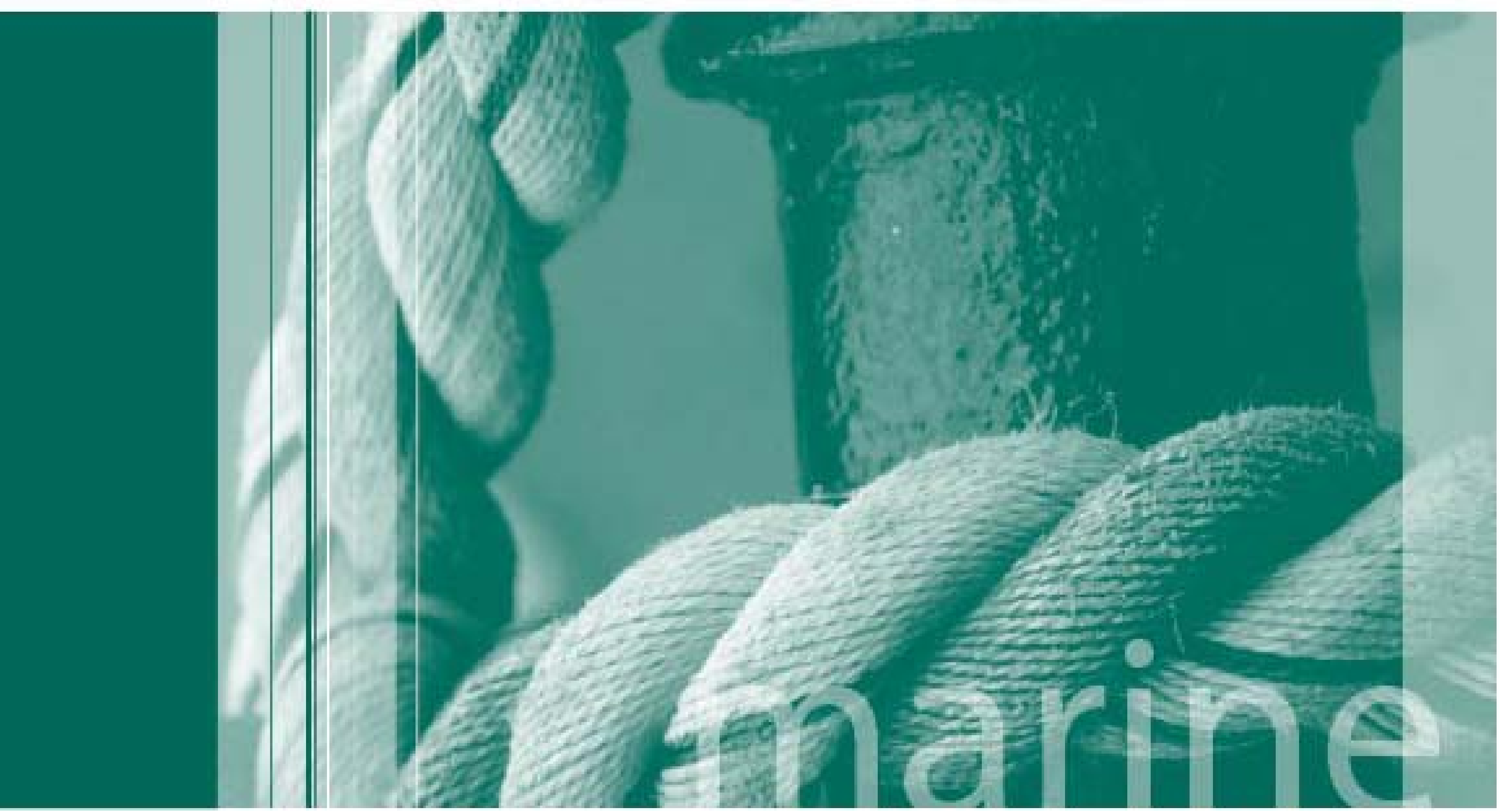
Sinking of U.S. Fish Processing Vessel *Alaska Ranger*
Bering Sea, March 23, 2008



Accident Report

NTSB/MAR-09/05
PB2009-916405

National Transportation Safety Board

NTSB/MAR-09/05
PB2009-916405
Notation 8032A
Adopted September 30, 2009

Marine Accident Report

Sinking of U.S. Fish Processing Vessel *Alaska Ranger*
Bering Sea, March 23, 2008

National
Transportation
Safety Board

490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2009. Sinking of U.S. Fish Processing Vessel *Alaska Ranger*, Bering Sea, March 23, 2008. NTSB/MAR-09/05. Washington, DC.

Abstract: This report discusses the March 23, 2008, sinking of the U.S. fish processing vessel *Alaska Ranger* in the Bering Sea, 120 nautical miles west of Dutch Harbor, Alaska. The *Alaska Ranger* had left Dutch Harbor the previous day to fish on Petrel Bank, a fishing ground 500 nautical miles to the west. About 0230 on the morning of March 23, the crew discovered flooding in the vessel's rudder room, and at 0246, the vessel broadcast a Mayday call. The U.S. Coast Guard immediately launched search and rescue operations. The crew evacuated the vessel before it sank sometime after 0430. The Coast Guard and the crew of another fishing vessel, the *Alaska Warrior*, rescued 42 of the 47 persons who had been on the *Alaska Ranger*. Five crewmembers died in the accident. The wreckage of the *Alaska Ranger* lies in 6,000 feet of water at the bottom of the Bering Sea and was not examined. The vessel's estimated replacement value was $15 million.

The NTSB participated fully in a Coast Guard Marine Board of Investigation convened immediately after the sinking. The NTSB's investigation of the accident identified the following safety issues: the vessel's movement astern, company operations, postaccident drug and alcohol testing, emergency response, implementation of the Coast Guard's Alternate Compliance and Safety Agreement, and oversight of U.S. commercial fishing industry vessels.

On the basis of its findings, the NTSB made recommendations to the Coast Guard, the National Marine Fisheries Service, the North Pacific Fishery Management Council, and Fishing Company of Alaska, 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 NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

Recent publications are available in their entirety on the Internet at <http://www.ntsb.gov>. Other information about available publications also may be obtained from the website or by contacting:

National Transportation Safety Board
Records Management Division, CIO-40
490 L'Enfant Plaza, SW
Washington, DC 20594
(800) 877-6799 or (202) 314-6551

NTSB publications may be purchased, by individual copy or by subscription, from the National Technical Information Service. To purchase this publication, order report number PB2009-916405 from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
(800) 553-6847 or (703) 605-6000

Contents

Figures

Acronyms and Abbreviations

ACSA	Alternate Compliance and Safety Agreement[1]
AWOS	Automated Weather Observing System
CFR	*Code of Federal Regulations*
COI	certificate of inspection
EEZ	exclusive economic zone
EPIRB	emergency position indicating radio beacon
H&G	head-and-gut
H.R.	House Resolution
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTSB	National Transportation Safety Board
NVIC	navigation and vessel inspection circular
OCMI	officer in charge, marine inspection
RCC	search and rescue coordination center
U.S.C.	*United States Code*

[1] Documents referring to ACSA employ the terms "Alternate" and Alternative" interchangeably when spelling out the acronym. This report has regularized the usage as "Alternate" except in citations.

Executive Summary

On March 23, 2008, the U.S. fish processing vessel *Alaska Ranger* sank in the Bering Sea 120 nautical miles west of Dutch Harbor, Alaska. The vessel was owned by Fishing Company of Alaska, Inc., headquartered in Seattle, Washington. Five of the 47 people on board died in the accident.

