxswain failed at several attempts to rescue the mate by

[8]The guidelines prohibit a Coast Guard helicopter and crew from being placed at risk unless human lives are in danger, the mission has a reasonable chance of success, and no other alternatives exist. Further, the guidelines state that risk of damage to an aircraft is not acceptable unless the value of the property to be saved is greater than the cost of damage to the aircraft, and the aircraft is expected to be fully recoverable.

maneuvering the MLB alongside the barge. According to the coxswain, the surf was too rough for safe maneuvering, and the MLB was in danger of running aground.

About 5:47 p.m., the coxswain radioed the station and asked that the air station dispatch a helicopter to rescue the mate. The coxswain then left, believing there was nothing more he could do without endangering his own crew.

The barge grounded about 6 p.m. on the rocks of Nebraska Shoal, off Moonstone Beach, releasing about 828,000 gallons of oil.

At 6:10 p.m., a second MLB was dispatched from Coast Guard Station Castle Hill in Newport, Rhode Island; it was to wait at the accident scene until the helicopter arrived. The MLB arrived on scene at 7:28 p.m. but could not get close to the grounded barge because of the dangerously high surf.

At 7:11 p.m., the helicopter left the air station. (The pilot stated that because of the approaching storm he had been forced to wait more than an hour before taking off. He said that he had needed the time to check the weather, plan a safe flight route, and file an instrument flight rules flight plan with the Federal Aviation Administration. He was waiting for the front to come through and did not want to be on scene when it did.) At 7:54 p.m., the helicopter arrived on scene. The pilot said that the mate was holding on to an A-frame on the deck of the barge in order to keep himself from being washed overboard by the large waves that repeatedly crashed over the deck. The pilot lowered a rescue swimmer to the deck; the swimmer wrapped a belt around the mate, who was uninjured, and both men were safely hoisted to the helicopter. It departed the scene about 8:15 p.m. and arrived at Providence Airport at 8:50 p.m.

About 8:30 p.m., the tug grounded. The towline between the two vessels was still intact.

Injuries

The swimmer was treated for hypothermia and released. No one else was injured.

Damage

The *Scandia* grounded on Moonstone Beach in South Kingston, Rhode Island. Nearly all of the tug's combustible interior, from the fidley grating upward through the galley, crew accommodations, and wheelhouse, was consumed by fire. The fire destroyed the navigation and communication systems and equipment. The damage to the tug was estimated to be $1.5 million.

The grounding tore open 11 of the *North Cape*'s 14 cargo tanks. Estimated structural damage to the barge was $3.6 million.

This accident resulted in Rhode Island's largest[9] oil spill and severely affected the local fishing industry in the short term and threatened local beaches and the habitats of marine life and birds. Rhode Island's fishing industry employs about 35,000 people and generates about $500 million a year. Much of the catch of lobsters, crabs, and fish was embargoed by Health Department officials to keep oil-contaminated seafood away from consumers. The governor of Rhode Island declared a state of emergency so that Federal funding could be used to compensate fishermen and others whose businesses and livelihoods were affected by the oil spill.

The Eklof Marine Corporation (EMC) hired salvage and environmental cleanup contractors to use deflection and oil-containment booms to help keep the oil away from pristine areas. The rough weather moved the booms from their intended locations and allowed oil to seep into environmentally sensitive ponds and fisheries. The Rhode Island Department of Environmental Management (DEM), the Federal Environmental Protection Agency (EPA), and the National Oceanic and Atmospheric Administration (NOAA) formed teams to study the effects of the oil on the fisheries and seabirds.

According to NOAA's estimates, the oil killed millions of lobsters, harmed over a million pounds of shellfish, and affected thousands of pounds of fish in Block Island Sound and Rhode Island salt ponds. Thousands of seabirds and fish, such as flounder, tautog, and herring, washed ashore following the spill. Study teams estimated that it would take 1 to 5 years, depending on the species, for the affected fish and bird populations to return to the levels they had reached before the accident. Federal and State officials are using these studies to develop detailed plans for restoring the natural resources.

NOAA used computers to calculate the trajectories of the oil and the effects of currents and weather on the dissipation of the oil. The calculations and field samples showed that within a week of the spill, the level of petroleum hydrocarbons in the water had fallen below the level considered toxic to shellfish and lobsters.

NOAA estimated that the economic impact on human (public) use of the beachfront was minor. (*Public use* includes boat-based fishing, recreational diving, charter and party boat operations, beach use, and tourism.) However, the total scope of the environmental damage is still being assessed.

Potential claims from the State of Rhode Island related to the natural resource damage are estimated to be $45 million.

[9]Before this accident, the largest marine pollution incident in Rhode Island was the one that occurred in June 1989, in which the 560-foot-long tank ship *World Prodigy* ran aground on Brenton Reef, off Newport, spilling 200,000 gallons of home heating oil into Narragansett Bay. The spill was successfully cleaned up with minimal environmental damage. In comparison, the grounding of the *Exxon Valdez* in March 1989 in Prince William Sound, Alaska, spilled about 10,836,000 gallons of oil, resulting in catastrophic damage to the environment.

Crew Information

Crew Requirements

Under 46 *Code of Federal Regulations* (CFR) 15.610, the captain of the *Scandia* had to be licensed by the Coast Guard and could not work more than 12 hours in a 24-hour period. Because the *Scandia* operated round the clock, Coast Guard regulations required it to have a second licensed deck officer, a mate.

When the *Scandia* was being operated but was not towing a barge, it did not have to carry a tankerman, a dayman, or a chief engineer. The *North Cape* was unmanned, and its certificate of inspection required two tankermen for loading and unloading the cargo.

The entire *Scandia* crew met the Coast Guard's requirements for training and qualifications.

Captain

The captain was licensed as a mate for coastal vessels under 500 gross tons with a radar observer endorsement; thus, his license exceeded the one he was required to have in order to operate towing vessels like the *Scandia*. He had completed the following Coast-Guard-approved courses: basic and advanced firefighting (in October 1994) and survival at sea.

His marine experience consisted of 14 years with the McAllister Brothers Towing Company, where he had progressed from deckhand through mate to captain. At the time of the accident, the EMC had employed him for more than 7 years. He had served on the *Scandia* on several nonconsecutive occasions for a total of 2 years. He had been captain of the vessel since September 1995.

On January 18, he said he slept for about 5 hours (12:30 a.m. to 5:30 a.m.). He worked the 6-a.m.-to-noon shift, then took a nap before the fire started.

Mate

The mate had a license for coastal vessels under 500 gross tons with a radar observer endorsement; he also had a tankerman's certificate. He stated that he had participated in drills aboard the *Scandia*. He had not taken any courses in firefighting or survival.

He said he had worked in the marine industry for 17 years, starting on river towboats that pushed tank barges on the inland waterways. Then, he worked on offshore vessels in the oil industry in Louisiana, where he worked as tankerman, mate, chief mate, and captain.

The EMC had employed him for about 4 1/2 years. For the first year he had served as tankerman, the remaining time as mate on various EMC vessels. He had served as the mate of the *Scandia* since December 1994.

On the day of the accident, he said he had slept for about 5 1/2 hours before he started his watch at noon.

Chief Engineer

The chief engineer had a marine engineer's license for motor vessels of unlimited horsepower operating on limited oceans routes. He had 13 years of marine experience. He had been in the offshore supply-vessel industry as an oiler, assistant engineer, and chief engineer. Before joining the EMC, he had worked as chief engineer for 3 1/2 years on offshore supply vessels for Tidewater Marine. The EMC had hired him about 69 days before the accident, and he had spent the time as chief engineer of the *Scandia*. He said that he had participated in fire drills, and that "we try to have a fire drill once every 2 weeks."

Coast Guard regulations require all licensed engineers, regardless of the vessel's gross tonnage or horsepower, to take firefighting training. The chief engineer had completed Coast-Guard-approved courses in basic and advanced firefighting about 4 years before the accident. He had been trained in using portable fire extinguishers, firefighting foam, fire hose teams, breathing apparatus, and fireman's outfits. He had also taken cold-water survival training while he was employed by a previous employer.

Coast Guard regulations do not require uninspected towing vessels (UTVs)[10] or unmanned barges to have a licensed engineer on board. The EMC had provided the engineer to operate the pumps on the barge when the cargo was being loaded or unloaded and to perform routine maintenance on the tug.

The chief engineer was on watch from 6 p.m. until midnight on Thursday. That night he slept for about 5 hours, and then worked his 6-a.m.-to-noon shift in the engineroom on the day of the fire.

Dayman

The dayman held a merchant mariner's document (MMD) endorsed as an able-bodied seaman (AB). He had obtained his maritime training over a 7-year period at the Naval Institute and Marine College, Russia. He had spent the next 7 years at sea, 5 as third mate and 2 as second mate, on Russian fishing trawlers. As a mate, he had attended a week-long firefighting school each year.

[10]Towing vessels are uninspected, unless the vessel admeasures over 300 gross tons and is oceangoing. According to Coast Guard statistics, all but 10 of the 5,216 towing vessels in the United States are uninspected.

The EMC had hired him about 6 weeks before the accident, and his responsibilities included cooking and cleaning the galley and accommodations. He also helped moor the barge and tug. The accident trip was his first trip on the *Scandia*. He stated that when he boarded the tug, the captain told him what his duties were and how to use the survival suit. He stated that he did not know how to operate the semi-portable CO_2 system that protected the engineroom.

The dayman said he worked from 8 a.m. to 10 p.m. on the vessel on January 18 and then relaxed on board. He said that he went to bed that night at 11 p.m. and awoke at 7 a.m. on January 19.

Tankerman 1

The tankerman held an MMD endorsed as an AB. He had taken a course in loading and discharging tank vessels and had a tankerman rating. He stated that he had had no training in either firefighting or lifesaving. However, he correctly described to Safety Board investigators how to operate the CO_2 system in the fidley. He said his last emergency drill on the *Scandia* was an abandon-ship drill, which was held about a month before the accident.

He had worked as tankerman for 7 of the 10 years that he had worked in the marine industry. He had worked for the EMC as a tankerman for nearly 5 1/2 years and had served on the *Scandia* for about a year. Before joining the EMC, he had been employed by two other towing companies.

He said he had slept about 5 1/2 hours (6 a.m. to 11:30 a.m.) before starting his shift at noon on the day of the accident.

Tankerman 2

The tankerman held an MMD endorsed as an AB and worked as the second tankerman, the steward, and the wiper on the *Scandia*. His 11 years in the marine industry included 9 as a tankerman and 2 as a deckhand. The EMC had employed him for over 4 years, and he had served on the *Scandia* for a little over a year. He had worked with the *North Cape* for about 4 years. He did not have firefighting training; none was required by regulations. He stated that he had last participated in a firefighting drill just over a month before the accident.

The tankerman was on watch from 6 p.m. to midnight on January 18. After that, he said, he had slept for about 5 1/2 hours before starting his watch at 6 a.m.

Vessel Information

Scandia

The oceangoing towing vessel was 111.5 feet long, 30 feet wide, and 10.5 feet deep. It was operated by the EMC (see figures 2, 3, and 4). It was built in 1968 and admeasured 198 gross tons. It was documented by the Coast Guard to operate on coastwise and foreign voyages.

Engineroom. The main deck of the *Scandia* continued inside the engineroom, where it was called the "fidley deck"; the space above the deck was called the "fidley," and the space below was called the "lower engineroom."

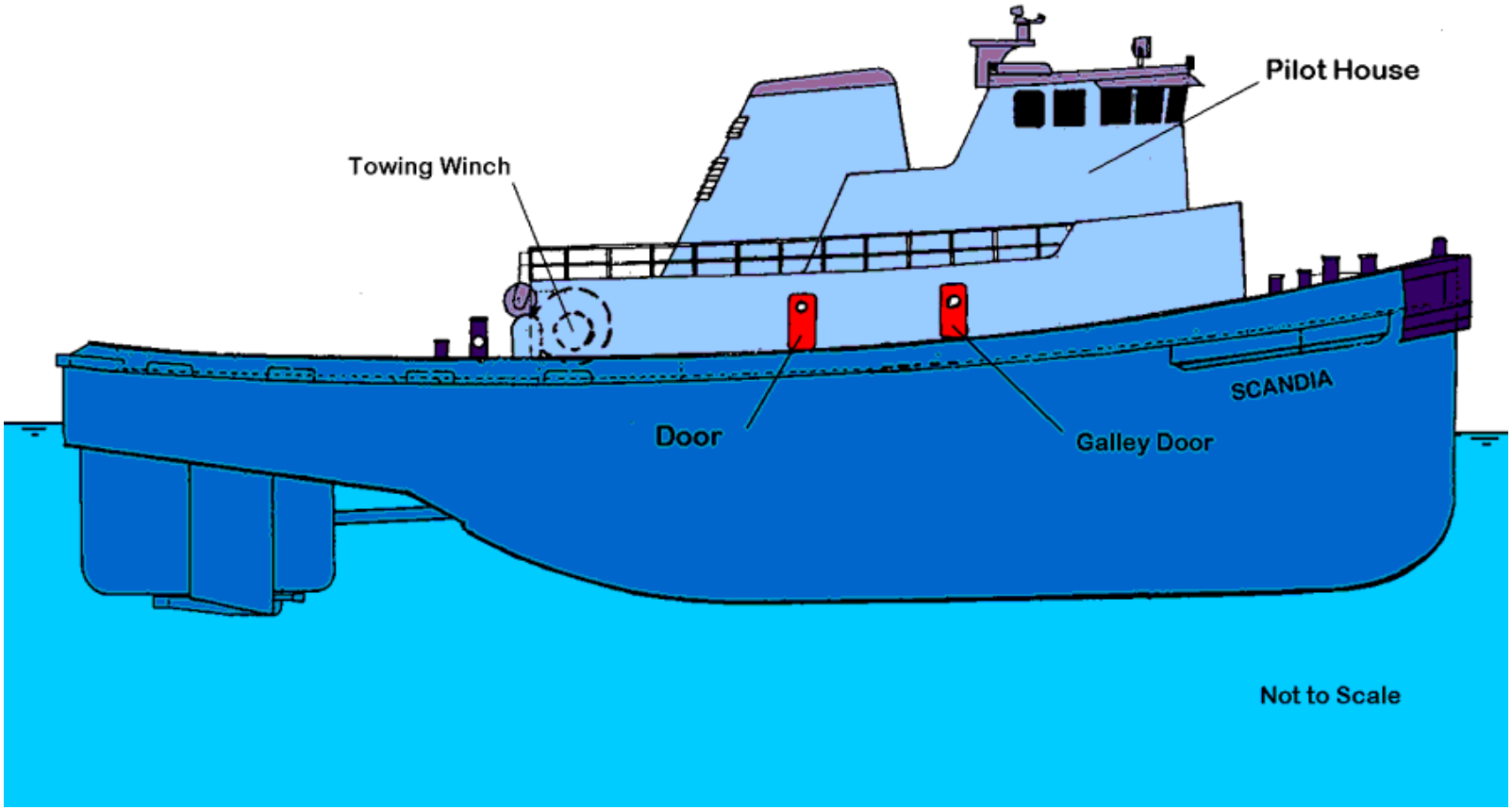
The *Scandia*'s 3,600-horsepower propulsion diesel engine was situated longitudinally on the tug's centerline in the lower engineroom. The engine's exhaust manifold pipe, 10 inches in diameter and thermally insulated, ran on top of the engine, 7 inches below the fidley deck grating. The temperature of the manifold, under the insulation blanket, was about 950^{o} F under normal operating conditions. An exhaust gas turbocharger was attached to the aft end of the engine's exhaust manifold; the turbocharger was about 15 feet aft of the center of the fidley deck grating and just below it. The aft end of the turbocharger connected to a rubber pipe that formed a vibration connection to the plenum that drew fresh outside air into the engine.