The National Transportation Safety Board determines that the probable cause of the sinking of the *Alaska Ranger* was uncontrolled, progressive flooding due to a lack of internal watertight integrity and to a breach of the hull's watertight envelope, likely caused by a physical rudder loss. Contributing to the loss of life was the vessel's movement astern, which likely accelerated the flooding and caused the liferafts to swing out of reach of many crewmembers.

The safety issues discussed in the report concern the vessel's movement astern, company operations, postaccident drug and alcohol testing, emergency response, implementation of the U.S. Coast Guard's Alternate Compliance and Safety Agreement program, and oversight of U.S. commercial fishing industry vessels. Safety recommendations are made to the Coast Guard, the National Marine Fisheries Service, the North Pacific Fishery Management Council, and Fishing Company of Alaska.

(This page intentionally left blank)

.

Factual Information

Background

The U.S. fish processing vessel *Alaska Ranger* (figure 1) was a 35-year-old freezer-trawler owned and operated by Fishing Company of Alaska, Inc. The vessel was part of the "head-and-gut" (H&G) fleet, based in Seattle, Washington, that operates in Alaskan waters.[1] Commercial fishing vessels such as those in the H&G fleet are exempt from U.S. Coast Guard inspection by law.[2] The vessels are, however, required to meet Coast Guard regulations regarding lifesaving and fire-protection equipment for uninspected vessels, found at 46 *Code of Federal Regulations* (CFR) Parts 24–28 (Subchapter C). The specific requirements for commercial fishing industry vessels are found at 46 CFR Part 28.

Figure 1. *Alaska Ranger* docked in Dutch Harbor, Alaska, November 2002. Vessel's wheelhouse is the white structure on the left. Another fishing vessel and an oil tank are partially visible behind the *Alaska Ranger*. (Photo courtesy U.S. Coast Guard)

[1] At the time of the accident, the H&G fleet consisted of about 23 freezer-trawlers and 41 freezer-longliners. Trawlers trap fish in a funnel-shaped net ("trawl") dragged astern. Longliners lay a long line and catch fish on baited hooks that hang from the line on leaders. Both types of vessel freeze their catch on board.

[2] Title 46 *United States Code* (U.S.C.) 3302, Public Law 98-89, August 1983. As discussed in the "U.S. Commercial Fishing Industry" section, the law mandates inspection of certain large fishing industry vessels (fish processors over 5,000 gross tons and fish tenders over 500 gross tons). The Coast Guard has identified only one fish processor as subject to inspection.

The sinking of the *Alaska Ranger* was investigated jointly by the Coast Guard and the National Transportation Safety Board (NTSB), with the Coast Guard as the lead investigative agency. In March 2008, immediately after the sinking, the Commandant of the Coast Guard convened a Marine Board of Investigation. NTSB investigators participated fully in the proceedings. Approximately 50 witnesses testified before the Marine Board, including surviving and former crewmembers, repair vendors, and industry experts.

Accident Narrative

On Friday, March 21, 2008, while fishing for groundfish (yellowfin sole) in the Bering Sea, the *Alaska Ranger* encountered southward-moving ice that pushed it out of the fishing grounds. The vessel returned to the Aleutian Island port of Dutch Harbor, where the crew changed nets and other gear to fish for mackerel. Shortly after noon on Saturday, March 22, the *Alaska Ranger* departed Dutch Harbor for Petrel Bank, a fishing ground 500 nautical miles[3] to the west and away from the ice (figure 2).

Forty-seven people were on board the *Alaska Ranger*, affiliated with three different employers (table 1). The crew included two deck officers (a master and a mate) and three engineering officers (a licensed chief engineer and two assistant engineers, one licensed and one unlicensed). Most of those on board worked in the vessel's factory space as fish processors.

Table 1. Personnel on board the *Alaska Ranger* at the time of the accident, by employer.

Fishing Company of Alaska	North Pacific Resources	National Marine Fisheries Service
Master	Fishmaster	Fishery observers (2)
Mate	Factory technicians (4)	--
Chief engineer	--	--
Assistant engineers (2)	--	--
Cooks (2)	--	--
Steward	--	--
Factory processors (32)	--	--

Five crewmembers were Japanese nationals, including the fishmaster, who had been on board the *Alaska Ranger* since 2005. The Japanese crewmembers[4] were not employees of Fishing Company of Alaska but worked for North Pacific Resources, the U.S. subsidiary of a Japanese company, Anyo Fisheries Company, Ltd.[5] North Pacific Resources had an exclusive agreement to purchase all catches from Fishing Company of Alaska vessels. According to North Pacific Resources information, Fishing Company of Alaska vessels carried fishmasters to ensure

[3] One nautical mile = 1.1508 statute miles.

[4] For purposes of this report, all those on board are referred to as crewmembers, regardless of affiliation.

[5] As explained in the "Management of Alaska Fisheries" section, foreign fleets, primarily from Japan and Russia, accounted for most commercial fishing in the Bering Sea and Gulf of Alaska until 1986.

the “harvest of adequate numbers of the desired target species.” Other Japanese nationals worked on board to ensure that fish processing was “timely” and that quality control met Japanese market standards.[6]

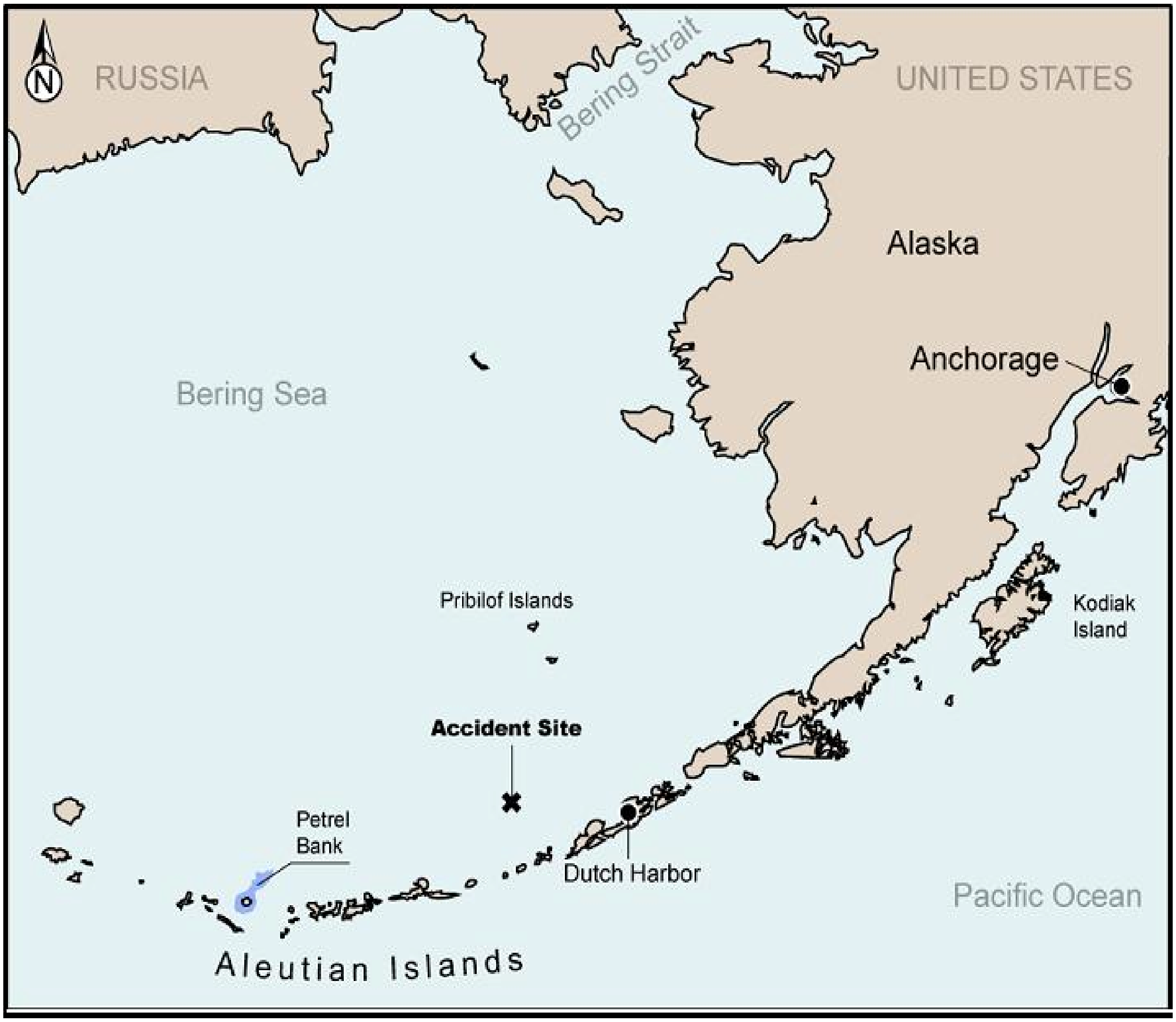


Figure 2. Area of Bering Sea where *Alaska Ranger* sank.

As required by 50 CFR 679.50, the *Alaska Ranger* also carried two observers from the National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric

[6] Citizenship and licensing requirements apply to all U.S. documented vessels. By law (46 U.S.C. 8103), only a U.S. citizen may serve as master, chief engineer, radio officer, or officer in charge of a deck or engineering watch. At least 75 percent of the unlicensed seamen on board a documented vessel must be U.S. citizens or aliens lawfully admitted to the United States for permanent residence. The remainder may be foreign nationals, but they must be lawfully allowed to be employed under the Immigration and Nationality Act of 1952. The Japanese crewmembers on the *Alaska Ranger* held E-specialty visas for fisheries workers. North Pacific Resources paid the Japanese crewmembers and billed Fishing Company of Alaska for their cost.

Administration (NOAA).[7] Observers accompany commercial fishing vessels to monitor operations and collect catch data, such as fish length and species, that are used in managing more than 40 U.S. fisheries, including those off Alaska. The Bering Sea/Aleutian Island and Gulf of Alaska fisheries are managed by a mix of Federal and state laws and agencies (see “Management of Alaska Fisheries” section).

According to the Fishing Company of Alaska operations manager, transit time to Petrel Bank was 2 to 2 1/2 days. The operations manager said that the crew ordinarily rested while the vessel traveled to the fishing grounds: “When there is no fish, they will sleep and watch a movie and things.” Survivors testified that most of those on board were asleep at the time of the accident.

At 0201[8] on Sunday, March 23, 2008, according to satellite telephone records, the mate on the *Alaska Ranger* received a call from the mate on the *Alaska Spirit*, another vessel in the Fishing Company of Alaska fleet that was about 115 nautical miles behind the *Alaska Ranger* and also on its way to Petrel Bank. The *Alaska Spirit* mate described his conversation with the other mate as “personal stuff,” with no mention of any problems on board the *Alaska Ranger*. The call ended at 0226.

About 10 minutes later, the *Alaska Ranger* mate called the *Alaska Spirit*, and, according to the *Alaska Spirit* mate, “said they were taking water in the rudder room. He didn’t sound nervous . . . He sounded fine. He just said, ‘Come this way. I don’t know what is going to go on here, but we are taking water inside the rudder room.’” The rudder room was on the vessel’s lower level, or hold (figure 3). In addition to asking the *Alaska Spirit* to run toward the *Alaska Ranger*’s position, the *Alaska Ranger* mate asked the other vessel to call the Coast Guard, the Fishing Company of Alaska office in Dutch Harbor, and other boats in the fleet. The *Alaska Spirit* mate made the requested calls.[9]

The *Alaska Ranger* assistant engineer on the night watch (1900–0700) said that he was in the engineroom and was alerted to the flooding in the rudder room by an alarm signaling high water in the bilges. (No vessel records survived the accident. Hence, the exact time the bilge alarm sounded could not be determined.) He said that he immediately went to investigate, opened the watertight door from the auxiliary machinery space to the rudder room, and saw “a wall of water” coming toward him.[10] He said that he closed the door but the seals leaked, so he secured the dogs[11] with a hammer, which stopped the leaking.

[7] As described in the “Management of Alaska Fisheries” section, NMFS operates the fishery observer program under authority of the Magnuson-Stevens Fishery Conservation and Management Act and the Marine Mammal Protection Act, which require the government to collect data on activities affecting marine resources.

[8] Times in this report are Alaska daylight time according to the 24-hour clock.

[9] According to satellite phone records, the *Alaska Spirit* began making the calls at 0238 and reached the Coast Guard at 0259.

[10] The assistant engineer on the day watch told the Marine Board that during the time he had been on the *Alaska Ranger*, the watertight door to the rudder room was always hooked open.

[11] Dogs are fasteners. Watertight and weathertight doors have dogs that clamp the door tight to its frame.