The company's port engineer estimated that the fidley deck grating was about 135^{o} F under normal operating conditions. The holes in the fidley deck grating allowed air to move up from the lower engineroom to the fidley, where an exhaust fan in the stack vented the air to the outside. Two ventilation fans drew outside air into the lower engineroom.

Two diesel generators, one on each side of the main engine, provided the vessel's electrical power. An oil-fired boiler (for hot water and heat) was in the aft starboard corner. All fuel and lube oil system components for the *Scandia*, including tanks, piping, valves, pumps, motors, and controls, were in the lower engineroom. The forward end of the lower engineroom had a workshop, including a wooden worktable.

The *Scandia*'s fire pump was in the lower engineroom; the pump was operated by the engine for the starboard generator via a power take-off clutch. To operate the pump, a crewmember had to come down from the fidley, using either the port or starboard stairway, open sea water valves to the pump, and engage the clutch. The pump could not be started from outside the engineroom.

Fidley. A steel door from the galley/mess was the forward entrance to the fidley. A semi-portable CO_2 fire extinguishing system, consisting of two 50-pound CO_2 cylinders, a hose reel, hose, and nozzle, was in the fidley, near the door. To reach the controls of the system, a crewmember had to open the door and move about 6 feet into the fidley.



Ffigure 2. Outboard Profile

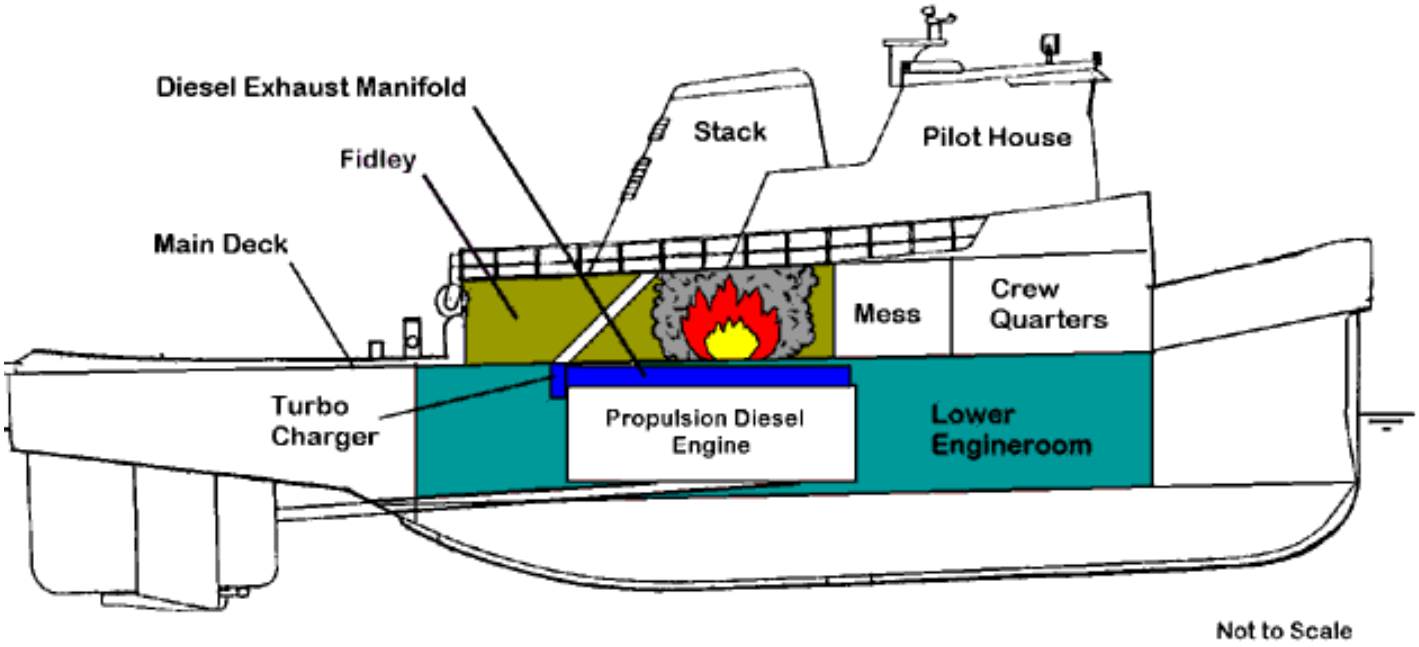


Figure 3. Inboard Profile

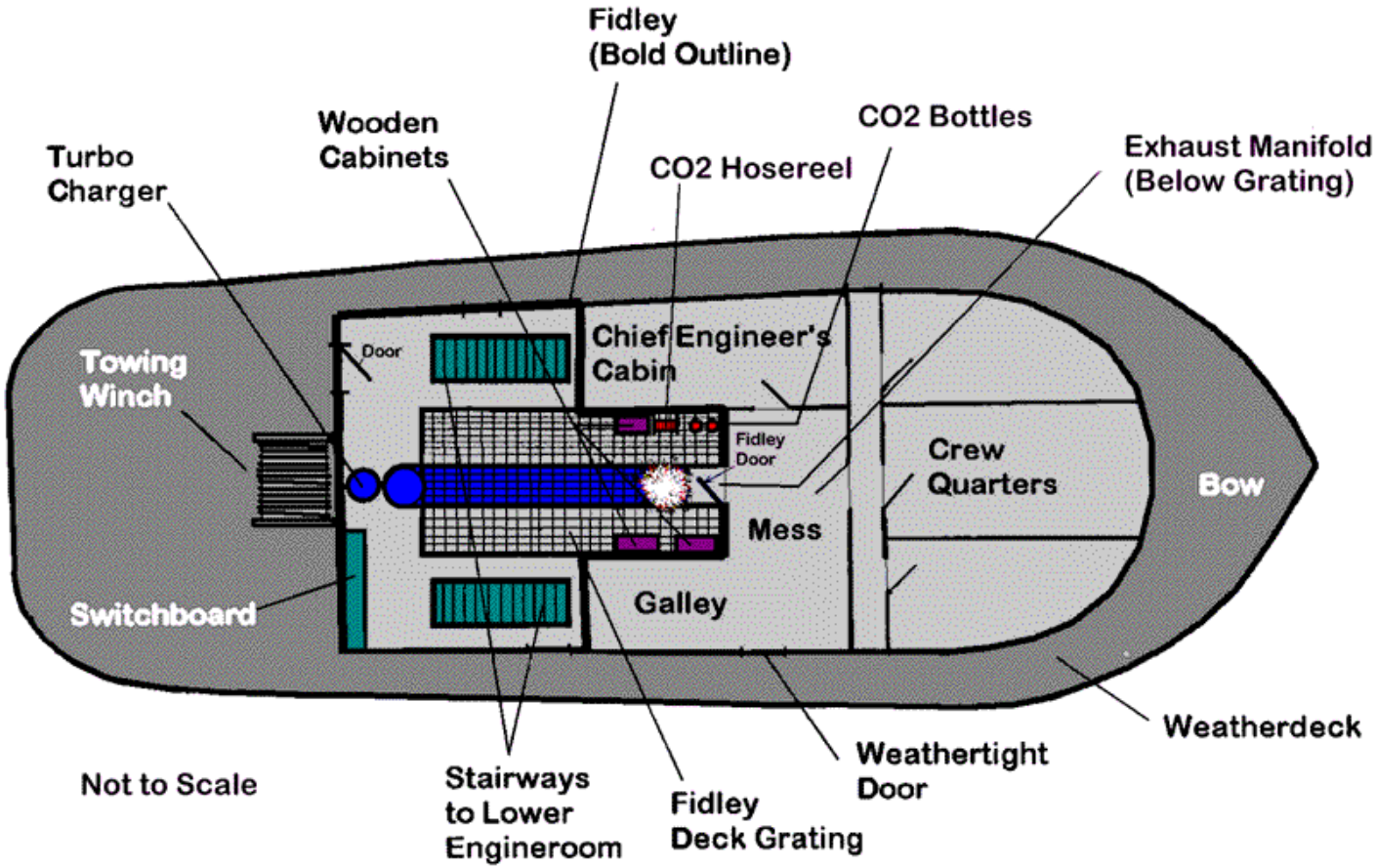


Figure 4. Fidley Deck

Three wooden storage cabinets, about 3 feet high and 5 feet long, were inside the fidley near the door. The cabinets contained machinery spare parts and were attached to the bulkhead. The vessel's electrical distribution systems, switchboards, and transformers were in the fidley.

A watertight steel door at the aft end of the fidley led to the exterior of the main deck aft, where the winch for towing barges was. Emergency remote controls for shutting off fuel pumps to the propulsion and generator engines were on a bulkhead just outside the fidley's aft door, along with remote controls for closing the valves from the fuel tanks. Also located here were the control switches for the engineroom ventilation supply fans and exhaust fans.

Crew Accommodations. Accommodations for the chief engineer, the two tankermen, and the dayman and the galley/mess were all on the main deck. Above the main deck were the pilothouse and the cabins of the captain and the mate. The furnishings, interior bulkheads, and overheads in the accommodations were made of varnished wood and other combustible materials.

The *Scandia* was a UTV. UTVs are required to comply with regulations at 46 CFR Subchapter C, Part 25, which the *Scandia* did. These regulations required the *Scandia* to have at least three 15-pound portable fire extinguishers, lifesaving equipment, emergency position indicating radar beacons, and engineroom ventilation systems. In addition to meeting these requirements, the *Scandia* also had a semi-portable CO_2 fire extinguishing system, additional portable fire extinguishers, a fire pump, and remote closing devices for fuel pumps, valves, and ventilation fans. (The regulations do not require vessels such as the *Scandia* to have remotely operated fixed fire extinguishing systems in the engineroom, remotely operated fire pumps, SCBAs, or firesuits. The *Scandia* was not equipped with these items.)

The Coast Guard does not require UTVs to be classed by ship classification societies such as the American Bureau of Shipping (ABS). However, the EMC kept the *Scandia* in ABS class as Towing Vessel for Ocean Service. ABS surveyors carried out annual hull and machinery surveys[11] and dry dockings at 24- to 30-month intervals.

Safety Board investigators reviewed the ABS survey records from January 1992 to April 1995, when the last survey before the fire was done. The ABS reported the overall condition of the *Scandia* to be satisfactory[12] during this period. As a condition of maintaining ABS class, the ABS requires the vessel owner or operator to tell ABS

[11] Surveys are visual and operational examinations of selected mechanical and electrical equipment and systems and include the visual and ultrasonic examination of the hull plating and structure.

[12] In ABS survey reports, a vessel condition (machinery, electrical, material) is noted as "Satisfactory" or "Un-satisfactory." This comment is used to indicate whether the equipment met or failed to meet the operational or material requirements in an ABS survey.

surveyors about any significant problems on a vessel that may affect its classification. The EMC did not report any such problems to the ABS during this period. According to the ABS, machinery classification surveys are typically conducted with the vessel in port, when the main engine is not running. According to ABS rules, a survey is a spot check of a vessel's condition at a point in time and is not intended to provide a continuous evaluation of the vessel, and the ABS is not responsible for the maintenance of the vessel.

North Cape

The single-hulled barge *North Cape* was 340 feet long, 70 feet wide, and 27.8 feet deep. It was built in 1978 and admeasured 5,506 gross tons. The *North Cape* had a centerline longitudinal bulkhead and transverse bulkheads that divided the cargo block into seven pairs of port and starboard tanks; the vessel's total cargo capacity was 4.2 million gallons (100,000 barrels). For loading and unloading the cargo, the barge had a cargo pumproom on the deck forward and two pumprooms on deck aft.

The Coast Guard had issued a certificate of inspection for the *North Cape* for unmanned operation on coastwise and ocean routes and for the carriage of Grade A and lower grades of oil. The *North Cape* was also classed with the ABS as an oil barge.

The Coast Guard does not require unmanned barges to have anchors and windlasses, as no crewmembers are normally on board to operate them. (Manned barges are required to have anchors.) Nor does the ABS require such equipment as a condition of classification. The *North Cape*, however, had a 6,000-pound bow anchor. On the day of the accident, it was temporarily held in place on the bow anchor sled by a wire rope sling and shackle attached to an A-frame just behind the sled. The temporary arrangement was used while the windlass and its brake--which normally secured the anchor--were being repaired ashore.

The *North Cape* was equipped with the anchor and windlass for operational convenience, according to the EMC; the vessel's logbook showed that it had often anchored while waiting for access to an oil terminal or for traffic to clear in a congested waterway. The mate stated that he had secured the anchor in the temporary fashion just before starting the trip and that the anchor had been similarly secured before when the windlass was being repaired.

Company Information

The *Scandia* and the *North Cape* were operated by the EMC, Staten Island, New York. The EMC operated 42 vessels, including 22 tank barges, 12 tugs, 2 integrated tug/barges, and 6 tank ships. The vessels operated along the East Coast, on the inland waterways, in the Gulf of Mexico, and on Central and South American waters. The company had about 50 employees on shore and 225 employees on vessels.

The EMC's management consisted of a president, a vice president, an operations (and safety) manager, a port captain, and three port engineers. The EMC's 10-acre Staten Island facility included a full marine repair yard that consisted of a machine shop, an electric shop, a welding shop, and a safety and training building. The EMC did most of its vessel repairs in its yard using EMC personnel. (In February 1998, the president of the EMC told the Safety Board that the EMC had changed its corporate policy after this accident, when the EMC began contracting for all repair work.)

EMC's Vessel Maintenance Program

In January 1996, the EMC gave the Safety Board investigators its Operation Notice 17-93, which briefly described the way in which the company's vessel inspection program (VIP) was intended to function. According to the document, the program was administered by the EMC's operations manager and was aimed at detecting and correcting unsafe shipboard conditions and practices which, if left undetected, could lead to accidents.

The VIP required captains to inspect their vessels once a month, to ensure that their crews completed the repairs and maintenance within their capability, and to complete monthly discrepancy reports for their vessels and forward them to the operations department. The operations department was responsible for reviewing the discrepancy reports and for correcting problems, by directing either company repair personnel or subcontractors to do repairs at the EMC's repair yard. According to Operation Notice 17-93, serious safety discrepancies were to be corrected within about 2 weeks.

Maintenance of Scandia

The Safety Board reviewed the *Scandia*'s discrepancy reports for 1994 and 1995. One particular discrepancy was reported by captains as many as nine times between May 1994 and July 1995 and was characterized by them as a "fire hazard." The problem was described in a handwritten attachment to the June 1995 discrepancy report:

> The turbocharger is leaking oil in a bad way, it was looked at when we was in the yard for fire repairs,[13] but nothing was done to it to correct the problem. The smoke is so bad that if we don't open the watertight door at the rear of the engineroom, the smoke forces the smoke in the galley and the rest of the tug. Oil comes out of the turbo and soaks the blanket and down on top of the engine and burns off. I've had complaints of headaches from the crew, irritated and sickening smell, all watertight doors should be closed underway, the amount of smoke coming out of the back door of the engineroom is always pointed out by other tugs as we pass them like there is a real problem in the engineroom. Chief [engineer] says it has flashed

[13] The writer is referring to the engineroom fire on March 1995, which is described in this section of the report.

> and caught fire once before, He put it out with a CO_2 extinguisher….
> [footnote added]

In addition to the turbocharger oil leak, the reports also mentioned a leak in the main engine exhaust system as another source of the smoke in the engineroom. Some other safety discrepancies reported by vessel masters are noted below:

- The July 1995 report stated that the casing for the main fire pump was rusted through ("quarter-size holes") and that the backup bilge pump was being used instead.

- The December 1995 report stated that the captain had to shut down the boiler "due to fire hazard."

- The November 1995 report stated that the "fire hose threads do not match tug piping."

- The September and October 1995 reports stated that "the captain's room leaks water when raining. A lot of water!!! Floods!!!"

- All reports from January to December 1995 stated that "magnetic compass needs calibrating."

- Eleven reports requested the replacement of safety guards on the air compressor belt.

- Six monthly reports requested safety guards for couplings on the steering gear pumps.

- Five reports from 1994 stated that both emergency escape hatches were sealed and inoperable.

- Five reports stated that hydraulic oil was leaking from steering gear valves.

The EMC's maintenance personnel could not provide documentation or details about when or whether the above discrepancies had been corrected. In February 1998, Safety Board investigators again interviewed the EMC operations manager, who administered the VIP, and the operations department supervisors responsible for reviewing and taking corrective action about discrepancy reports to determine why no action had been taken for long periods on the discrepancy reports. Their testimony is summarized below:

- The company did not have a policy of keeping a record of repairs and did not have any record of repairs on the *Scandia*. (The EMC gave the Safety Board receipts for some repairs that subcontractors had done on the *Scandia*.) When Safety Board investigators showed the operations supervisors the discrepancy

reports, the supervisors could not recall any specifics about whether the problems mentioned in the reports had been corrected.

- After the discrepancy reports were reviewed, the operations staff acknowledged that it often took no action and that vessel maintenance needs were not communicated to maintenance personnel. The staff said that the maintenance system suffered from a lack of communication among various departments in the EMC organization.

- The EMC did not have a system of maintenance oversight to monitor whether repairs were properly conducted.

- An operations supervisor who reviewed the reports on the turbocharger oil leak and smoke explained that he did not take action because he did not have the technical knowledge to tell the difference between major and minor problems.

- Another operations supervisor responsible for reviewing the reports suggested that some captains exaggerated problems on their discrepancy reports, so he ignored the reports. The employment of two of the captains who had filed the discrepancy reports had been terminated around the time the accident occurred.

The captain of the *Scandia* asked Safety Board investigators to refer to the discrepancy reports to evaluate the maintenance of the *Scandia*.

Company Training and Drills

Company representatives stated that the EMC's vessel crews received on-site training in drug and alcohol awareness, benzene handling, and tank barge vapor-recovery systems. Employees were also trained at the U.S. Merchant Marine Academy, New York, in survival at sea and in vapor-recovery systems. The company did not, and was not required to, train its employees at marine firefighting school.

The captain said that he tried to hold one emergency drill during each of his 2-week stints on the tug. (The drills covered firefighting, dealing with a man overboard, donning survival suits, and abandoning ship.) He said he usually held the drill on a Sunday, around noon at the change of the watch, so as not to interfere with the crew's sleeping periods.

He said that during fire drills, the crew laid out the hose from a fire hydrant, while the chief engineer activated the fire pump and provided pressurized water to the fire hydrants and the hose on deck. Tankerman 1 stated that firefighting drills on the *Scandia* involved the chief engineer starting the fire pump and the tankerman running the fire hose down an exterior side of the boat to extinguish an imaginary fire. He added that the drill was followed by a discussion of the firefighting scenario and that the participants

discussed each crewmember's duties and station during a fire. Tankerman 2 stated that drills were held every 4 to 6 weeks in summer.

The captain said it was company policy to conduct drills; however, the EMC could not provide records of the drills. Coast Guard regulations do not require drills.

Fire Damage

Safety Board investigators examined the damage on the *Scandia* and found no fire or smoke damage below the fidley grating, while the vessel was completely gutted above it. Investigators found evidence of severe fire damage near the center of the grating, which was directly above the main engine exhaust manifold.

All the plastic switches, wooden workbenches, and various other combustible materials below the grating were unaffected by fire. There was no evidence of fires or leaks from the fuel or lube oil systems in the lower engineroom, where those systems and the *Scandia*'s machinery were located. There was no evidence of a crankcase fire or explosion on the propulsion or generator engines.

The metal casing of the exhaust gas turbocharger did not have any flame damage; the paint on the casing showed moderate discoloration from the effects of heat. (The turbocharger was about 15 feet aft of the center of the grating and just below it, and attached to the aft end of the engine's exhaust manifold pipe.) The rubber vibration pipe connection between the turbocharger and the air intake plenum was intact, but its upper exterior surface was moderately burned.

From the grating upward, the engineroom was completely gutted by fire. All combustible insulation on the interior bulkheads, the overheads, and the wooden cabinets had been consumed. All electrical equipment in the fidley, including the main switchboard, circuit breakers, cables, and transformers, had been destroyed.

Fire had destroyed the combustible contents of the vessel from the main deck up to the pilothouse, including the galley/dining area, the crew accommodations, and the stairway. The sheathings on all bulkheads and overheads, made of marinite and varnished wood, as well as mattresses, furnishings, and clothing, had been destroyed. Only the exterior steel of the superstructure remained.

Near the grating, investigators observed the following:

- The grating had been deformed by the heat of the fire and sagged down about 2 inches toward the exhaust manifold, where a section of the manifold's thermal insulation blanket had come loose.

- The protected glass globe of a light fixture, about 8 feet above the grating, had melted and sagged downward toward the exhaust manifold before solidifying.

- Of two lifting I-beams in the fidley overhead, the port beam was warped from heat in a location above the sagging section of the deck grating.

- Black trickle marks of a solidified substance were found on the loosened insulation, as well as on the top and sides of the main engine. (Core Laboratories, Houston, Texas, could not positively identify samples of the substance sent to them by Safety Board investigators for analysis because the samples were contaminated with the barge's cargo oil when the *Scandia* ran aground and its engineroom flooded.)

- On the exterior of the vessel, the ventilation louvers on the port side of the stack showed heat damage, while the paint around the starboard louvers showed little heat damage.

On March 5, 1995, while the *Scandia* was moored at the Northeast Oil Terminal in New Haven, Connecticut, it had a fire in its engineroom. The fire was caused by a malfunction in the vessel's oil-fired hot-water heating system, which was in the aft starboard corner of the lower engineroom. The lower engineroom was significantly damaged, and extensive repairs were done at the EMC's repair facility later that month. After the repairs were completed, the *Scandia* was surveyed to the satisfaction of the ABS and continued operations. Safety Board investigators examined the hot-water boiler after the 1996 fire and found no recent fire damage.

During the 1995 fire, the *Scandia*'s crew fought the fire until firefighters from the local fire department arrived. According to a handwritten statement attached to the March discrepancy report, two crewmen borrowed breathing apparatus from the fire department firefighters and put out the fire. Afterward, the captain recommended that the EMC equip the *Scandia* with two sets of firesuits and SCBAs, so that the crew could effectively fight fires in the future. The EMC did not comply.

Waterway Information

Long Island Sound is a deep navigable waterway connecting New York Harbor in the west to Block Island Sound, Rhode Island, on the east (see figure 1). Long Island Sound is about 110 miles long and 10 to 25 miles wide, and the waters are well marked with navigation aids. Marine traffic is sheltered from ocean storms and strong southerly winds by remaining in the lee of Long Island when transiting the sound. After leaving Long Island Sound, vessels proceed through the "Race," which serves as a "gateway" to the next sound--Block Island Sound. Vessels are exposed to high southerly winds, waves, and ocean swells while in the Race because it does not have any islands to provide protective land cover. The *Scandia* had passed through the Race and by Watch Hill when the fire was reported.

Block Island Sound is bounded by Rhode Island to the north and by Block Island to the south. The Atlantic Ocean lies east and south.

The coast of Rhode Island is lined with federally protected salt water ponds extending from Narragansett to Westerly, Rhode Island. The ponds are breeding grounds for fish and shellfish, and they are a refuge for waterfowl migrating along the Atlantic seaboard. At high tide, the sea breaches most of the ponds.

The *North Cape* grounded about midway along a string of eight federally protected salt water ponds. The *Scandia* grounded near Trustom Pond, the centerpiece of a national wildlife preserve.

Meteorological Information

At 7:20 p.m. on January 18, FleetWeather faxed the following forecast to the captain:

January 18, evening, New York Harbor (departure of the *Scandia*): Winds out of the east-southeast at 15 to 25 knots, becoming south-southeasterly and increasing to 30 to 38 knots, with clouds, fog, and a chance of showers.

January 19, early morning, Long Island Sound (planned transit of the *Scandia*): Southerly winds increasing to 35 to 45 knots. Seas 3 to 7 feet.

January 19, between Watch Hill and Chatham, Massachusetts (Block Island and Rhode Island Sounds; planned transit of the *Scandia*): Southerly winds increasing to 35 to 45 knots a.m.; becoming westerly at 20 to 28 knots by late p.m., with rain, and seas of 4 to 8 feet. Much higher seas on waters exposed to south this p.m. (January 18) through January 19.

The captain did not obtain further weather updates from FleetWeather on the day of the fire, nor did the EMC give him updates. When asked whether he had received weather updates, the captain did not tell Safety Board investigators in January 1996 that he had heard storm warnings on the tug's radio. Safety Board staff again interviewed him in February 1998 (see appendix), when he told investigators that he had been aware of the storm from radio broadcasts, but he did not provide details of when or what he heard.

The Coast Guard routinely receives weather information from the National Weather Service (NWS) and makes urgent weather broadcasts, called safety marine information broadcasts (SMIBs), to warn mariners in case severe weather is forecast. Group Woods Hole broadcast a storm warning (SMIB) at 11:09 p.m. on January 18 and again on January 19 at 7:52 a.m., 12:26 p.m., and 2:26 p.m. The broadcasts were storm warnings[14] for the region from Chatham to Watch Hill. (The *Scandia* had passed Watch Hill about an hour before it caught fire). For January 19, the SMIB forecast southerly winds from 25 to 35 knots during the day, increasing to 40 to 50 knots late in the day, and 10- to 20-foot seas. It also forecast rain, drizzle, and fog. For that night it forecast

[14] According to the NWS, storm warnings are issued when winds of 48 knots or more are forecast.

southwest winds at 40 to 50 knots, diminishing later to 25 to 35 knots, and seas between 10 and 20 feet.

A January 19 news release from the Coast Guard District Office warned mariners from Maine to New Jersey of a fast moving storm that could severely affect the area:

> A period of potentially dangerous winds from 40-50 knots with higher gusts is expected late today (19th Jan Friday) and tonight. Seas from 15 to 25 feet and minor coastal flooding are also expected.... Mariners are strongly reminded to closely monitor weather and Coast Guard emergency radio frequencies and seek safe shelter if needed.

In addition to information about weather forecasts, Safety Board investigators obtained information regarding actual on-scene weather conditions from several other sources. A SAR message from Coast Guard Group Woods Hole described the on-scene weather at the time of the accident (2 p.m.) as southerly winds at 25 knots and seas between 6 and 8 feet. Also, the fishing vessel *Seafarer*, which was a mile away, was the first vessel to arrive on scene at 2:30 p.m.; its operation was not hampered by the weather. The fishing vessels *Nautilus* and *Huntress* were also operating in the area at that time.

A situation report (SITREP) from the air station indicated that the on-scene weather was estimated at 10- to 12-foot seas and winds of 26 knots gusting to 36 knots, about 3 p.m., when the Coast Guard helicopter was providing air cover while the MLB crewmen rescued the crewmembers from the tug.

At 4:30 p.m., the Coast Guard cutter *Point Turner* reported seas of 25 to 30 feet near the accident site.[15] According to a SITREP from Group Woods Hole, the on-scene weather had deteriorated to 20- to 30-foot seas and winds in excess of 50 knots by about 5 p.m., when the Coast Guard MLB with two tug crewmen reached the barge to try to release its anchor.

Toxicological Information

Coast Guard postaccident drug and alcohol testing regulations (46 CFR) require that specimens be collected "as soon as practicable following an accident."

At approximately 10:30 p.m. on the day of the accident, the Coast Guard tested each member of the *Scandia*'s crew with a breathalyzer for the presence of alcohol. All the results were negative.

[15]The *Point Turner* was forced to abort its mission to assist the *Scandia* when sea action broke the attachments for the ship's refrigerated stores container.

Urine samples were collected to test for the presence of drugs[16] about 5 a.m. the day after the accident and analyzed at South County Hospital, Wakefield, Rhode Island. The results for five of the crewmembers were negative. Results of the initial drug screening of the sixth crewmember, tankerman 1, identified the presence of amphetamines.

Consistent with Federal regulations, the EMC contracted for the services of a medical review officer (MRO) to further analyze and interpret the test results. Subsequent testing was then done at a federally approved testing laboratory, Greystone Health Sciences Corporation, in La Mesa, California. The MRO attributed the presence of the amphetamines to a valid prescription medication being taken by the deckhand. The results of the drug test conducted at this facility showed that the presence of amphetamines was below the drug screening cutoff level. The MRO then certified that tankerman 1 tested negative for all drugs. Because a blood sample was not analyzed, it is not possible to determine whether the medication had impaired the tankerman.

Survival Factors

Coast Guard Rescue Boats

The coxswain told Safety Board investigators that he had initially selected a UTB instead of an MLB because the UTB was faster and had a closed cockpit to protect the crew from the weather.

According to the Coast Guard's *Operator's Handbook*, the UTB is a light-weight aluminum-hulled, 26-knot, multi-mission vessel and is designed for moderate weather and seas. The MLB is an all-steel high-endurance boat designed for SAR missions in rough seas, including heavy surf and bad weather. It has a semi-enclosed coxswain's platform and a maximum speed of 13 knots.

Hypothermia Protective Clothing

The crewmen on the SAR mission wore anti-exposure coveralls, the standard garments worn by Coast Guard crewmembers during cold-weather operations in closed-cockpit boats. A coverall provides mobility and adequate protection from limited exposure to wind and spray, but it is not designed to protect someone who is immersed in cold water from hypothermia.

When the coxswain, his crewmen, and the two tug crewmen later returned to the *North Cape* on the salvage mission, everyone except the coxswain wore survival suits. A survival suit encapsulates the wearer, providing excellent thermal protection for someone

[16] The urine samples were tested for the five drugs specified in Coast Guard (46 CFR 16.350) and Department of Transportation (49 CFR 40.21) regulations: marijuana, cocaine, opiates, amphetamines, and phencyclidine.

immersed in cold water. But the suit is cumbersome and bulky, making it difficult for the wearer to perform actions requiring dexterity. Both the UTB and the MLB carry survival suits.

On the salvage mission, the coxswain wore a dry suit. The dry suit fits tightly so that it can keep the wearer dry and warm even if he is immersed in cold water. The suit is durable and flexible, and allows the coxswain the dexterity needed to operate the vessel, but it is not buoyant. Dry suits are normally stored at the boat station, rather than carried aboard the boats.

When a coxswain is on a rescue mission, he is responsible for designating a crewmember to be a swimmer. If the coxswain knows before he gets to the accident scene that someone will have to be rescued from the water, he is supposed to have the swimmer don either a wet or a dry suit and a safety harness before the rescue boat arrives (Coast Guard Commandant Instruction M10470.10C "Hypothermia Protective Clothing"). (A wet suit allows a layer of water to enter between the wearer's skin and the wet suit. Once the layer of water is warmed by the wearer's own body heat, it provides limited protection from hypothermia.)