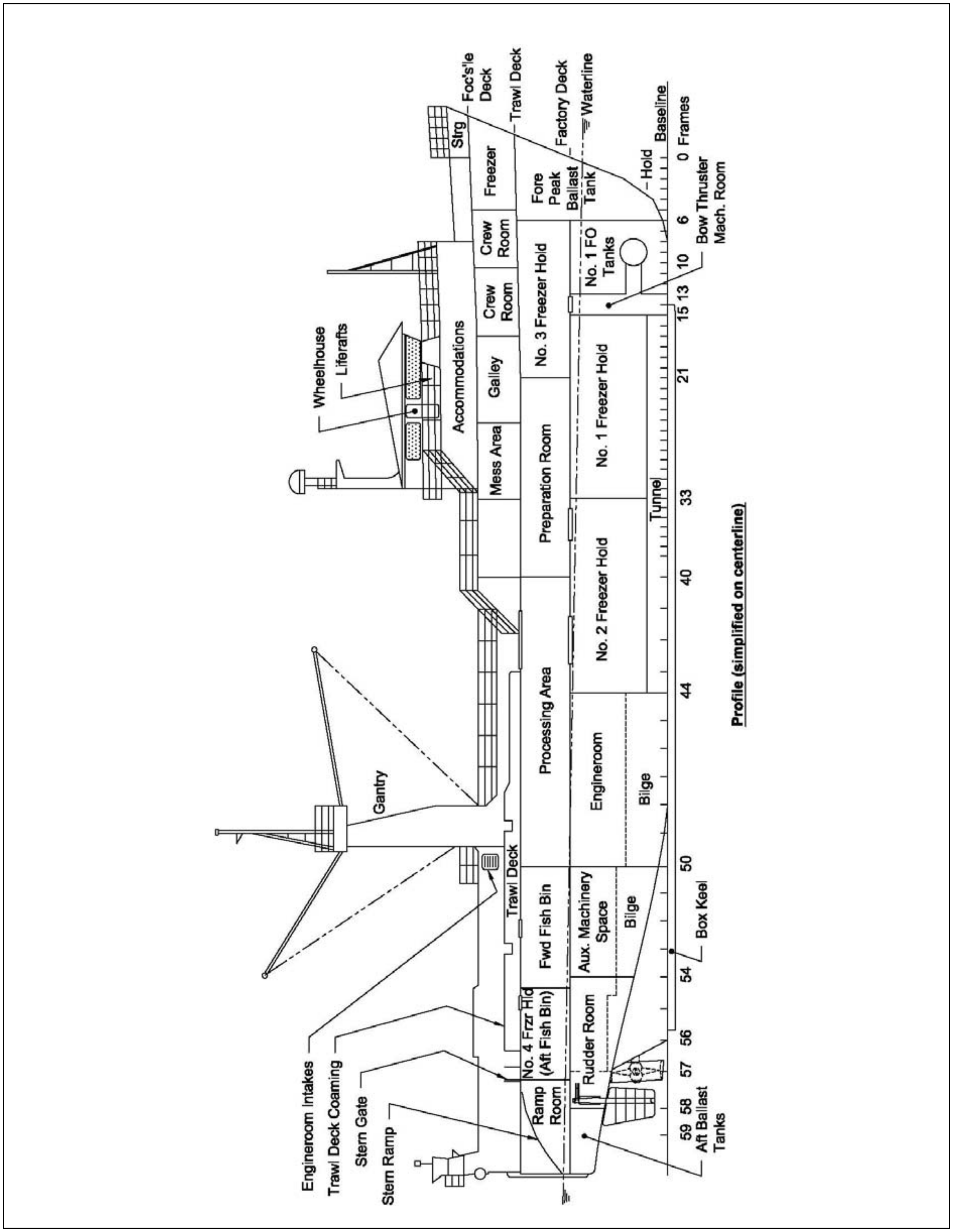


Figure 3. Profile view of *Alaska Ranger*. Flooding involved the aft compartments on the hold and factory decks. Most crewmembers were asleep in quarters on the foc's'le and forward trawl decks when flooding began. Liferafts were stored next to the wheelhouse above the foc's'le deck. (FO = fuel oil)

The night-watch assistant engineer said that he called the bridge and told the mate, who was on watch, to sound the general alarm. He then notified the chief engineer that the vessel was flooding, started one of the engineroom's two bilge and ballast pumps (configuring it to pump bilge water out of the vessel), reconfigured the other pump to remove bilge water (it was already supplying cooling seawater to the vessel's incinerator), and opened the suction valves to the rudder room, the auxiliary machinery space, and the engineroom.

The night-watch assistant engineer stated that the chief engineer arrived in the engineroom about 10 minutes after the general alarm sounded, stayed a minute, said they should abandon ship, and left. The other (day-watch) assistant engineer, who was on the bridge, stated that the chief engineer came to the wheelhouse and reported that the vessel had lost a rudder and that they needed to abandon ship. According to survivors, by that time the vessel had begun sinking by the stern.

Two of the Japanese crewmembers testified that they went through the auxiliary machinery space to the engineroom and saw water leaking above the watertight door to the rudder room, where two freezer pipes penetrated the bulkhead separating the auxiliary machinery space from the rudder room (see figure 3). As instructed by the fishmaster, the crewmembers returned several times to the engineroom to monitor the flooding. One said that the last time he was in the engineroom, the water in the bilges was approximately 1 meter (39 inches) below the deck plates. According to vessel drawings, the engineroom bilges ranged from 6 to 8 feet deep (forward to aft).

Members of the ship's emergency squad also went to investigate the flooding. Emergency squad members said that both watertight doors to the ramp room on the factory deck were open, and that the ramp room was flooded up to their shins but not up to the coamings (raised sills) of the doors. The squad began to set up an emergency pump, but the night-watch assistant engineer and a Japanese crewmember came up from the engineroom and told them to stop work and muster (assemble) at the wheelhouse.

The night-watch assistant engineer and the crewmember said that they saw water outside the ramp room and in the ramp room itself. The night-watch assistant engineer could not determine the source of the water. He said that when the water reached two transformers in the ramp room, they began "popping," and for fear of being electrocuted, he and the crewmember ran from the space. The night-watch assistant engineer said that they did not close either door to the ramp room, but that they closed the next two starboard watertight doors as they moved forward. According to testimony, all other watertight doors on the aft factory deck were closed, as were both chutes through which waste was discharged from the factory.

At 0246, the *Alaska Ranger* broadcast a Mayday call. The Coast Guard communication station in Kodiak responded, and the *Alaska Ranger* reported that the vessel was taking on water in the rudder room. The communication station notified the Coast Guard search and rescue coordination center (RCC) in Juneau.[12] At 0254, the RCC ordered rescue aircraft to the scene. At the same time, a Coast Guard cutter diverted to the accident site after receiving the *Alaska*

[12] The RCC in Juneau controls all search and rescue operations in Alaska, including U.S. waters in the North Pacific Ocean, the Bering Sea, and the Arctic Ocean.

Ranger's Mayday call. (See "Survival Factors" section for details about the emergency response.)

At 0254, the mate or master of the *Alaska Ranger* reported to the Coast Guard that the vessel had lost steering. By that time, the crewmembers had mustered to the wheelhouse, donned immersion suits,[13] and at the Coast Guard's request, activated the vessel's emergency position indicating radio beacon (EPIRB).[14] One crewmember stated that the vessel's stern was low at that point but not under the water.

At 0310, the *Alaska Ranger* radioed the Coast Guard and the mate or master reported, "We think we've lost a rudder." About 0330, according to radio transmissions, approximately an hour after the bilge alarm sounded, the *Alaska Ranger* lost electrical power. Within minutes, said a crewmember, "We were going in reverse." The vessel's stern continued to sink. The night-watch assistant engineer stated that after the loss of power, he and the master left the wheelhouse to check that a watertight door on the trawl deck had been closed and to investigate the extent of flooding. The night-watch assistant engineer said that the starboard watertight door to the trawl deck was open and that water was covering the stern and reached to the door's coaming.

The night-watch assistant engineer did not enter the engineroom, but he said the master told him that the engineroom was dry and that there was no water in the bilges. The engines were still running. The night-watch assistant engineer said the master told him that "he didn't want to be dead in the water." The night-watch assistant engineer stated: "At that time, we were still level, you know. So I thought we were going to be all right . . . I didn't think we were going to sink." As the men made their way back to the wheelhouse, the vessel heeled to starboard and did not return upright. Several crewmembers said that a large wave from port struck the vessel before it heeled, but the day-watch assistant engineer said that he had not seen a large wave, just "waves hitting us." Survivors testified that the master gave the order to launch the liferafts shortly after the vessel heeled.

At 0402, the Coast Guard communication station in Kodiak received a message from the *Alaska Ranger* that the crew was preparing to abandon ship. Subsequent radio transmissions from the vessel indicate that crewmembers began entering the water as early as 0423. About 0430, the first rescue helicopter approached within 70 miles of the *Alaska Ranger* and contacted the vessel by radio. The mate or master reported that the vessel was listing 45°, that the crew expected it to capsize, and that the last seven crewmembers were preparing to abandon ship. The vessel sank shortly afterward.

---

[13] An immersion suit, also known as a survival suit, is a buoyant suit that covers the wearer's entire body, except for the nose and eyes, and protects against heat loss and undue ingress of water. Requirements for fishing industry vessels regarding the carriage of immersion suits are found at 46 CFR 28.110.

[14] An EPIRB is a tracking transmitter for use in detecting and locating vessels in distress. When triggered, the EPIRB emits a coded signal that is detected by stationary and orbiting satellites, part of an international satellite system for search and rescue. The EPIRB transmits a unique registration number that corresponds to identifying information about the vessel, including owner, type, nationality, radio call sign, and number of crewmembers. The EPIRB also transmits a signal that aircraft and rescue craft can home in on. The vessel-identifying information is kept in an EPIRB registry, managed in the United States by NOAA. An EPIRB signal is relayed to a NOAA control center that processes the distress signal and alerts search and rescue authorities as to who is in distress and where the vessel is located.