Swimmer's Hypothermia

The coxswain returned to the station as soon as he discovered that the swimmer had hypothermia. The coxswain told Safety Board investigators that he probably would have taken the tug crewmen directly to the barge had the swimmer not been hypothermic. He also said that had it not been for the explosion on the tug, he would have transferred the tug crewmembers directly to the MLB without their having to enter the water.

Other Information

Towing Vessel Industry

There are about 5,200 towing vessels in the United States, constituting, after fishing vessels, the largest segment of the U.S. commercial vessel industry. Most towing vessels are under 1,500 horsepower and operate mainly on inland waterways. The vessels push or tow 37,000 barges along the U.S. coasts, inland waterways, rivers, harbors, bays, and the Great Lakes. Over 32,000 crewmembers are employed for about 90 million on-duty hours annually aboard the vessels.

The members of the American Waterways Operators (AWO) include the majority of the owners and operators of U.S. towing vessels and barges. It is the national trade association for the inland and coastal barge and towing industry. The AWO has recently established a responsible carrier program (RCP) designed to improve marine safety and environmental protection. The RCP provides AWO members with broad guidelines and a model to use in developing company-specific safety programs that incorporate safe

operating practices not currently required by Coast Guard regulations. According to the AWO, the RCP is a voluntary safety program, and each company should tailor the program to its own operations. The EMC is a member of the AWO and is currently working to adopt the RCP. However, not all towing companies in the United States are members of the AWO, and many companies have their own safety programs.

Towing Vessel Accidents

The Safety Board's investigation of the September 1972 accident of the tug *Carolyn* and the unmanned barge *Weeks No. 254* identified the need to arrest a drifting barge using its anchor, similar to the issue of arresting the drift of the *North Cape* in this accident. The Safety Board found that the *Weeks* could have been prevented from drifting into the Chesapeake Bay Bridge and Tunnel (CBBT) by using the barge's anchor. The bridge's piers were damaged extensively, and the CBBT was closed for 14 days. The resulting loss, excluding the cost of repairing the CBBT, was estimated at $3,397,000 (in 1972 dollars).

The accident occurred when the tug *Carolyn* lost propulsive power while towing the *Weeks* in the Chesapeake Bay. The vessels drifted in heavy winds and collided with the CBBT. The Coast Guard cutter *Madrona* and the commercial tug *Warrengas* were standing by to assist.

The Safety Board determined that the probable cause of this accident was the failure of the captain of the tug to inform the *Madrona* or the *Warrengas* that the barge had a quick-release anchor and the decision of the commanding officer of the *Madrona* not to take the tug in tow as a last resort.

Although unmanned barges are not required by regulation to have anchors, the *Weeks* had one and a trailing trip wire to release the anchor. To activate the trip wire, the tug would have had to circle to the rear of the barge, but the tug had lost propulsion. Either of the assist vessels could have activated the trip wire but did not because their crews were not told of the wire's existence, and a trip wire is a rare feature on an unmanned barge. The tug dropped its own anchor, but the anchor was too small to hold against the combined pull of the barge and the tug. The Safety Board recommended that the Coast Guard:

> Determine the need for anchors on unmanned barges and practical methods of controlling such anchors in order to prevent damage to any vessel, bridge, or other structure or other loss to bystanders on the navigable waters of the United States. (M-74-4).

In October 1976, the Coast Guard responded that the effectiveness of "braking" with an anchor depends on the time and distance available when the navigator finds the vessel in imminent danger of collision. The Coast Guard argued that most accidents occur when a vessel is navigating close to other vessels, piers, or bridges, where the effectiveness of dropping an anchor is negligible. Therefore, the Coast Guard concluded,

unmanned barges do not need to have anchors. In June 1977, the Safety Board classified the safety recommendation "Closed--Acceptable Response."

Coast Guard Information on Towing Vessel Accidents. According to the Coast Guard, between 1992 and 1996, towing vessels had 188 fires, almost all of which started in an engineroom. Many of the fires resulted in a total constructive loss of the tug, and several could not be brought under control without the help of outside emergency responders. In number, fires ranked as the second most common type of towing vessel accident, after groundings.

Coast Guard data show that 80 percent of the total fatalities (64 deaths) in the towing vessel industry between 1992 and 1995 are the result of slips on and falls overboard from tugs and barges during operations. The Coast Guard does not consider the data on crew injuries to be reliable, as the reporting threshold for injuries is subject to interpretation and, for various reasons, injuries are often not reported.

In 1994, the Coast Guard published a report[17] about the types and causes of accidents involving towing vessels. The report was based on statistics for 1981 through 1991. The study stated that the majority (58 to 62 percent) of towing vessel accidents were caused by human errors rather than by causes identifiable during vessel inspection, such as those associated with equipment or material failures (17 to 20 percent). The Coast Guard concluded that inspection requirements for towing vessels were not justified by the results of this study.

Data on Oil Spills From Vessels. Coast Guard data on oil spills show that, in 1995, among all vessel types, barges were the leading contributors to medium oil spills (10,000 to 100,000 gallons) and to major oil spills (over 100,000 gallons). Medium and major oil spills accounted for 37 percent of the number of spills and 75 percent of the volume of oil spilled. Tank barges accounted for all three major oil spills in 1995 and for three of the four major oil spills in 1996, including this accident.

The statistics for 1994 are similar: barges spilled 69 percent of the oil spilled and accounted for 38 percent of the number of medium and major oil spills. Of the oil spilled in medium and major oil spills, tanks ships accounted for only 3 percent of the volume.

Between 1992 and 1996, barges spilled 67 percent of the oil spilled in medium and major oil spills, while tank ships and freight ships spilled 8 percent and 6 percent, respectively.

Comparison of Regulations. Coast Guard regulations for tank vessels (tankers) are different from those for tug-oil barge systems in many areas of vessel safety. Table 1 compares some of the regulations in safety areas that are discussed in this accident report, such as fire safety and anchors on vessels.

[17] *Towing Vessel Inspection Study,* August 1994, U.S. Coast Guard.

Table 1. Summary of Coast Guard Fire Safety and Other Regulations

(Tank Ships versus Tug-Oil Barges)

Issues	Tank Ships	Tug - Barge System		
		Uninspected Towing Vessels	Manned Oil Barges	Unmanned Oil Barges
Structural Fire Protection	Incombustible bulkheads, decks, insulation, ceiling, linings. Combustible veneer, max. 2 mm thick.	Combustible material permitted.	Not applicable	Not applicable
Fixed Firefighting Systems in Machinery Spaces	Required	Not required	Not applicable	Not applicable
Portable, Semi-Portable Fire Extinguishers	Required	Portables	Portables	Portables required during cargo operations.
Fire Pump and Fire Main System	2 Required	Not required	Not required	Not required
SCBAs and Firesuits	2 Required	Not required	1 required if barge depth greater than 15 feet.	Not required
Anchors and Handling Equipment	Required	Not required	Required	Not required
OPA 90 Single-Hull Phaseout Schedule	Required	Not applicable	Required	Required

Regulatory History of Towed Oil Barges

Following the grounding of the *Exxon Valdez* in Alaska, Congress enacted the Oil Pollution Act of 1990 (OPA 90), which mandates that all single-hull tank vessels and barges operating in U.S. waters be either phased out of service or retrofitted with a double hull by 2015. The phaseout deadline for a particular vessel depends on its age and size, with older and larger vessels scheduled to be phased out earlier, while smaller vessels (under 5,000 gross tons) can remain in service until 2015. According to the schedule, the *North Cape* must be either phased out or converted to a double hull by January 1, 2005. The Coast Guard estimates OPA 90 will affect 86 U.S. barges, 143 U.S. tank ships, and

856 international tank ships. In other words, 85 percent of the total domestic deadweight capacity presently available is scheduled to be retired or converted by 2015.

On July 30, 1996, the Coast Guard published regulations designed to minimize the risk of oil pollution from single-hull barges until they are phased out in 2015. The regulations specify operational measures for towing vessels, including bridge resource management, vessel-specific watch keeping procedures, and minimum under-keel clearance. More regulations resulted from the grounding of the *Morris Berman*[18] in Puerto Rico and from the *Mauvilla*[19] accident (in which the towboat hit a railroad bridge in Alabama, causing 47 fatalities on Amtrak's Sunset Limited). In July 1996, the Coast Guard also issued a final rule, "Navigation Safety Equipment for Towing Vessels," to "help ensure that the mariner piloting a towing vessel has adequate equipment to safely navigate the waters being transited." Under the rule, the towing vessel must have radar, searchlights, radios, compasses, swing-meters, echo-sounders, electronic position-fixing devices, and marine charts and publications. The rule also establishes standards for the maintenance, inspection, and serviceability of towlines and towing gear.

In January 1997, the Coast Guard did an economic analysis and concluded that it is not economically feasible to retrofit double hulls onto single hulls. The Coast Guard determined that the potential environmental benefits are not significant compared with the costs of retrofitting a double hull, in view of the limited time remaining before the single-hulled vessels are phased out.

Tug of Opportunity System (TOS)

A TOS is an organized system for diverting a tug, which may be towing or escorting another vessel or idling, to arrest a drifting oil barge or vessel. Under this system, information regarding the capabilities and locations of suitable tugs is monitored so that in an emergency the proper resources can be immediately dispatched to help. In addition, the system ensures that the tug is appropriate for the condition of the sea and for the size of the vessel to be helped. The Coast Guard is considering implementing such a system, operated by industry, in the U.S. Pacific Northwest. An alternative approach is to have dedicated tugs stationed in environmentally sensitive or otherwise high-risk areas to assist barges and tankers in distress.

Risk Assessment

The Ports and Waterways Safety Act of 1972 charged the Coast Guard with managing risk in the waterways of the United States. The Coast Guard's Office of Marine Safety and Environmental Protection is responsible for preventing or mitigating the effects of marine accidents on the public and the environment. According to "Program

[18]For more information, read Marine Accident Brief Report--*Grounding of the U.S. Tank Barge* Morris J. Berman, *San Juan, Puerto Rico, January 7, 1994* (DCA-94-MM-008).

[19]For information, read Railroad Accident Report -- *Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, September 22, 1993* (NTSB/RAR-94/01).

Principles" of the Office of Marine Safety and Environmental Protection's *1996 Performance Report*, risk management is the "business" of the office and its primary mission.

Risk is the combination of the probability of an accident occurring together with its consequences. Risk assessment[20] is an organized and systematic search for high-risk conditions existing in a system. It is a complex process by which the risks in a system are identified, prioritized, and presented. After the risks are identified, risk management strategies can be developed and prioritized in order of effectiveness.

The system stakeholders can use the results of the risk assessment to select certain risk management strategies over others, based on the level of system risk they are willing to accept. The level of acceptable risk is often dictated by economic, social, and political considerations.

In response to the *Scandia* accident, a regional risk assessment team (RRAT) was formed under the leadership of the Coast Guard and included representatives from the departments of environmental protection of the Northeastern States (Rhode Island, Maine, Connecticut, Massachusetts, and New York), the AWO, and environmental advocacy groups. In February 1997, the representatives completed a report titled *Regional Risk Assessment of Petroleum Transportation on the Waters of the Northeast United States* (RRAT report). In the report, the RRAT reviewed current industry practices, reviewed casualty and oil spill data, critiqued Federal regulations, and assessed industry programs that influence vessel operation. The RRAT's purpose was to develop recommendations to help the Coast Guard develop regulations to improve safety and reduce the risks of transporting petroleum products by tug-barges through the Northeastern States. The scope of the report was limited, as it did not address fire safety on towing vessels; the Towing Safety Advisory Committee[21] (TSAC) later submitted recommendations on fire safety to the Coast Guard for consideration in its rulemaking.

Rulemakings after Accident

The Coast Guard Authorization Act of 1996 required the Coast Guard to develop regulations, in consultation with the TSAC, to reduce the number of oil spills from single-hull barges.

The Act requires an oil barge to have at least one of the following features:

[20]For more information on risk assessment as it applies to marine vessel operations, see Marine Accident Report--*Allison of the Liberian Freighter* Bright Field *with the Poydras Street Wharf, Riverwalk Marketplace, and New Orleans Hilton Hotel in New Orleans, Louisiana, December 14, 1996* (NTSB/MAR-98/01).

[21]The TSAC provides the Coast Guard with industry and operations-related recommendations to assist with the development of regulations. The TSAC is authorized by Congress and represents a broad cross section of the towing industry.

(a) an operable anchor and a crewmember capable of stopping the barge from drifting ashore,

(b) an emergency system that will allow the tug to retrieve the barge if the tow line breaks, and

(c) any other means, equivalent to the above, to protect the barge from grounding.

In addition, the Act requires that a tug engaged in towing barges have a fire suppression system or its equivalent.

In response to the Coast Guard Authorization Act of 1996, the Coast Guard issued a notice of proposed rulemaking (NPRM) in October 1997 to improve towing-vessel and tank barge safety in a variety of areas. The proposed rules were developed in consultation with the TSAC, as required by the Authorization Act, and were based on the recommendations made in the RRAT report. The Coast Guard proposed the following rules in response to the *Scandia* accident:

For improving fire suppression measures aboard towing vessels, the Coast Guard proposed that all new tugs and, within 2 years, all existing tugs have the following:

- A firemain system and fire pump that can be operated from the tug's pilothouse and locally at the pump.

- Fixed fire extinguishing systems in enginerooms on new tugs longer than 79 feet,[22] in addition to the portable extinguishers that regulations currently require. For smaller new tugs and existing tugs of any size, semi-portable extinguishers are required in addition to the portable fire extinguishers currently required.

- Remote fuel and engine shutdowns.

- Muster list that identifies the crew's responsibilities and procedures in a firefighting emergency.

- Instruction and drills, including engineroom firefighting drills that are held at least once a month.

- Safety orientations to familiarize crewmembers with their vessel's safety features.

The NPRM solicited public comment on voyage planning requirements and mentions recommendations made by the RRAT and the TSAC to the Coast Guard on this

[22]Seventy-nine feet is used to differentiate between large and small tugs for application of the regulations and follows the same breakpoint used for fishing vessel regulations. The need for the differentiation is based on the practicality, space limitations, and cost effectiveness of installing certain equipment on small tugs.

subject. The recommendations include requiring documented company policies and procedures to take into account weather forecasts and the adequacy of vessel equipment before starting a voyage.

The NPRM proposed any one of three methods for stopping drifting tank barges:

- *Operable Anchor for Manned Barges*: In an emergency, a trained person on the barge can drop the anchor. The anchor system should be maintained and inspected to ensure that it is operable. The NPRM did not propose operable anchors for unmanned barges.

- *Emergency Barge Retrieval System*: The tug and barge are equipped with an emergency retrieval system that allows the tug to retrieve the barge if the towline breaks. The tug's crewmembers must be trained in the use of the equipment, and annual retrieval drills should be conducted. The system can be used on either an unmanned or a manned barge.

- *Any Other Approved System*: This option allows for the use of systems developed by industry in the future that offer a level of safety equal to or greater than the level offered by the other measures.

Pollution Response

The method of coordinating the participating agencies; the Federal, State, and local governments; the trustees; and the industry, civic, and environmental groups that were involved in cleaning up the pollution are outlined in the area contingency plan. The pollution cleanup was coordinated by the Coast Guard acting as the Federal on-scene coordinator (FOSC). The FOSC set up a command post in Galilee, Rhode Island, and was assisted by the Coast Guard's Atlantic Strike Team (AST) and a regional response team composed of Federal, State, and local government representatives and the EMC. An estimated 700 people were involved in the pollution response and cleanup. The Federal Government billed the EMC about $1,900,000 for the cost of cleaning up the pollution.