Injuries

Surviving crewmembers said that it was difficult to reach the liferafts. All 22 crewmembers who reached the rafts survived the sinking. Crewmembers who could not reach the liferafts remained in the frigid water at least an hour before the first rescue helicopter arrived. Some crewmembers were in the water as long as 5 hours. Of the crewmembers in the water, 20 survived and 5 did not (table 2).

Table 2. Injuries sustained in the *Alaska Ranger* sinking.

Type of Injury	Total
Fatal	5
Serious	0
Minor	42
Total	47

NOTE: Title 49 CFR section 830.2 defines a fatal injury as any injury that results in death within 30 days of an accident. It defines serious injury as that which requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; results in a fracture of any bone (except simple fractures of fingers, toes, or nose); causes severe hemorrhages, nerve, muscle, or tendon damage; involves any internal organ; or involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface.

Four bodies—those of the master, mate, chief engineer, and one of the fish processors—were recovered. The body of the fishmaster was not recovered, and he is presumed dead. Survivors gave conflicting testimony to the Marine Board as to whether the fishmaster evacuated the vessel before it sank. The 42 survivors, who suffered varying degrees of hypothermia, were treated on board the two rescue ships that returned them to Dutch Harbor (see “Survival Factors” section).

Damages

According to a vessel survey conducted in July 2006, the estimated market value of the *Alaska Ranger* was $5.5 million. The survey report estimated the cost to replace the *Alaska Ranger* at $15 million.

Personnel Information

Deck Officers

Master. The 65-year-old master did not survive the accident. He held a Coast Guard license as master of steam or motor vessels of not more than 1,600 gross domestic tons or

3,000 international tons[15] on near-coastal waters (defined at 46 CFR 10.104 as ocean waters not more than 200 miles from shore); a master's license for uninspected fishing industry vessels of not more than 2,000 gross domestic tons on near-coastal waters; and a mate's license for steam or motor vessels of not more than 1,600 gross domestic tons (3,000 international tons) on oceans. He had worked for Fishing Company of Alaska since the company began operating in 1985. He had served as mate on the *Alaska Ranger* before taking over as master on March 5, 2008. He had also served as master or first mate on four other Fishing Company of Alaska vessels: *Alaska I* (no longer in service), *Alaska Patriot*, *Alaska Victory*, and *Alaska Pioneer*. He stood the bridge watch from 0700 until 1900 every day.

Mate. The mate, age 50, did not survive the accident. He held a Coast Guard license as master of vessels of not more than 1,600 gross domestic or 3,000 international tons on oceans. He had worked on the *Alaska Ranger* since March 5, 2008. Immediately before that, he had served as master of the *Alaska Pioneer*, and since being hired by Fishing Company of Alaska in 1992, had served as either master or mate on all seven of the company's vessels. Before coming to Fishing Company of Alaska, the mate had worked in the tuna fleet based in San Diego, California. The mate stood the 1900–0700 bridge watch.

Engineering Officers

Chief Engineer. The chief engineer, age 65, did not survive the accident. He held a Coast Guard license as chief engineer of uninspected fishing industry vessels of not more than 6,000 horsepower. He had worked for Fishing Company of Alaska briefly in 1994, then sailed with another company. He returned to Fishing Company of Alaska in 2007, serving as chief engineer on the *Alaska Patriot* during March and April and on the *Alaska Victory* in December. He began serving as chief engineer on the *Alaska Ranger* on January 3, 2008, where he remained until the accident.[16] He did not stand watch.

Day-Watch Assistant Engineer. The day-watch assistant engineer, age 48, held a Coast Guard license as assistant engineer of uninspected fishing industry vessels of not more than 4,000 horsepower. He reported to the *Alaska Ranger* on January 8, 2008. He began his career with the tuna fleet at age 16, based first in San Diego, then in Samoa. He had held a Coast Guard license since 1997, but he told investigators that he had 35 years of experience on fishing vessels. He stood the watch from 0700 until 1900 every day.

Night-Watch Assistant Engineer. The night-watch assistant engineer, age 49, was not licensed, but he told investigators that he was "working toward" getting a Coast Guard license. He held a merchant mariner's document (Z-card) that certified him to serve as a wiper and an oiler.[17] He began working for Fishing Company of Alaska in 1991 and had been with the

[15] International tonnage according to the International Tonnage Convention (International Convention on Tonnage Measurement of Ships, 1969) is normally greater than domestic tonnage because international regulations allow less internal space to be exempted from tonnage calculations than permitted by domestic regulations.

[16] Because of illness, the chief engineer was not on board the vessel from January 18 until February 19, 2008.

[17] Oilers (who lubricate the machinery) and wipers (who clean the machinery and engine spaces) are unlicensed members of the engineering crew. They also assist the engineers as directed.

company since then. Most of his experience had been on the *Alaska Ranger*. He stood the watch from 1900 to 0700 and was on watch at the time of the accident.

Processors

The processors on the *Alaska Ranger* worked in three shifts, each with a factory manager in charge. The processors worked continuous sequences of 12 hours on and 6 hours off, with a half hour meal break during the 12-hour portion. The processors were not licensed and did not hold merchant mariner's documents.

Vessel Information

General

The *Alaska Ranger* was built in 1973 by McDermott Shipyard of Morgan City, Louisiana. Under the name *Ranger*, the ship operated as an offshore supply vessel in the petroleum industry until Fishing Company of Alaska purchased it in 1987. Between 1987 and 1989, the vessel was converted at the United Marine Shipbuilding shipyard in Seattle to serve in the Aleutian Island fishing trade.

Documents from a marine survey conducted after the conversion state that the vessel was stripped to the main deck and "reconstructed from that point up, adding a shelter [trawl] deck and new house [superstructure]."[18] The main working deck of the supply vessel became the fishing vessel's enclosed factory deck. The *Alaska Ranger* made its maiden fishing voyage in May 1989. The vessel's principal characteristics were as follows:

Gross tonnage:	1,562 domestic, 1,577 international
Length:	189.4 feet
Beam:	40 feet
Maximum speed:	12 knots
Propulsion:	Two 3,500-horsepower, V-16 cylinder marine diesel engines
Cargo capacity:	585 long tons[19] (fish products)

According to a marine survey conducted in July 2006,[20] the *Alaska Ranger* was equipped with numerous navigation, communication, and fish-finding devices. Navigation equipment included short-range (3-centimeter) and long-range (10-centimeter) radars, a gyrocompass, a magnetic compass, electronic chart plotters, global positioning system devices, and a Loran-C position-indicating receiver. Communication equipment included very-high-frequency radios,

[18] Survey performed by Pacific Marine Surveys, Inc., Seattle, Washington, May 8, 1989.

[19] One long ton = 2,240 pounds.

[20] Survey performed by Abdhi Consulting Services, Issaquah, Washington, July 9, 2006.

single-sideband radios, an Inmarsat-B satellite communication system, a NavTex radio warning system receiver, and a satellite telephone. The fish-finding equipment consisted of sounders, plotters, catch monitors, and recorders.

As required by NOAA, the *Alaska Ranger* was equipped with a vessel monitoring system, which allowed fisheries regulators to track where it was fishing. Position data transmitted during the accident sequence are plotted in figure 4.

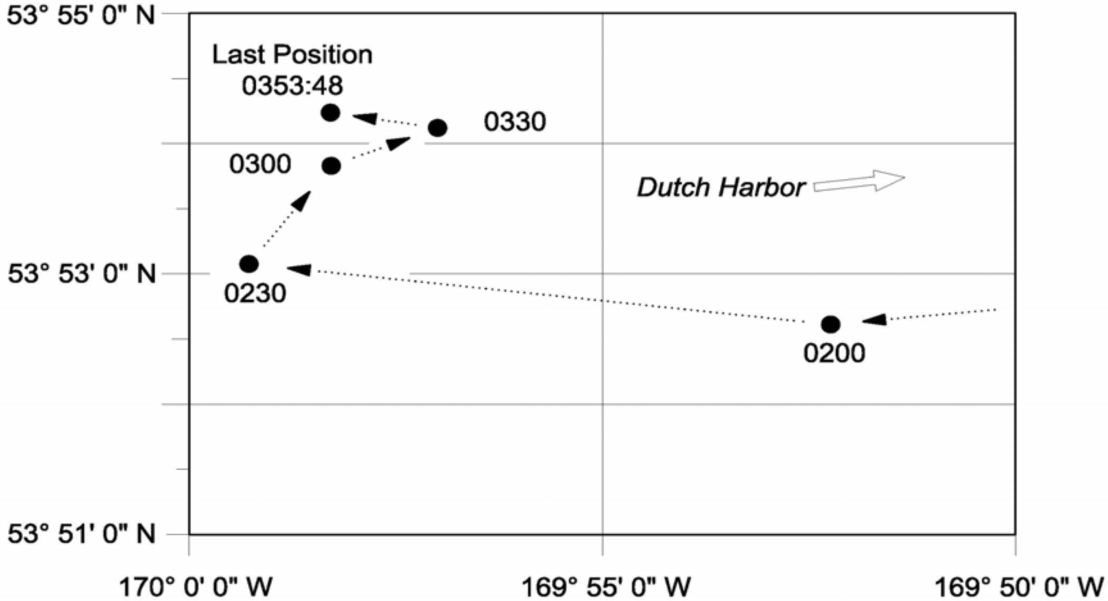


Figure 4. Vessel's position before it sank, from data transmitted every half hour by vessel monitoring system. The *Alaska Ranger*'s position is shown from about 30 minutes before flooding was discovered (0230) until about 30 minutes before it sank. The vessel reportedly lost electrical power about 0330. Arrows and dotted lines indicate only the vessel's heading—its track between data points was not monitored.

The vessel also had an automatic identification system unit, a satellite weather image receiver, and an electromagnetic speed log and was equipped with computers, monitors, printers, and a fax machine. The vessel did not carry a voyage data recorder, nor was it required to do so.

Construction Details

Structure and Arrangement. The *Alaska Ranger* was constructed entirely of welded steel. As converted, the vessel had a hold and two decks running from bow to stern (figure 5), in addition to the foc's'le deck and wheelhouse at the bow (refer to figure 3).

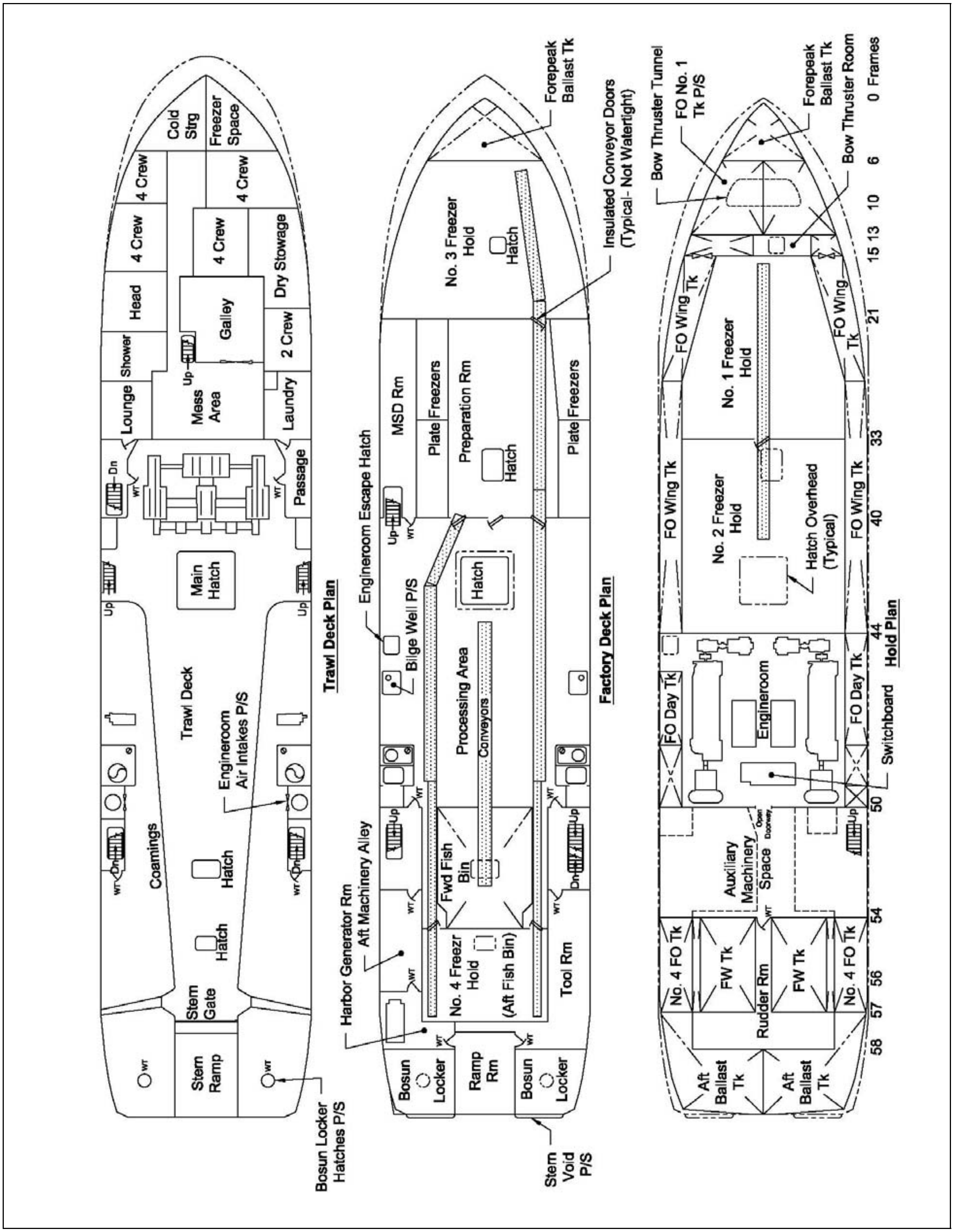


Figure 5. Plan view of *Alaska Range*r trawl deck, factory deck, and hold. (FO = fuel oil; FW = freshwater; MSD = marine sanitation device; P/S = port and starboard; Tk = tank; WT = watertight)

The hold was divided by transverse bulkheads into a forepeak tank, compartments containing port and starboard fuel oil tanks and bow thruster machinery, freezer holds, engineroom, auxiliary machinery space, compartments containing freshwater and fuel oil tanks, rudder room, and aft ballast tanks. The engineroom contained the main engines, the generators, and the main electrical switchboard (a large cabinet that stood on the engineroom deck). The rudder room contained the upper rudder stocks (shafts) and the linkages used in setting the rudder positions.