The DEM and NOAA were notified of a potentially major oil spill about 3 p.m. on the day of the accident, according to Coast Guard status reports on pollution response and notification activities (POLREPs). NOAA personnel estimated the trajectory of the potential spill to determine its probable impact on the coastline. POLREPs show that the AST was activated about 4 p.m. and arrived on scene around midnight. The AST assisted the FOSC by coordinating response, salvage, and lightering (pumping out remaining oil from the *North Cape*) activities, monitoring contractors, and assessing shoreline cleanup priorities. About 6:15 p.m., the EMC authorized its oil-spill cleanup contractors to deploy deflection booms, sorbent materials, and onshore/offshore oil skimmers to protect areas identified by the Coast Guard as being environmentally sensitive. About the same time, the EMC also engaged a marine salvage company and deployed three tugs and a 30,000-barrel-capacity oil barge to lighter the remaining oil from the *North Cape* so that it would not exacerbate the pollution by continuing to leak. The lightering operations were

severely restricted over the next few days by intermittently stormy weather (winds up to 50 knots and 6- to 8-foot seas), which endangered the lightering and salvage crews. The AST report states that 74,550 barrels of heating oil were lightered from the *North Cape*. The *North Cape* was eventually re-floated off Nebraska Shoal on January 26, 1996, and removed from the scene.

Analysis

Exclusions

The following factors were eliminated as causal to the accident: the crew's qualifications, fatigue, and use of drugs.

The Coast Guard took the tug crewmembers to shore about 3 hours after the fire was detected. The opportunity to conduct chemical testing was further delayed because of the crewmembers' involvement in the salvage operations. During the salvage operation, two tug crewmembers tried to board the barge, and the captain and remaining crewmen were on shore monitoring the salvage and communicating with the salvage crew. Thus, all tug crewmen were involved in the salvage operation in some capacity. The last crewmember, who was airlifted from the barge, was returned to shore after 10 p.m. Shortly thereafter, all crewmembers were tested for alcohol.

Because 9 hours had elapsed between the fire and the breathalyzer test, the Safety Board cannot conclusively determine that alcohol was not present in any of the *Scandia* crewmembers.[23] [24]

On the day of the accident, none of the tug crewmembers reported suffering from any serious medical conditions. No evidence suggests that any of the crewmembers were impaired by alcohol or controlled substances. Tankerman 1 had been taking prescription medicine containing amphetamines. Although it could not be determined what, if any, effect the medicine had on him at the time of the accident, nothing about his performance suggests that he was impaired.

Although the crewmembers had less than 6 hours of sleep before the start of their shift,[25] it does not appear that their performance was impaired by fatigue or that fatigue played any role in this accident.

The qualifications of the crewmembers either met or exceeded the requirements of the Coast Guard.

[23] Because of the rate at which humans metabolize alcohol, evidence of alcohol is usually eliminated from the body in about 8 hours.

[24] Because problems and solutions associated with the timing of postaccident drug and alcohol testing were explored in a March 13-15, 1997, Safety Board Public Hearing and were comprehensively addressed in a subsequent Safety Board report, they are not discussed here. For more information, read Marine Special Investigation Report—*Postaccident Testing for Alcohol and Other Drugs in the Marine Industry and the Ramming of the Portland-South Portland (Million Dollar) Bridge at Portland, Maine, by the Liberian Tankship* Julie N *on September 27, 1996* (NTSB/SIR-98/02).

[25] Because the crewmembers worked on a 6-hour-on-6-hour-off schedule, it is unlikely that they slept for a full 6 consecutive hours when they were off duty.

Safety Issues

In this accident, the Safety Board identified the following safety issues, which are examined in this report:

Origin and cause of fire.

Management oversight of vessel maintenance.

Risk assessment:

Weather and voyage planning.

Barge retrieval systems.

Anchors on unmanned barges.

Fire safety of towing vessels.

Search and rescue:

Deployment of Coast Guard rescue boat.

Hypothermia protective clothing.

Decision to return to barge to drop its anchor.

Environmental pollution and cleanup.

Fire

Safety Board investigators analyzed the fire damage they saw in the *Scandia*'s fidley to determine the fire's point of origin and cause.

The investigators ruled out the exhaust gas turbocharger in the lower engineroom as a point of origin for several reasons. Because the turbocharger was separated by as much as 15 feet (aft) from the center of the fidley, which was the part that was most severely damaged by the fire, and because no burn path indicated that the fire had traveled between the two locations, the moderate heat discoloration of the paint on the turbocharger casing alone does not indicate that the turbocharger was likely to have been the place where the fire began.

The absence of damage on the casing from flame impingement, together with the fact that the rubber vibration joint remained intact and unmelted, indicates that the turbocharger was not exposed to the large high-temperature fire that consumed the parts of the vessel above. Instead, the discoloration of the casing and the surface burns on the rubber joint are consistent with damage sustained during the long periods when the lube oil from the turbocharger leaked onto the adjacent hot engine manifold and onto the rubber joint and burned--a maintenance problem repeatedly mentioned on EMC

discrepancy reports. However, the effects of heat from the fire in the fidley, which was just above the rubber joint and turbocharger, would have exacerbated the burn and discoloration caused by the leaking oil. The Safety Board determines that although the leaking turbocharger oil was a serious fire hazard, it was not the cause of the fire. Because the lower engineroom had no other damage from fire or smoke, the Safety Board ruled it out as the location of the origin of the fire.

The most intense heat damage was concentrated around the center and port areas of the fidley grating, where the steel had melted and sagged downward. The I-beam on the port side, which was above the sagging section of grating, was warped from the heat, showing that the hottest area was both below it and toward the port side. Because the natural convection of air causes heat to rise and fires to burn upward, the fire most likely originated at the grating and then traveled upward.

Also, glass globes of light bulbs soften when heated and normally bulge out in the direction of the hottest temperature, providing a clue to where a fire has started. In this case, the bulb pointed to the sagging section of the fidley grating.

Greater heat damage on the port-side ventilation louvers on the exhaust stack, compared to the starboard louvers, also indicates that the fire was more intense on the port side of the fidley.

The testimony of the captain and the dayman, both of whom fought the fire, is also consistent with the physical evidence of the fire damage, in that they reported seeing scattered small fires near the center of the fidley and toward the port side but no fire in the engineroom below.

All these factors lead to the same conclusion; consequently, the Safety Board concludes that the fire on the *Scandia* originated near the center of the fidley grating, which was above the main engine exhaust manifold.

The Safety Board attempted to determine what may have caused the fire. Because laboratory tests failed to identify the blackened residue on the manifold where its insulation had come loose and on the sides of the engine below it and because the EMC and the crew could not provide any useful information, investigators considered substances that were likely to have been used aboard the tug at the time it caught fire.[26] Because the *Scandia* was approaching the confined waters near Providence, the normal practice would have been to haul in the towline (barge) and put the *Scandia* in the pushing mode. The crew was probably preparing to apply grease to the steel towline before hauling it in, in keeping with common industry practice.

[26]Various greases, lubricants, and paints were typically used by the crew of the *Scandia* for routine maintenance and operation of the tug's towline, machinery, and equipment. According to the manufacturer's data sheets, the greases and lubricants are petroleum based and pose a fire risk; consequently, they should be stored in sealed containers away from hot surfaces and areas of high temperature, such as the fidley.

As part of the preparation, a crewmember may have placed a container of the towline grease (or a similar flammable lubricant) on the fidley grating to melt the grease before applying it. According to the EMC, the towline grease is normally stowed in a 5-gallon container on the weather deck, where it was cold that day and where the grease might have solidified. The EMC did not have a documented and enforceable policy of prohibiting the storage of flammable liquids in the engineroom. Because the *Scandia* was rolling in 8- to 10-foot seas, the grease probably spilled from its container onto the grating.

In this event, the grease-like substance would have melted and dripped onto the part of the manifold with loose insulation; the temperature of the manifold, 950° F, would have been high enough to ignite[27] the substance on contact. The blackened residue observed on the manifold and on the sides of the engine below it was most likely the burned, grease-like substance.

The substance that spilled is more likely to have been a high-viscosity grease-like material, such as towline lubricant, than a comparatively low-viscosity kerosene or diesel, as the latter would have run through the grating onto the engine and ignited. Such an event would have left evidence of a fire on the top and sides of the engine and, probably, also on the walkways around the engine.

The Safety Board concludes that rough seas may have caused a container of flammable lubricant to fall onto the part of the engine manifold that had loose insulation, where the lubricant ignited on contact; however, the cause of the fire could not be precisely determined.

After igniting at the manifold, the fire, because of natural convection, spread upward into the fidley and set fire to the puddles of spilled grease lying on the grating. The burning puddles provide a reasonable explanation for what the crewmen described as a number of small scattered fires on the grating. The flames from the burning grease then gradually set fire to the wooden storage cabinets attached to the bulkhead; from there, the fire progressed to the bulkheads themselves and then to the overheads. Because the tug's interior bulkheads were sheathed with combustible materials, the fire from the fidley continued to spread upward to the accommodations and to the remaining parts of the *Scandia*. Because the fire moved up and away from the manifold, the remaining sections of insulation on the manifold were not burned.

The Federal Bureau of Investigation participated in the U.S. Department of Justice's criminal investigation of this accident but found no evidence to suggest that anyone had deliberately set the fire, and neither the EMC nor the vessel's crew was subsequently charged by the Department of Justice with deliberately setting the fire. (See appendix.) Safety Board investigators also found no evidence that the fire was deliberately set.

[27] The flash point of the towline grease/lubricant used on the *Scandia* was about 457° F, according to the EMC.

Management Oversight of Vessel Maintenance

After reviewing the *Scandia*'s discrepancy reports, interviewing EMC operations department personnel responsible for the oversight of vessel maintenance, and evaluating the implementation of the EMC's VIP, the Safety Board determined that the EMC's management oversight of vessel maintenance was poor, which resulted in reducing the safety of its vessels.

The VIP formed the cornerstone of the EMC's program of having its management oversee vessel maintenance. However, the Safety Board found that although the EMC had a VIP on paper, the EMC did not implement the VIP in practice, as evidenced by the discrepancy reports. Had the EMC followed its VIP, there would not have been the numerous instances of extended delays in repairing safety and maintenance items because the program required that serious safety deficiencies be repaired within about 2 weeks. Instead, safety and maintenance problems were not corrected for months, sometimes for more than a year. For example, when the *Scandia*'s engineroom underwent extensive repairs after the 1995 fire in the boiler, the EMC could have fixed the long-outstanding problems noted on the discrepancy reports for the previous months.[28] Instead, the EMC did not fix serious[29] discrepancies, as evidenced by a subsequent discrepancy report that the turbocharger was leaking and by a leak in the exhaust system.

Significant delays in making repairs, as evidenced by the crew's repeated complaints on their monthly discrepancy reports, demonstrate that the EMC's management did not oversee the maintenance process and did not have controls to ensure that repairs were done in a timely enough manner to comply with the EMC's own procedures.

Because the EMC, by policy, did not keep maintenance or repair records, the operations department did not have a database with which to track the *Scandia*'s history of repairs and maintenance. Without such a history, maintenance managers could not monitor trends in failure rates of the *Scandia*'s equipment and could not make informed decisions about the vessel's need for preventative maintenance. The result was poor maintenance of the *Scandia* and repeated complaints from its captains. Lacking a proactive preventative maintenance approach, the EMC defaulted to making repairs only after systems broke down, hampering the vessel's operation and the EMC's commercial objectives.

Not only did the absence of a planned maintenance program result in the *Scandia* being poorly maintained, the absence probably affected the maintenance of the entire

[28] When a vessel undergoes extensive repairs and overhauls, it is generally economical, as well as convenient, to do other outstanding repairs.

[29] According to the ABS, exhaust leaks can be serious safety hazards and result in a vessel's safety classification status being withdrawn; however, ABS rules state that it is the vessel owner's responsibility to bring known deficiencies that could affect a vessel's classification status to the ABS's attention. There is no record in ABS survey documents of the turbocharger and exhaust leaks. Regulations do not require uninspected tugs to be classed with the ABS.

EMC fleet. The EMC's process for exercising vessel maintenance (the VIP) was applied to all vessels in the EMC fleet and was enforced by the same personnel at the EMC.

The EMC's practice of making repairs only after serious breakdowns had already occurred, rather than taking a preventive maintenance approach, and its poor oversight of maintenance resulted in a reduction of the *Scandia*'s safety. Some of the discrepancies, such as missing safety guards, required relatively minor effort to fix; consequently, they should have been expeditiously repaired by vessel crewmen. By allowing the vessel's fire pump to corrode to the point of developing holes the size of a quarter, by permitting fire hoses with mismatched hose threads, and by sealing off emergency escape hatches, the EMC rendered these key safety features ineffective.

Because the engineroom smoke described in the discrepancy report for June 1995 was severe enough to have been seen by passing vessels, the smoke was likely to have discouraged the *Scandia*'s crewmembers from effectively monitoring the proper functioning of engineroom equipment during their engineroom tours. In addition to being an obvious safety hazard for the *Scandia*, the severe smoke also posed a health hazard for its crew.

The Safety Board, therefore, concludes that the EMC's oversight of vessel maintenance for its fleet was inadequate and that the implementation of its VIP was ineffective. The Safety Board believes that the EMC should develop and implement an effective management oversight program that provides maintenance managers with enough information to track maintenance trends and to make informed maintenance decisions that will ensure the safety of the company's fleet and crews.

The International Maritime Organization (IMO) adopted the International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) in 1993. The ISM Code provides important guidance to shipping companies for exercising oversight of the operation and maintenance of oil tankers in international trade. However, no comparable guidance applies to tug-barges involved in domestic oil transportation. Therefore, the Safety Board believes that the Coast Guard and the AWO should cooperate to develop and implement an effective safety management code to ensure adequate management oversight of the maintenance and operation of vessels involved in oil transportation by barges.

The Safety Board notes that although the EMC is establishing a personal computer-based maintenance and repair database for its fleet, enough information is not yet available to judge its quality.

Risk Assessment

The assessment and management of risk are the foundations of the Coast Guard's marine-safety and environmental-protection regulations, which are designed to prevent marine accidents and their effects on the public and environment.

The RRAT's risk assessment, performed after the *Scandia* accident, was intended to assist the Coast Guard in developing effective towing vessel safety regulations. However, after analyzing the regulations proposed by the NPRM in light of this accident investigation, the Safety Board finds that a number of significant risks are not adequately addressed by the risk management strategies proposed in the NPRM. Some of the proposed risk management strategies include:

- Weather and voyage planning.
- Barge retrieval systems.
- Anchors on unmanned barges.
- Fire safety of towing vessels.

Each of these risk management strategies is discussed below in light of the risks exposed in this investigation.

Weather and Voyage Planning. The Safety Board analyzed the captain's vessel operations in light of the predicted weather and the actual on-scene weather and found that although a winter storm was rapidly approaching, the captain continued to proceed into the open seas of the Race, thus reducing his margin of safety for avoiding the storm. Further, the captain did not take into account updated weather information to reassess his decision to continue his voyage beyond the sheltered waters of Long Island Sound to the Race, and neither he nor the EMC had any plan to consider alternatives in case the vessel was endangered by the storm.

The SMIBs, the NWS weather forecasts, and the Coast Guard's news release all predicted that the seas and winds would worsen rapidly later that afternoon. A comparison of the forecasts with accounts of actual on-scene weather, obtained from several SITREPs and from the MLB crewmen, shows that the forecasts were accurate in predicting that the storm would intensify in the late afternoon. Weather information from the MLB crewmembers is reliable because they were on scene both before and after the storm had reached its height. That the rapid change in on-scene weather was consistent with the forecast of a "fast moving storm" during the late afternoon is evidenced by the timeline below:

1:57 p.m.: winds S-SE/ 25 knots, seas 6 to 8 feet

about 3 p.m.: winds 26 to 36 knots, seas 10 to 12 feet

4:30 p.m.: seas 25 to 30 feet

5 p.m.: winds S-SE /40 to 50 knots, seas 20 to 30 feet

In the 1 1/2 hours after the fire started, the weather deteriorated significantly enough for the *Scandia* to be in danger of being swamped by 20- to 30-foot waves.

Because the *Scandia* was just over an hour away[30] from the shelter of Narragansett Bay (which lay en route to Providence) when the fire started, the captain might have reached the bay during the 1 1/2 hours if the fire had not broken out. However, the captain did not have detailed weather updates or information with which to plan or "time" his voyage; he simply proceeded toward the bay because it was the shelter closest to him and was en route to his destination. The captain's margin of safety was so narrow that he might have failed to reach the shelter of the bay even had there been no fire, because the timing of fast-moving storms usually cannot be predicted precisely.

The weather also played a key role in the grounding of and pollution from the *North Cape*. After the *Scandia*'s crew was rescued by the Coast Guard, the waves rapidly increased between 3 p.m. and 4:30 p.m. The crewmen who later boarded the barge to release its anchor discovered that the waves had increased to between 20 and 30 feet and were washing over the barge, making it impossible to release the "jury-rigged" anchor without risking severe injury. Had the weather not turned so severe, they may have been able to release the anchor, even though it would have taken longer than if the windlass had been in place. (The effect of releasing the anchor is discussed later under "Anchors on Barges.")

The severity of the weather also prevented other assist vessels, such as the tug *Morton Bouchard*, from reaching the scene in time to prevent the *North Cape* from drifting aground. The tug *Catherine* departed about 3:50 p.m. from New London, Connecticut, but was considerably slowed because the storm was reaching its peak about that time. Both tugs arrived after the *North Cape* had already run aground. After the storm gained intensity, 30-foot waves and 50-knot winds forced the Coast Guard cutter *Point Turner* to abort its attempt while en route to the *North Cape*. A small harbor tug at the station's harbor, the *Capt Tom*, overheard the *Scandia*'s MAYDAY but was unable to assist because it was incapable of operating in such severe weather without endangering itself.

Despite the prediction of a sharp deterioration in the weather, the captain of the *Scandia* allowed himself only a narrow margin in which to avoid facing such weather in open seas; consequently, the Safety Board analyzed the EMC's operations to determine whether establishing voyage planning procedures could increase the safety of the operations of the EMC's vessels.

This investigation shows that the EMC had no procedures that would enable the crew to assess weather-related voyage risks or require the captain to obtain updated weather information or require the captain to consult the EMC's shoreside management about the risk of continuing the voyage under the prevailing weather conditions. The lack of participation by the EMC's shoreside management in evaluating and responding to the risks posed by the predicted storm reduced the operational safety of the tug and barge.

[30] Based on a reduced speed of 5 knots due to the weather and a distance of 6.5 miles to the entrance of Naragansett Bay from the *Scandia*'s location when the fire was reported.

Because the captain did not obtain updated weather information, he did not have the information necessary to assess the risk involved in continuing his voyage into the Race. He may have underestimated how close he actually was to the storm front. Updated and long-term (48 to 72 hours) weather information would have helped him plan his voyage more prudently, significantly increasing the safety margin of his operations.

The captain and the EMC's shoreside management did not consult about continuing the voyage from Long Island Sound into the Race. Had the EMC's management helped the captain to identify the risks, alternative courses of action could have resulted. An example of an alternative would have been the captain seeking safe harbor while the *Scandia* was sailing in the sheltered lee of Long Island Sound before proceeding into the exposed waters of the Race, where the vessel encountered rapidly worsening weather. The lack of an operable windlass may have deterred the captain from seeking shelter in the sound because once an anchor is dropped, it cannot be retrieved without a windlass. However, the need for an anchor in case the weather rapidly worsened should have been considered by the EMC through use of an equipment checklist as a part of voyage planning procedures.

Although the EMC left all weather-related decisions entirely to the captain, the Safety Board points out that current maritime safety management practices, such as those embodied in the ISM Code, emphasize that responsibility for vessel safety cannot be limited to ship captains but must be shared by the upper levels of the company's shoreside management.[31] Therefore, the Safety Board believes that the EMC should develop and implement procedures whereby designated management officials communicate with ship captains at sea in times of potential or actual emergencies and during safety-critical periods of a voyage. The procedures should be directed toward facilitating the making of timely decisions that affect the safety of company vessels and crews. The Safety Board also believes that the Coast Guard should require towing vessel companies to develop and implement procedures whereby management officials communicate with ship captains at sea in times of potential or actual emergencies and during safety-critical periods of a voyage.

Voyage planning does more than improve the communications between a captain and his company's shoreside management; voyage planning can significantly improve a company's oversight of operations and its evaluation of weather-related risks, thereby reducing, at the planning stages of a voyage, the risk of an accident. The *Scandia* accident shows that EMC's inadequate oversight of vessel operations resulted in the *Scandia*'s lack of preparedness to encounter the predicted bad weather and contributed to the accident. For example, if the EMC had had a checklist to ensure that the loose equipment and material aboard the *Scandia* were secured in heavy weather, to ensure that flammable materials were not stored in the engineroom, and to ensure that the *North Cape* was adequately equipped for the anticipated weather, the crew might have thought through the

[31]For more information, see Marine Accident Report--*Near Grounding of the Liberian Tank Ship* Patriot, *Bay of Campeche, Mexico, October 15, 1995* (NTSB/MAR-97/01/SUM).

process of preparing for heavy weather and taking the necessary precautions, thus significantly improving the safety of operations.

The Safety Board, therefore, concludes that because the EMC did not have adequate voyage planning procedures to ensure that adequate weather information and operational precautions were considered in its decisionmaking, the risk reduction measures that could have been taken before the voyage began were not taken. Consequently, the Safety Board believes that the EMC should develop and implement voyage planning procedures and checklists for its towing vessels to ensure that adequate risk reduction measures are taken before starting a voyage, including an assessment of weather risks, of the adequacy of the vessel's equipment, and of operational precautions. Further, the Safety Board believes that the Coast Guard, in conjunction with the towing vessel industry, should develop and implement requirements for voyage planning standards and checklists for towing vessel companies to ensure that adequate risk reduction measures are taken before starting a voyage, including an assessment of weather risks, of the adequacy of the vessel's equipment, and of operational precautions. Moreover, the AWO should encourage its member towing vessel companies to develop and implement such standards and checklists. The Coast Guard's NPRM solicited public comments on voyage planning, and the Safety Board's recommendations, based on the findings of this accident investigation, are particularly relevant to the Coast Guard's request. They highlight the importance of voyage planning to the safety of tug-barge operations.

Barge Retrieval Systems. In its NPRM, the Coast Guard proposed the use of an emergency barge retrieval system as an acceptable method by which a tug can recover its barge if the towline breaks.

If the towline between a tug and its barge breaks, the tug can use an emergency barge retrieval system to retrieve its barge, but only if the tug, itself, is operational. In this accident, however, even if the *Scandia* had had a retrieval system, the vessel could not have used the system because the vessel was completely disabled by the fire. The same consequence would also result if a tug were to suffer other casualties, such as flooding, sinking, capsizing in heavy seas, or grounding. In such situations, a tug that has a retrieval system and is dispatched from another location is needed to retrieve the drifting barge.

While a number of tugs set out to assist the *North Cape* and were prevented by the weather from arriving on scene in time, the tugs were not strategically located when they started their journey to assist and were selected by chance. No organized system ensured that the tugs were strategically located so they could reach the accident scene in time or that the tugs were powerful enough or possessed the proper equipment to provide the assistance necessary. There was also no assurance that their crewmembers were trained to handle emergency retrieval operations without seriously endangering themselves and their tugs. A TOS or an alternative system, therefore, may be necessary to complement the proposed retrieval system:

In this accident there was a 4 ½-hour period, from the start of the fire to the grounding of the barge, within which the barge could have been retrieved. The Safety Board concludes that the use of a tug assistance system in conjunction with a barge retrieval system would have significantly improved the chance of arresting the drift of the *North Cape* and preventing its grounding. Therefore, the Safety Board believes that the Coast Guard and the towing industry should institute a pilot project in the northeastern United States to evaluate the benefits of using an organized tug-assistance system to complement the proposed barge retrieval system or, if appropriate, develop and implement an alternative system to ensure barge retrieval if a tug becomes incapable of performing that function.

Anchors on Unmanned Barges. An appropriately designed and installed anchoring system may have reduced the possibility of grounding and pollution.

The captain had probably long been aware of the oncoming storm and could have chosen to wait out the storm by dropping anchor in a harbor of safe refuge in Long Island Sound. However, the lack of a windlass would have deterred him because there is no easy way to retrieve an anchor without a windlass, and he would have lost the anchor--a valuable piece of equipment. This fact may explain why the captain never considered this option.

It is difficult to say with certainty whether the drifting *North Cape* could have been completely stopped before running aground even if the anchor and windlass had been properly installed and operable. The ability of an anchor to stop a vessel depends on various unknown factors, such as the holding power of the sea bottom compared to the magnitude of the drag forces exerted on the barge by the seas and wind. While an anchor is often ineffective in stopping a self-propelled vessel within a limited distance when the vessel is traveling at speed, the *North Cape* was drifting slowly, and there was a considerable distance for the anchor to take hold on the bottom before the barge grounded. Having an anchor drag along the bottom would have slowed the barge down and may have stopped it before it reached shore, thus giving the assist tugs much more time to reach it. The Safety Board therefore concludes that an operable anchor may have reduced the chance of the barge grounding.

Anchors are routinely used to hold (to “anchor”) a vessel in a waterway and are safety devices. (Although anchors are also used in emergencies as a braking device to stop the motion of a vessel that is underway at speed, anchors are not designed for this purpose and are likely to fail.) Just as Coast Guard regulations require anchors on manned barges to enhance their safety, so would anchors increase the safety of unmanned barges. The Coast Guard, however, does not require an unmanned barge to have an anchor because the Coast Guard recognizes that normally there is no one on an unmanned barge to release the anchor.

Nevertheless, the *North Cape* was not unique in having an anchor and windlass because many owners equip their unmanned barges with an anchor and windlass for operational convenience. On such a barge, a crewman jumps from the tug to the barge.

While the jump is usually safe under routine conditions, in rough seas or unfavorable conditions, the probability of injuries and deaths can be unacceptably high. In this accident, the lives of two tug crewmen were seriously endangered by the turbulent seas when they jumped aboard the *North Cape* to release the anchor. Even if the anchor and windlass had been properly installed, the Safety Board would have considered the risk to the crewmen's lives to be just as excessive. The Board's determination is supported by Coast Guard accident statistics, which show that slips and falls overboard are the largest cause of deaths and injuries in the towing industry.

The Safety Board thinks that such risk reduction strategies as remotely operated quick releases for barge anchors should be considered as a way of avoiding the risks associated with transferring people to an unmanned barge. An example of using conventional technology for a remote anchor release is the trailing trip wire system that was used on the *Weeks*. The Safety Board notes that a trailing trip wire is not effective unless the tug is functional enough to be able to approach the trip wire to trip it. The Safety Board concludes that when a tug is disabled, modern devices, such as radio-frequency transmitters, that are suitably located on the tug may be effective in releasing the barge's anchor by remote control and that the use of such transmitters does not involve imposing risks on the crew. A remotely operated mechanism can be designed to operate independently of the tug's primary power systems so that the device is not dependent on the tug's ability to propel or steer itself. A remote device can be activated quickly even if a tug has lost propulsion or steering, is involved in a fire, or is sinking.

In its NPRM, the Coast Guard invited readers to propose technological solutions to the problem of arresting drifting barges that are better than the existing techniques, which are often hazardous to the crews. The Safety Board, therefore, believes that the Coast Guard, in conjunction with the towing vessel industry, should develop modern remote anchor release devices for barges in emergencies that do not expose crewmen to unnecessary risk. Further, the Safety Board believes that the AWO should encourage its members to work with the Coast Guard to develop a means of releasing anchors on unmanned towed barges by remote control from the towing vessel.

Fire Safety of Towing Vessels. The safety of the Nation's fleet, about 30,000 barges, and its personnel and cargo, as well as the safety of the marine environment, depends to a large extent on the fire safety of the vessels that tow the barges. The fact has been consistently demonstrated by accident statistics for towing vessels, which show that fires are the second largest cause of towing vessel accidents. The statistics also show that almost all fires occur in the engineroom, where ignition sources, such as hot operating machinery and electrical equipment, are close to flammable fuels and oils and to the combustible materials used in the vessel's construction. The *Scandia* fire demonstrates how rapidly a fire on a tug can get out of control and cause a second accident involving a barge in its tow. The second accident caused large-scale pollution that significantly damaged the environment and drew public attention to this accident. The Safety Board determines that the chances of preventing pollution from towed oil barges would be greatly enhanced if Coast Guard regulations adequately addressed the fire safety of towing vessels.

Despite the fact that the *Scandia* had firefighting equipment, such as the semi-portable fire extinguishing system and the fire pump, that exceeded the Coast Guard requirements, the crew could not reach the equipment during the emergency. The intensity of the smoke and heat prevented the crewmembers from entering the fidley, and they could not reach the controls for the semi-portable extinguisher, which were only a few feet inside the fidley door. Consequently, the equipment was ineffective in fighting the fire.

To use the semi-portable system, crewmembers would have had to enter the fidley and move close to the fire so that they could manually unreel the hose and direct its nozzle toward the base of the fire. To enter the fidley, however, the crew would have had to wear firemen's outfits and SCBAs. (A fireman's outfit provides protection from the heat, and an SCBA provides smoke-free, breathable air.) Firemen's outfits and SCBAs would also have significantly increased the effectiveness of the portable extinguishers, as the crewmen would have been able to get the extinguishers closer to the fire. The Safety Board notes that after the earlier fire on the *Scandia* (in 1995), the captain recommended that the EMC equip the vessel with two sets of firesuits and SCBAs and that the EMC did not comply. (The Safety Board also notes that the EMC has now provided its fleet with the equipment, but only after being directed to do so by a court.)

The Safety Board concludes that the *Scandia* accident demonstrates the need for SCBAs and firesuits on towing vessels. Therefore, the Safety Board believes that the Coast Guard should require SCBAs and firesuits aboard all towing vessels, as well as training in their use.

The crew would have been safer if the *Scandia* had had a fixed firefighting system in the engineroom that could be remotely operated from outside the engineroom. Crewmembers would not have been subject to the physical risks involved in entering a fire- and smoke-filled fidley, and the firefighting would have been more effective.