An alarm panel in the engineroom could sound separate alarms for high bilge levels in the forward hold, bow thruster compartment, engineroom, auxiliary machinery space, and rudder room. The engineroom had two bilge and ballast pumps and a fire pump. The bilge piping system also contained a line that could serve as a dedicated emergency bilge suction. According to the owner of Transmarine Propulsion Systems of Seattle (Transmarine), the company's engineering and maintenance contractor, the bilge and ballast pumps in combination with the emergency fire pump could pump water out (dewater) at a maximum rate of 1,400 gallons per minute.

The factory deck was used to process, prepare, and freeze the vessel's catch. The space was divided into a forward freezer hold, a preparation room containing four enclosed plate freezers, a processing area containing conveyor belts leading to the forward freezer hold and two fish bins, a ramp room, two bosun lockers,[21] a generator room, an aft machinery alley, and an onboard sewage treatment tank (marine sanitation device). Hatches led from the forward freezer hold and the preparation room to the freezer holds below. The fish bins were connected by hatches to the trawl deck above. Fish were transferred to the processing area from the trawl deck through a hatch that could be closed watertight.

The entire aft end of the trawl deck was used for catching and bringing fish on board. The fishing gear included the trawl (a conical net towed behind the vessel on cables) and four trawl doors (used to spread the opening of the trawl horizontally; weights were used to open the trawl vertically). The trawl was set into the water and hauled on board over an inclined ramp running through the stern. The deck held fishing gear, winches, and other equipment. Aft was a large fixed gantry, equipped with hoists and supported by a tower on either side. The towers served as engineroom exhaust trunks. The forward end of the trawl deck, which was enclosed, contained food preparation and serving areas and crew quarters.

Wear plates were fitted to the stern to protect it against strikes by the trawl doors (figure 6). The wear plates, each about 15 feet high by 12 feet wide, were welded to frames. The frames were welded to the stern, creating inaccessible void spaces approximately 6–8 inches deep.

[21] Bosun lockers are compartments where tools, ropes, and other deck equipment are kept.

Figure 6. Wear plates fitted over stern of *Alaska Ranger*, shown in 2005. Stern ramp in the center allowed nets to be launched into the sea and then hauled on board with their catch.

Watertight Bulkheads and Openings. Drawings prepared after the vessel's conversion indicate that six of the bulkheads that divided the hold into compartments were watertight. Subdivision of a vessel's interior into watertight compartments is essential for it to survive damage from a collision, grounding, or other event that causes water to penetrate the hull. By restricting the ingress of water to a particular compartment, watertight bulkheads prevent progressive flooding and ultimately, vessel sinking. A bulkhead must be strong enough to remain watertight even if the adjacent compartment completely floods.

The company's electrical engineering contractor told the Marine Board that the bulkhead penetrations through which cables and wires passed were watertight. The bulkhead dividing the auxiliary machinery space from the engineroom was not watertight, being broken by an open archway and by cutouts for the engine shafts. A single watertight door separated the auxiliary machinery space from the rudder room. The door between the No. 1 and No. 2 freezer holds was not watertight (refer to figure 5).

As shown in figure 5, the factory deck had eight watertight doors. Two watertight doors led to the ramp room—one from the harbor generator room on the port side and one from the tool room on the starboard side. A watertight door also separated the harbor generator room from the aft machinery alley. Each of the ladderways, port and starboard, leading to the upper decks and down to the hold was accessed by two watertight doors. Another watertight door led to the marine sanitation device. The forward freezer hold, including the access doors from the preparation room, was insulated, but the access doors were not watertight. According to vessel drawings and Fishing Company of Alaska, none of the openings between the preparation room and the processing area were watertight.

Four hatches were cut in the factory deck, two for transferring fish to the No. 2 freezer hold, one for escaping from the engineroom below, and one for accessing the bow thruster machinery room. Chutes used to discharge fish remains overboard were situated on the port and starboard sides of the processing area. The chutes had hydraulically operated closures, controlled by emergency shutdown switches on the bridge, as well as dogs to secure them from the sea.

The trawl deck contained four watertight doors, two forward separating the superstructure from the upper deck and two aft giving access down to the factory deck by means of the port and starboard ladderways. Three hatches on the trawl deck allowed transfer of cargo between it and the factory deck, and two hatches afforded access to the bosun lockers on the factory deck. All five hatches could be closed watertight. Open air intake vents for the engineroom, with exhaust vents above, were located near the ladderways. The harbor generator room on the factory deck would have required similar ventilation openings, but their locations are not shown on the vessel drawings. Ventilation for other spaces and for the aft tanks is also not shown on the drawings but would have been present.

Propulsion and Electrical Systems

Propulsion. The *Alaska Ranger* was propelled by two 3,500-horsepower Polar Nohab main engines, each driving a Bird-Johnson (now Rolls-Royce) controllable-pitch propeller. Propellers, which convert an engine’s mechanical power to the thrust that drives a ship through the water, have at least two blades mounted perpendicular to a hub on the aft end of the propulsion, or propeller, shaft. As a propeller turns, it advances through the water just as a screw bores into wood. The propeller blades are angled, or pitched, such that the greater the pitch, the farther the propeller travels during each revolution of the shaft.

Marine propellers are of two main types, *fixed pitch* or *controllable pitch*. In a fixed-pitch propeller, the blades are cast as part of the hub or bolted to it, so their position cannot be altered. The speed of the vessel through the water depends on the rotational speed of the blades, which in turn depends on the amount of power transmitted from the engine by means of the propeller shaft. Motion ahead or astern is accomplished by changing the direction in which the propeller shaft rotates, which can be done using clutches, gears, or other means, depending on the engine type. Changing the rotational direction of the propeller shaft requires slowing the engines, then accelerating them after the change is made.

In a controllable-pitch propeller, the blades are not fixed in position but are fastened to the hub in a way that allows them to rotate and thereby change pitch. The blade pitch determines both the vessel’s speed and its direction (forward or astern) through the water. To increase vessel speed, the blades are set at a higher pitch that increases the distance traveled per shaft revolution.

Lowering the pitch decreases the distance traveled per revolution, thereby slowing the vessel. To change the vessel's direction from ahead to astern, the blades are rotated from a positive pitch to a negative one. Neutral position rotates the blades to a place where the thrust ahead and astern is equal, resulting in zero net thrust, although the propeller continues to rotate.

Controllable-pitch propeller systems are custom designed for individual ships. The blades are engineered for a particular hull and according to the particular performance requirements and operating conditions of a vessel, with the aim of maximizing propulsion efficiency and minimizing noise and vibration. One of the stresses on the system design is the tendency, while the propeller moves through the water, of the blades to rotate about their axis and change pitch, a phenomenon known as "spindle torque." Spindle torque has a hydrodynamic component due to the pressure field acting on the blade surfaces, a centrifugal component resulting from the blade mass distribution, and a frictional component resulting from the relative motion of the surfaces inside the propeller hub.[22] Spindle torque must be balanced by the hub mechanism to hold the blades in a commanded pitch setting and must be overcome to effect a change in pitch.

In a hydraulic-type controllable-pitch propeller,[23] a hydraulically operated mechanism in the hub rotates the individual blades simultaneously to adjust the pitch. Mechanical linkage rods or hydraulic lines, or both, running through the hollow propeller shafting connect the hub mechanism to an oil distribution box at the forward end of the shaft. The oil distribution box translates the commanded vessel speed and direction to a hydraulic signal that drives the blade rotation mechanism.

The electrohydraulic system that controlled the *Alaska Ranger*'s propellers was normally operated from the bridge. To change the vessel's direction or speed, the operator in the wheelhouse manipulated a lever that fed an electrical signal to a control valve in the oil distribution box. The control valve directed the flow of hydraulic oil to the blade-positioning mechanism in the hub, producing the commanded vessel direction and speed.