The Safety Board supports the NPRM in proposing the requiring of fixed fire extinguishing systems in the enginerooms of new tugs but notes that the NPRM does not require fixed fire extinguishing systems aboard existing tugs. Also, the NPRM would not require tugs such as the *Scandia* to have firefighting equipment beyond what is already aboard the vessel, which the crew could not operate in this accident because the equipment controls were located in areas made inaccessible by the fire. The Safety Board concludes that the NPRM proposes a lower level of safety for existing tugs than for new tugs and would not make existing tugs any safer from the kind of fire that the *Scandia* experienced in this accident. The Safety Board, therefore, believes that the Coast Guard should require approved fixed firefighting systems in the enginerooms of existing towing vessels. (The EMC, under court order, has equipped its existing vessels with fixed fire extinguishing systems.)

Although the *Scandia* had a fire pump, it could only be operated from the pump in the lower engineroom. The crewmembers could not reach the lower engineroom because they could not even enter the smoke-filled fidley. (They needed to go down the stairway

in the fidley to the lower engineroom, engage the clutch, and start the pump.) The Safety Board concludes that because the *Scandia*'s fire pump could not be started from outside the engineroom, it could not be used for fighting this fire. Therefore, the Safety Board believes that the Coast Guard should implement the requirement in its NPRM that fire pumps on towing vessels also be operable from outside the engineroom.

Neither the chief engineer, who led the firefighting, nor any other crewman was aware that the emergency remote shut-offs for the engineroom ventilation fans were just outside the fidley's aft door. The fans continued to supply the fire with fresh air, causing the fire to grow and spread rapidly.

None of the crewmen activated the remote fuel pump or fuel valve shut-offs to the engineroom, which were also outside the aft door of the fidley.

Basic marine firefighting requires that all ventilation and fuel supply to the engineroom be shut off in the event of an engineroom fire. Although the chief engineer had completed a Coast-Guard-approved basic firefighting course, his statements to Safety Board investigators and his actions during the emergency show that he was not familiar with the location of the *Scandia*'s emergency shut-offs.

Although the crewmembers told Safety Board investigators that they had participated in emergency drills, they showed a lack of familiarity with the *Scandia*'s emergency firefighting systems. None of the crew had participated in engineroom firefighting drills on the *Scandia*, and none had been assigned specific duties in the event of a fire emergency. The chief engineer was the only crewman who said he knew how to operate the *Scandia*'s fire pump.

The Safety Board supports the proposals in the NPRM about requiring muster lists, drills on using SCBAs and fireman's outfits, and safety orientations that will familiarize crewmembers with their vessel before they sail. The Safety Board believes that the Coast Guard should incorporate these proposals in its regulations.

The Safety Board notes that it will be up to the vessel owners to comply with the regulations and that, for uninspected vessels, the Coast Guard intends to rely on spot checks rather than on an inspection program. Therefore, the Safety Board believes that the Coast Guard should require vessel owners to keep detailed, signed logs of all on-board drills to assist the Coast Guard in its spot checks.

Risk Assessment--Summation.

Because oil spill statistics from 1992 to 1996 show that oil barges spilled eight times more oil than tank ships, the Safety Board questions whether the Coast Guard's safety regulations for tug-barge systems are adequate when compared to those for tank vessels. A comparison of some of the fire safety regulations that are relevant to the *Scandia* accident shows that tank ships are subject to significantly higher safety regulations than tug-barge systems, although both carry similar cargoes. Regulatory

differences in fire safety, as well as in other areas, such as vessel inspection and equipment redundancies, may explain why the pollution from tug-barges is so much greater than that from tank ships.

If risks for tug-barge systems and tankers had been assessed with equal rigor, then the resulting regulations would probably have been comparable and would have provided an equivalent level of safety against pollution. Even though the RRAT conducted a risk assessment, based on which the Coast Guard issued the NPRM for improving tug-barge safety, the Board's investigation of this accident uncovered significant issues that were not addressed by the NPRM; thus, the proposed regulations may not be effective in reducing pollution. Even if the NPRM were adopted, it would not significantly reduce the overall regulatory discrepancy between tank vessels and tug-barges in many areas of safety, because the NPRM focuses only on safety issues relating to the *Scandia* accident. The Safety Board concludes that the large difference in the oil pollution data for the two vessel types quite likely results from the discrepancy in risk mitigation regulations that apply to them.

The Coast Guard has both the authority and the responsibility to direct a comprehensive risk assessment to mitigate the effects of marine accidents on the public and the environment. The Safety Board therefore believes that the Coast Guard should conduct a comprehensive risk assessment to develop risk mitigation regulations for tug-barge systems that provide a level of safety against marine pollution equivalent to that provided by regulations for tankers.

Deployment of Coast Guard Rescue Boat

The Coast Guard rescue boat crew lost 20 minutes in reaching the accident scene because the sea was unsafe for the 41-foot UTB, forcing the SAR crew to return for a 44-foot MLB.

The delay did not prevent the Coast Guard from rescuing the *Scandia*'s crew. However, the delay allowed the fire to progress and caused a more dangerous situation to develop for the crewmembers while they waited for the Coast Guard to arrive. The delay also forced the SAR crew to conduct a more difficult in-the-water rescue because the wheelhouse windows on the tug had "exploded" by then, forcing the tug crew to enter the water. If the SAR crew had initially deployed in the MLB, the crew would have arrived 20 minutes sooner than it did, and the coxswain would been able to conduct a direct vessel-to-vessel transfer of the tug crew as he had earlier envisioned. With an out-of-the-water transfer, the swimmer would not have suffered from hypothermia, and the crew of the *Scandia* would have been exposed to less risk.

The coxswain explained that he initially selected the UTB instead of the MLB because the UTB was significantly faster and more maneuverable and offered greater protection from the weather. The coxswain's points are valid, but he did not recognize that the wind and sea were too severe for a UTB until he was some distance out to sea.

The coxswain made the decision to use a UTB instead of an MLB. According to the Coast Guard's SAR plan, the selection of the boat is the responsibility of the officer-in-charge (OIC) at the boat station. Because the OIC was not present at the time of the accident, it became the officer-on-duty's (OD's) responsibility. However, the OD did not give the coxswain any guidance about the type of boat to use.

Although the coxswain had seen a weather report posted at the station earlier that morning, he did not check a more recent weather report at the station. Instead, he based his knowledge of the weather on what he could readily see from the station windows. When the coxswain launched, the duty watchstander did not supply the latest weather update.

In the Safety Board's opinion, the Coast Guard's procedures for deploying the proper boat were adequate. However, the Coast Guard station personnel did not adequately follow the procedures. For instance, the OD did not give the coxswain the necessary guidance for selecting the boat, and the coxswain failed to check the latest weather information.

The Safety Board concludes that the OD and the coxswain did not consider the weather and sea conditions sufficiently in selecting the rescue boat, and the result was a 20-minute delay in arriving on scene. The Safety Board believes that Coast Guard stations should conduct a mandatory pre-deployment briefing for all SAR missions to ensure that the on-scene weather and sea conditions are assessed accurately so that the proper rescue boat is selected.

Hypothermia Protective Clothing

The coxswain decided it was necessary to return to the station immediately so that the swimmer could be treated for hypothermia. The coxswain stated that had the swimmer not become hypothermic, the coxswain would have proceeded directly to the barge and attempted to drop its anchor before the weather worsened.

Coast Guard procedures[32] prescribing the use of hypothermia protective clothing specify that in cold-water areas, a surface swimmer should don either a wet suit or a dry suit and a safety harness en route to the scene of the accident if the coxswain or boat crew has prior knowledge that someone must be rescued from the water. The coxswain is responsible for selecting the swimmer from the boat crew. During the initial response to the *Scandia*, the coxswain did not tell the swimmer to outfit himself because the coxswain did not anticipate that a rescue from the water would be necessary. As a result, when the swimmer entered the water, he was wearing only anti-exposure coveralls, which were inadequate to protect him from hypothermia.

In the Safety Board's opinion, it is likely that someone, either a Coast Guardsman or a civilian, will fall into the water during any small-boat rescue operation in rough seas.

[32]U.S. Coast Guard Commandant Instruction M10470.10C "Hypothermia Protective Clothing."

Therefore, the need for a swimmer to enter the water should always be anticipated under such conditions. Since it is extremely difficult to remove anti-exposure coveralls and don a dry or wet suit on a rolling and pitching small boat in rough seas, a pre-designated swimmer should don appropriate thermal protective garments before the boat leaves the station in cold-water areas. The Safety Board concludes that had the swimmer been properly attired, he probably would not have become hypothermic. The Safety Board, therefore, believes that the Coast Guard should establish and implement procedures to require a pre-designated swimmer to don suitable thermal protective clothing before launching a small boat on a SAR mission in cold water.

Decision to Return to Barge

The Safety Board analyzed the group commander's decision to send a Coast Guard crew, along with two *Scandia* crewmen, to the *North Cape* to drop its anchor. This decision required an analysis of the potential risks of injury or death to the Coast Guard and civilian personnel, an assessment of the risk of loss of or damage to Coast Guard resources, and a judgment about the probability of success.

The group commander learned that assistance from commercial tugs would not be available in time; consequently, he knew that using a tug to re-establish control over the drifting barge was no longer an option. Then, after the air station declined to provide a helicopter to deliver the two tug crewmen to the barge, the group commander decided to send the MLB to the barge.

He said that he believed because of several factors that the mission was likely to succeed: the EMC had assured him that the crew was capable of dropping the anchor, the coxswain had agreed to deliver the crewmen to the barge, and the tug crewmen themselves were confident they could drop the anchor within 5 minutes of boarding the barge. Although the group commander believed he had made a reasonable decision, in the Safety Board's view, the decision was based on incomplete facts and was not fully justified.

Even though the EMC told the group commander that the tug crew could drop the anchor, the EMC did not fully understand either the condition of the surf in which the attempt would be made or the condition of the anchoring gear on the barge. The EMC had no knowledge of the limitations of the Coast Guard vessel or of the stress on the crew. While the EMC's advice may have been well intended, it was based upon incomplete knowledge of the conditions and should not have been a basis upon which the group commander made his decision.

Although the coxswain agreed to the group commander's decision, the coxswain had no way of knowing that the sea and weather had become much more dangerous or that the barge would be in the surf when he arrived on scene. According to the group commander, the return trip to the barge would not have been attempted without the coxswain's consent. However, it is possible that the coxswain was so tired from having

just completed a strenuous rescue operation in rough seas that he may have been incapable of accurately judging his own fitness for continued duty.

The chief engineer and mate of the *Scandia* both volunteered to return to the barge and believed that they could be successfully drop the anchor within 5 minutes of boarding the barge. However, neither man knew what condition the anchoring equipment would be in when they boarded the barge or had any information about how treacherous the on-scene conditions had become. Their belief that they could accomplish the task quickly was more a matter of wishful thinking than a matter of fact.

Thus, the three criteria on which the group commander based his decision were little more than opinions with no basis in fact. Of particular concern to the Board was his decision to place civilian lives at risk to conduct this dangerous mission. The Safety Board, therefore, concludes that although the coxswain, the Coast Guard boat crew, and the tug crew volunteers made a heroic attempt to prevent an oil spill, the decision to allow them to do so was ill-conceived and not justified.

The Coast Guard Air Station Cape Cod had informed the group commander that the air station would not provide a helicopter to deliver anyone to the barge because aviation risk assessment criteria specify that SAR personnel should only be placed at risk if human lives are in danger. When the group commander proceeded with the salvage mission, he did not tell the air station. Had he told the air station, its personnel may have reviewed the criteria for launching and may have made a decision not to place civilian and Coast Guard personnel at unnecessary risk.

While the group commander thought he had assessed the risks fully before he ordered the attempt to drop the barge anchor, in the Safety Board's view he had not. He did not fully recognize the severity of the sea and weather conditions or anticipate that another life-threatening rescue would be necessitated as a result of the dangers encountered by the salvage crew. Such an assessment has been identified in previous Safety Board investigations.

As a result of its investigation of the 1991 capsizing and sinking of the U.S. commercial fishing vessel *Sea King*,[33] the Safety Board issued Safety Recommendation M-92-54 to the Coast Guard:

> Incorporate into the training of SAR personnel procedures to ensure the gathering and dissemination of pertinent information by all appropriate SAR personnel to facilitate a thorough assessment of the potential risks to persons involved in a SAR mission.

As the result of the investigation of three 1993 accidents[34] involving Coast Guard SAR responses that proved unsuccessful because of the inadequacy of the risk

[33]For more information, read Marine Accident Report--*Capsizing and Sinking of the U.S. Fishing Vessel* Sea King *Near Astoria, Oregon, January 11, 1991* (NTSB/MAR-92/05).

[34]For more information, read Marine Accident Brief Reports--*Grounding of the U.S. Sailing Pleasure*

assessments, the Safety Board issued Safety Recommendation M-94-7 to the Coast Guard:

> Provide risk assessment training to all Coast Guard personnel directly involved in SAR missions.

On November 21, 1994, the Coast Guard Commandant stated:

> I concur with these recommendations. The Coast Guard has taken action to add risk assessment training for SAR personnel at appropriate levels in the operational chain of command, and full implementation is expected by May of 1995.

The Commandant's response further indicated that, as a result of the Board's recommendations, risk assessment training had been included in training courses for small-boat coxswains, for pilots and aircrews, for small-boat station commanders, for cutter commanders and executive officers, for operations-center watchstanders, and for group and station commanding officers and executive officers. As a result of the Commandant's response, Safety Recommendations M-92-54 and M-94-7 were classified "Closed--Acceptable Action."

While the Safety Board is gratified that the Coast Guard has incorporated risk assessment training in the training for all levels of SAR activity, from small-boat coxswain to group commander, training in and of itself does not ensure that proper risk assessments will be made in all cases. To be truly effective, training must be reinforced by pertinent operational guidelines. According to the pilot of the second rescue helicopter, the operations officer at the air station declined to provide helicopter assistance for the salvage mission after consulting personnel from the Group. The request was denied because the formal risk assessment guidelines, which are in the Coast Guard Commandant's Instruction 3710, *Air Operations Manual*, prohibit the placing of a Coast Guard helicopter and air crew at grave risk for any operation, such as a salvage mission, that is not a life-threatening emergency. (The risk of losing the aircraft or the air crew is considered a grave risk.)

The group commander did not have any comparable published formal risk assessment guidelines to follow in making his assessment of the risks presented by the salvage operation. In the Board's opinion, it is just as necessary to provide guidelines for placing Coast Guard surface craft and surface personnel at "grave risk" as it is to provide such guidelines for aircraft and aviation personnel. The guidelines should clearly explain the procedures for conducting risk assessments and analyses that are necessary before conducting SAR and salvage missions, for identifying grave risk to surface craft and personnel, and for obtaining concurrence and approval from the respective district commands. In particular, the guidelines should emphasize the need to protect civilian

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Craft Rite of Passage*, Isle of Palms, South Carolina, August 4, 1993* (DCA-93-MM-023); *Sinking of the U.S. Pleasure Craft* Big Abalone*, Coos Bay, Oregon, August 20, 1993* (DCA-93-MM-029); and *Sinking of the U.S. Tug* Duke Luedtke*, in Lake Erie, Near Cleveland, Ohio, September 21, 1993* (DCA-93-MM-030).

lives from unnecessary "grave risk." The Safety Board concludes that developing and implementing risk assessment guidelines for the deployment of surface SAR units that are similar to those for the deployment of aircraft would enhance the quality of risk assessments by Coast Guard operational commanders. The Safety Board, therefore, believes that the Coast Guard should develop and implement risk assessment guidelines for the deployment of surface SAR units that are similar to those published in Coast Guard Commandant's Instruction 3710.

Coxswain's Decision to Leave Mate on Barge

After returning to the scene, the chief engineer and the mate successfully boarded the barge. After their attempt to drop the anchor had failed, the coxswain was able to retrieve only the chief engineer. The coxswain spent about half an hour attempting to maneuver the MLB near the barge so that he could retrieve the mate, but he was unable to do so because the sea had worsened considerably. He was faced with an extremely difficult decision in weighing the dangers faced by his crew and vessel against the safety of the stranded crewman. The coxswain realized that the MLB was at risk of capsizing in the rough surf and that some of the MLB's electronic equipment was functioning erratically because of the rough seas. He asked for a Coast Guard helicopter to rescue the stranded crewman. He then left because there was nothing more that he could do other than endanger his vessel and crew. The Safety Board concludes that the coxswain's decision to leave after asking for a rescue helicopter for the stranded crewman was reasonable, considering the need to protect his own crew and vessel and his inability to retrieve the crewman.

Pollution Response

Because the weather was rough enough to move the oil deflection booms from their intended locations and to hamper cleanup activities, some oil seeped into environmentally sensitive areas, resulting in a significant short-term impact on the fishing grounds and local fisheries. Because the spilled oil was light grade, much of it weathered and evaporated into the atmosphere under the action of sunlight and the turbulent waves, as demonstrated by the tests conducted by the EPA 5 days later, which showed that the level of petroleum hydrocarbon was well below the level considered harmful to marine life. Most of the remaining oil was corralled by the floating booms and mechanically skimmed from the surface by vacuum hoses.

However, NOAA is still assessing the degree of long-term environmental damage, including the impact on fish and bird populations, which are expected to need several years to return to the numbers they had reached before the accident.

As required by the area contingency plan, the responsible governmental agencies, parties, and environmental cleanup resources were notified soon after the crew abandoned the tug that a major oil spill was anticipated. Consequently, pollution cleanup resources were being transported to the scene well before the *North Cape*'s tanks were breached.

The Safety Board concludes that the notifications and the pollution cleanup response were adequate, considering the adverse weather following the accident.

Conclusions

Findings

1. Drugs, fatigue, and crew qualifications were not causal to this accident.

2. The fire on the *Scandia* originated near the center of the fidley grating, which was above the main engine exhaust manifold.

3. Rough seas may have caused a container of flammable lubricant to fall onto the part of the engine manifold that had loose insulation, where the lubricant ignited on contact; however, the cause of the fire could not be precisely determined.

4. The Eklof Marine Corporation's oversight of vessel maintenance for its fleet was inadequate, and the implementation of its vessel inspection program was ineffective.

5. Because the Eklof Marine Corporation did not have adequate voyage planning procedures to ensure that adequate weather information and operational precautions were considered in its decisionmaking, the risk reduction measures that could have been taken before the voyage began were not taken.

6. The use of a tug assistance system in conjunction with a barge retrieval system would have significantly improved the chance of arresting the drift of the *North Cape* and preventing its grounding.

7. An operable anchor may have reduced the chance of the barge grounding.

8. When a tug is disabled, modern devices, such as radio-frequency transmitters, that are suitably located on the tug may be effective in releasing the barge's anchor by remote control, and the use of such transmitters does not involve imposing risks on the crew.

9. The *Scandia* accident demonstrates the need for self-contained breathing apparatus and firesuits on towing vessels.

10. The Coast Guard's Notice of Proposed Rulemaking proposes a lower level of safety for existing tugs than for new tugs and would not make existing tugs any safer from the kind of fire that the *Scandia* experienced in this accident.

11. Because the *Scandia*'s fire pump could not be started from outside the engineroom, it could not be used for fighting this fire.

12. The large difference in the oil pollution data for tug-barge systems and tankers quite likely resulted from the discrepancy in risk mitigation regulations that apply to them.

13. The Coast Guard officer-on-duty and the coxswain did not consider the weather and sea conditions sufficiently in selecting the rescue boat, and the result was a 20-minute delay in arriving on scene.

14. Had the surface swimmer been properly attired, he probably would not have become hypothermic.

15. Although the coxswain, the Coast Guard boat crew, and the tug crew volunteers made an heroic attempt to prevent an oil spill, the decision to allow them to do so was ill-conceived and not justified.

16. Developing and implementing risk assessment guidelines for the deployment of surface search and rescue units that are similar to the guidelines for the deployment of aircraft would enhance the quality of risk assessments by Coast Guard operational commanders.

17. The coxswain's decision to leave after asking for a rescue helicopter for the stranded crewman was reasonable, considering his need to protect his own crew and vessel and his inability to retrieve the crewman.

18. The notifications and the pollution cleanup response were adequate, considering the adverse weather following the accident.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the fire damage aboard the tug *Scandia* and the subsequent grounding of and pollution from the barge *North Cape* was the Eklof Marine Corporation's inadequate oversight of maintenance and operations aboard those vessels, which permitted a fire of unknown origin to become catastrophic and eliminated any realistic possibility of arresting the subsequent drift and grounding of the barge. Contributing to the accident was the lack of adequate Coast Guard and industry standards addressing towing vessel safety.

Recommendations

As a result of this accident, the National Transportation Safety Board makes the following safety recommendations:

to the U.S. Coast Guard:

Conduct a comprehensive risk assessment to develop risk mitigation regulations for tug-barge systems that provide a level of safety against marine pollution equivalent to that provided by regulations for tankers. (M-98-103)

In conjunction with the towing vessel industry, develop and implement an effective safety management code to ensure adequate management oversight of the maintenance and operation of vessels involved in oil transportation by barges. (M-98-104)

Require towing vessel companies to develop and implement procedures whereby management officials communicate with ship captains at sea in times of potential or actual emergencies and during safety-critical periods of a voyage. (M-98-105)

In conjunction with the towing vessel industry, develop and implement requirements for voyage planning standards and checklists for towing vessel companies to ensure that adequate risk reduction measures are taken before starting a voyage, including an assessment of weather risks, of the adequacy of the vessel's equipment, and of operational precautions. (M-98-106)

In conjunction with the towing vessel industry in the northeastern United States, institute a pilot project to evaluate the benefits of using an organized tug-assistance system to complement the proposed barge retrieval system or, if appropriate, develop and implement an alternative system to ensure barge retrieval if a tug becomes incapable of performing that function. (M-98-107)

In conjunction with the towing vessel industry, develop modern remote anchor release devices for barges in emergencies that do not expose crewmen to unnecessary risk, and require their utilization. (M-98-108)

Require self-contained breathing apparatus and firesuits aboard all towing vessels, as well as training in their use. (M-98-109)

Require approved fixed firefighting systems in the enginerooms of existing towing vessels. (M-98-110)

Require that fire pumps on towing vessels also be operable from outside the engineroom. (M-98-111)

Require that towing vessels have muster lists, drills on the use of self-contained breathing apparatus and fireman's outfits, and safety orientations to familiarize crewmembers with their vessel before sailing. (M-98-112)

Require vessel owners to keep detailed, signed logs of all on-board drills to assist the Coast Guard in its spot checks. (M-98-113)

Require Coast Guard station search and rescue personnel to conduct a mandatory pre-deployment briefing for all search and rescue missions to ensure that the on-scene weather and sea conditions are assessed accurately so that the proper rescue boat is selected. (M-98-114)

Establish and implement procedures to require a pre-designated swimmer to don suitable thermal protective clothing before launching in a small boat on a search and rescue mission in cold water. (M-98-115)

Develop and implement risk assessment guidelines for the deployment of surface search and rescue units similar to the guidelines published in Coast Guard Commandant's Instruction 3710. (M-98-116)

to Eklof Marine Corporation:

Develop and implement an effective management oversight program that provides maintenance managers with enough information to track maintenance trends and to make informed maintenance decisions that will ensure the safety of the company's fleet and crews. (M-98-117)

Develop and implement procedures whereby designated management officials communicate with ship captains at sea in times of potential or actual emergencies and during safety-critical periods of a voyage. (M-98-118)

Develop and implement voyage planning procedures and checklists for your towing vessels to ensure that adequate risk reduction measures are taken before starting a voyage, including an assessment of weather risks, of the adequacy of the vessel's equipment, and of operational precautions. (M-98-119)

to American Waterways Operators, Inc.:

Develop an effective safety management code for your member companies to implement to ensure adequate management oversight of the maintenance and operation of vessels involved in oil transportation by barges. (M-98-120)

Encourage your member towing vessel companies to develop and implement voyage planning standards and checklists to ensure that adequate risk reduction measures are taken before starting a voyage, including an assessment of weather risks, of the adequacy of the vessel's equipment, and of the operational precautions. (M-99-121)

In cooperation with the Coast Guard, develop a means of releasing anchors on unmanned towed barges by remote control from the towing vessel. (M-98-122)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

JOHN A. HAMMERSCHMIDT
Member

ROBERT T. FRANCIS II
Vice Chairman

JOHN J. GOGLIA
Member

GEORGE W. BLACK, JR.
Member

July 14, 1998

Vice Chairman Robert T. Francis submitted the following statement:

I have concurred in the probable cause of this accident because I believe it adequately addresses the chain of events that ultimately led to the fire aboard the tug *Scandia* and the subsequent grounding of the *Scandia* and the tank barge *North Cape*. However, I can not concur in our criticism of the U.S. Coast Guard coxswain of Station Point Judith for his choice of the 41-foot utility boat for the initial response for the rescue of the crewmembers of the *Scandia*.

The report acknowledges valid reasons for the coxswain's initial choice–the utility boat was significantly faster, more maneuverable, and offered greater protection from the weather for the crew and, presumably, for the six rescued passengers from the *Scandia* tug. According to our investigation, the multi-mission, 41-foot utility boat is used most often to perform most missions, although the 44-foot motor life boat is available for more difficult sea conditions. The coxswain's decision to take the faster and more agile boat to rescue civilians in serious, life-threatening and immediate danger comported not only with the experience of the coxswain and station command, but also with the Coast Guard's procedures for deploying the appropriate boat–procedures that the Safety Board finds to be "adequate."

Of necessity, our accident investigation process reviews actions taken in such incidents with 20-20 hindsight, which enables the Safety Board to make considered decisions and thoughtful recommendations. However, I can not concur in the use of this distant and cool review to criticize the coxswain's decisions made under immediate, urgent, and critical circumstances on which the lives of the crew of the *Scandia* depended. The coxswain could have been better informed about the current weather and sea conditions before he left Station Point Judith. Yet, his decisions, the assembly of the duty boat crew, and the launch for the rescue operation all occurred within approximately 5 minutes. I am reluctant to criticize that sort of timeliness where lives are at stake. And, while outcome-determinative analysis is not desirable for Safety Board investigations, this mission was successful–the crew of the *Scandia* was rescued and the crew of the Station Point Judith 44-foot motor life boat all returned to the station despite the 20-minute delay to return to the station for the 44-foot motor life boat.

The Coast Guard performs the difficult and dangerous job of search and rescue admirably. For the Coast Guard, the answer to the question of initiating a search and rescue operation on our Nation's waters is not "whether" but "when." I want to ensure that our investigation and report here do not discourage prudent, courageous action or dampen the enthusiasm and commitment of those who choose to serve in the U.S. Coast Guard.

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Appendix

The National Transportation Safety Board was notified of this accident on January 19, 1996. Four investigators from the Safety Board's Washington, D.C., headquarters were dispatched to the scene, arriving on January 20. Investigators met with representatives of the U.S. Coast Guard, with local emergency response agencies, and with the operator of the *Scandia* and arranged to board the grounded tug as soon as possible. Sworn testimony was taken from the crew of the *Scandia* and from relevant Coast Guard personnel between January 22 and January 25. The barge *North Cape* was boarded and examined after the pollution abatement activities were completed and the vessel had been towed to a safe location. The initial on-scene investigation was completed on January 26.

Eklof Marine Corporation (EMC) (operator of the *Scandia* and the *North Cape*) and the U.S. Coast Guard were parties in the investigation.

The Safety Board investigated the accident under the authority of the Independent Safety Board Act of 1997 under Safety Board rules.

In September 1997, the EMC and affiliates, the president of the EMC, and the captain of the *Scandia* pled guilty to a series of State and Federal criminal charges of having been negligent in the operation of the *Scandia* and its tow. The pleas were the culmination of a coordinated criminal investigation involving the U.S. Attorney for the District of Rhode Island and the Rhode Island Attorney General, in which the Federal Bureau of Investigation, the Environmental Protection Agency, and the Coast Guard participated. Those who pled guilty admitted that the firefighting apparatus was inadequate, that operating the tow without a serviceable anchor had jeopardized safe operation, and that the vessels had been poorly maintained and operated in weather for which they were unfit. Additionally, they admitted to giving misleading information to Safety Board investigators. The Safety Board's investigation was deferred until the defendants were sentenced in January 1998, after which additional testimony was obtained from the EMC.

The EMC agreed to pay $8.5 million in fines for spilling oil and causing substantial harm to the marine environment. In addition, the EMC agreed to undertake the following $1 million remedial safety program:

- Install Coast Guard-approved, remotely operated, fixed CO_2 fire suppression systems in the enginerooms of its tugs and tankers.

- Equip each towing vessel with two fireman's outfits and SCBAs and start a company program to train and periodically drill its vessel captains and crews in the proper use of firefighting equipment.

- Install operable anchors and windlasses on all its barges.

- Accept a court-approved consultant to oversee the implementation of these measures.

In February 1998, the EMC told Safety Board investigators that, in addition to implementing the directives ordered by the courts, the company is in the process of setting up a personal computer-based system that will keep records of vessel maintenance and repairs in the future.

In February 1998, the Safety Board resumed its investigation by re-interviewing EMC personnel about vessel maintenance. No "at risk" testimony on vessel maintenance obtained in January 1996 has been used in this report. Only those parts of eyewitness testimony from the crew that were not contradicted by information from other sources have been retained in this report. Use of eyewitness testimony was necessary for describing the sequence of accident events and for maintaining continuity in the report. The use of the eyewitness testimony did not affect the validity of the analysis in this report.

The report is based on the information developed as a result of the investigation and on additional analysis done by the Safety Board. The Safety Board has considered all facts in the investigative record that are pertinent to the Board's statutory responsibility to determine the cause or probable cause of the accident and to make recommendations.

Acronyms and Abbreviations

AB	able-bodied seaman
ABS	American Bureau of Shipping
AST	Atlantic Strike Team
AWO	American Waterways Operators
air station	Coast Guard Air Station Cape Cod
CBBT	Chesapeake Bay Bridge and Tunnel
CFR	*Code of Federal Regulations*
DEM	Rhode Island Department of Environmental Management
EMC	Eklof Marine Corporation
EPA	Environmental Protection Agency
FleetWeather	FleetWeather Ocean Services
FOSC	Federal on-scene coordinator
IMO	International Martime Organization
ISM	International Safety Management
MLB	motor life boat
MMD	merchant mariner’s document
MRO	medical review officer
NOAA	National Oceanic and Atmospheric Administration
NPRM	notice of proposed rulemaking
NWS	National Weather Service
OD	officer-on-duty
OIC	officer-in-charge
OPA 90	Oil Pollution Act of 1990
POLREPs	pollution response and notification activities
RCP	responsible carrier program
RRAT	regional risk assessment team
SAR	search and rescue
SCBA	self-contained breathing apparatus
SITREP	situation report
SMIBs	safety marine information broadcasts
station	Coast Guard Station Point Judith
TOS	tug of opportunity system

TSAC	Towing Safety Advisory Committee
UTB	utility boat
UTV	uninspected towing vessel
VIP	vessel inspection program