Each of the *Alaska Ranger*'s propellers had two hydraulic pumps, main and standby. Both pumps were electrically driven, powered by the main switchboard.[24] The pumps were installed directly under the deckplates of the engineroom, aft of the main switchboard. According to the company's electrical engineering contractor, the pumps were enclosed with their motors and were "exposure proof, watertight."

As originally configured, each propeller had one electrical pump and one pump that was mechanically driven off the main engine. The instruction/parts manual states that the electrical pump was the main pump, with the mechanically driven pump serving as standby in case the other pump lost pressure, but that individual systems could vary. Documentation shows that after the mechanically driven pumps were damaged in late 1989, Transmarine replaced them with electric pumps, "due to part availability and expense of repairing existing units," according to a

[22] J. S. Carlton, *Marine Propellers and Propulsion*, 2nd edition (London: Butterworth-Heinemann, 2007), pp. 98–99.

[23] Mechanically operated controllable-pitch propeller systems are also available, though they are generally used on smaller vessels.

[24] The vessel was not equipped with an emergency electrical distribution panel (bus).

marine surveyor's report. From then on, the vessel ran with two electric pumps per propeller. Installing a second (standby) electrically driven pump provided redundancy for the pumps but did not provide them with an independent source of power. The pumps were overhauled yearly by a qualified hydraulic service technician.

According to survivor testimony, after the *Alaska Ranger* lost electrical power, it began moving backward. The owner of Transmarine told the Marine Board that in a 1988 sea trial, the *Alaska Ranger* had gone astern about 15 seconds after personnel shut off the hydraulic pumps while the vessel was traveling ahead. The astern motion was overcome by slowing the engine speed to idle and disengaging the propeller shaft. The Transmarine owner stated: "If we lose power to the hydraulic pumps . . . the blades will automatically go astern." The previous master of the *Alaska Ranger* testified that the company's port captain had told him that if the controllable-pitch propeller system failed, "the vessel would go full speed astern." He said that it had never happened to him, but that he had tested "different scenarios" and had told the master at the time of the sinking (who had been his mate) what would happen if the system failed.

About 5 years before the sinking, the *Alaska Ranger* had run into the vessel behind it at the dock after its propellers had gone from neutral to astern pitch while the engines were running. The Fishing Company of Alaska port engineer told the Marine Board that the incident occurred because the chief engineer had failed to engage the hydraulic pumps before starting the main engines.

Investigators identified three other cases in which failure of a hydraulic-type controllable-pitch propeller system contributed to an accident. The first was in June 1991, when the *Neerlandic*, a cargo ship, went astern and allided with a pier after "sudden failure of the vessel's controllable pitch propeller hydraulic and pneumatic control system," according to the Coast Guard marine casualty report.[25] In November 2007, before the passenger vessel *Explorer* sank in the Antarctic Ocean, its controllable-pitch propeller system went full astern and the vessel reached a speed of about 8 knots astern, according to the accident report.[26] The master and the chief engineer reportedly thought that the vessel had lost hydraulic pressure to the propeller system. More recently, in June 2008, the roll-on/roll-off cargo ship *Moondance* grounded in Northern Ireland when its controllable-pitch propellers shifted to astern position after an electrical blackout. The accident report cited loss of hydraulic pressure to the controllable-pitch propeller system and a default to full astern position.[27]

The propeller manufacturer's product manager told the Marine Board that in the event of a loss of hydraulic pressure to the propeller hub, "the oil distribution box would try to maintain pitch . . . but depending on the forces on the propeller blade, it could break away and go in any direction depending on what you are doing, backing on one, full ahead on the other." He further

[25] Marine Casualty Investigation Report MC910003207, June 13, 1991.

[26] *Report of Investigation in the Matter of Sinking of Passenger Vessel* Explorer *(O.N. 8495), 23 November 2007, in the Bransfield Strait near the South Shetland Islands* (Monroe, Liberia: Bureau of Maritime Affairs, Republic of Liberia, March 26, 2009).

[27] *Report on the Investigation of the Electrical Blackout and Subsequent Grounding of the Ro-Ro Cargo Ship* Moondance *in Warrenpoint Harbour, Northern Ireland, 29 June 2008,* report 5/2009 (Southhampton, United Kingdom: Marine Accident Investigation Branch; London: Bahamas Maritime Authority, February 2009).

stated that there is no method of hydraulically locking the propeller blades on the hub once the high-volume pumps fail.

The product manager described an emergency mechanical procedure for setting the propeller blades to forward pitch if the hydraulic pumps fail. The vessel is stopped, then the hubs are mechanically locked in full-ahead position. The procedure takes 15 minutes to an hour for a knowledgeable person to complete, according to the product manager.

Power Generation. The *Alaska Ranger*'s main engines were direct-coupled to two Stanford shaft generators that supplied electrical power throughout the vessel.[28] The generators were rated at 750 kilowatts of power at 480 volts alternating current. The engine speed was kept constant at 750 revolutions per minute to maintain generator output. The main engines could be shut down in the engineroom or from the wheelhouse using remote emergency controls. Fishing Company of Alaska's operations manager told the Marine Board that in January 2008, before the start of the fishing season, an outside contractor had tested the emergency controls and found that they operated correctly.

The night-watch assistant engineer testified that the vessel was operating on the shaft generators at the time of the accident. Besides those generators, the *Alaska Ranger* had three auxiliary generators—two 440-kilowatt Caterpillar generators in the engineroom, ordinarily used when the vessel was dockside offloading fish (and the main engines were not running), and a 150-kilowatt General Motors standby diesel-powered generator (the harbor generator) on the factory deck. The harbor generator could supply light power loads, such as illumination, but it was not designed to start automatically (which an emergency generator must) if the vessel lost power. As an uninspected fishing vessel, the *Alaska Ranger* was not required to have an emergency generator. Neither the Caterpillar generators nor the harbor generator was called into service during the accident.

Engine Horsepower. Fishing Company of Alaska correspondence indicates that the power output of the engines was derated to 3,000 horsepower each in 1988 when new shaft generators were installed. The vessel's critical profile (a Coast Guard document giving vessel particulars) listed the *Alaska Ranger*'s horsepower as 7,000, and no evidence was found that information about engine derating had been sent to the Coast Guard. According to the owner of Transmarine, the vessel's engine speed, and therefore its horsepower, could be raised by manually increasing the engine's governor (speed regulator).

Rudders

The *Alaska Ranger* had two conventional spade-type rudders,[29] one behind each propeller. The rudders were controlled from the wheelhouse by an electrohydraulic system. From

[28] At the time of the sinking, according to the assistant engineer on watch, the generator attached to the starboard main engine was supplying all the electrical power to the vessel, and the port engine's generator was energized but was not powering any of the vessel's circuits.

[29] Spade rudders hang freely under a vessel; other types of rudders swing on pins that are secured to the hull. The stock of a spade rudder is more susceptible to bending forces than other rudder types.

testimony and drawings, the rudders installed at the time of the accident appeared to match the original design. Each rudder stock fit in a watertight housing, or trunk, that extended from the bottom hull plate to within about 20 inches of the rudder room overhead. The bottom of the rudder trunk was welded to the hull.

Each rudder stock was machined to fit a locking ("jump preventer") ring that was bolted to the top of the trunk to keep the rudder from lifting (figure 7). Two bearings, upper and lower, kept the rudder stock from shifting in any lateral direction. The rudder stock above the locking ring was tapered and "shrink fitted" to a matching taper inside the large end (hub) of the tiller. The resulting tight fit between the tiller and the rudder stock allowed torsion (twisting force) to be transmitted from the steering gear to the rudder without slippage.

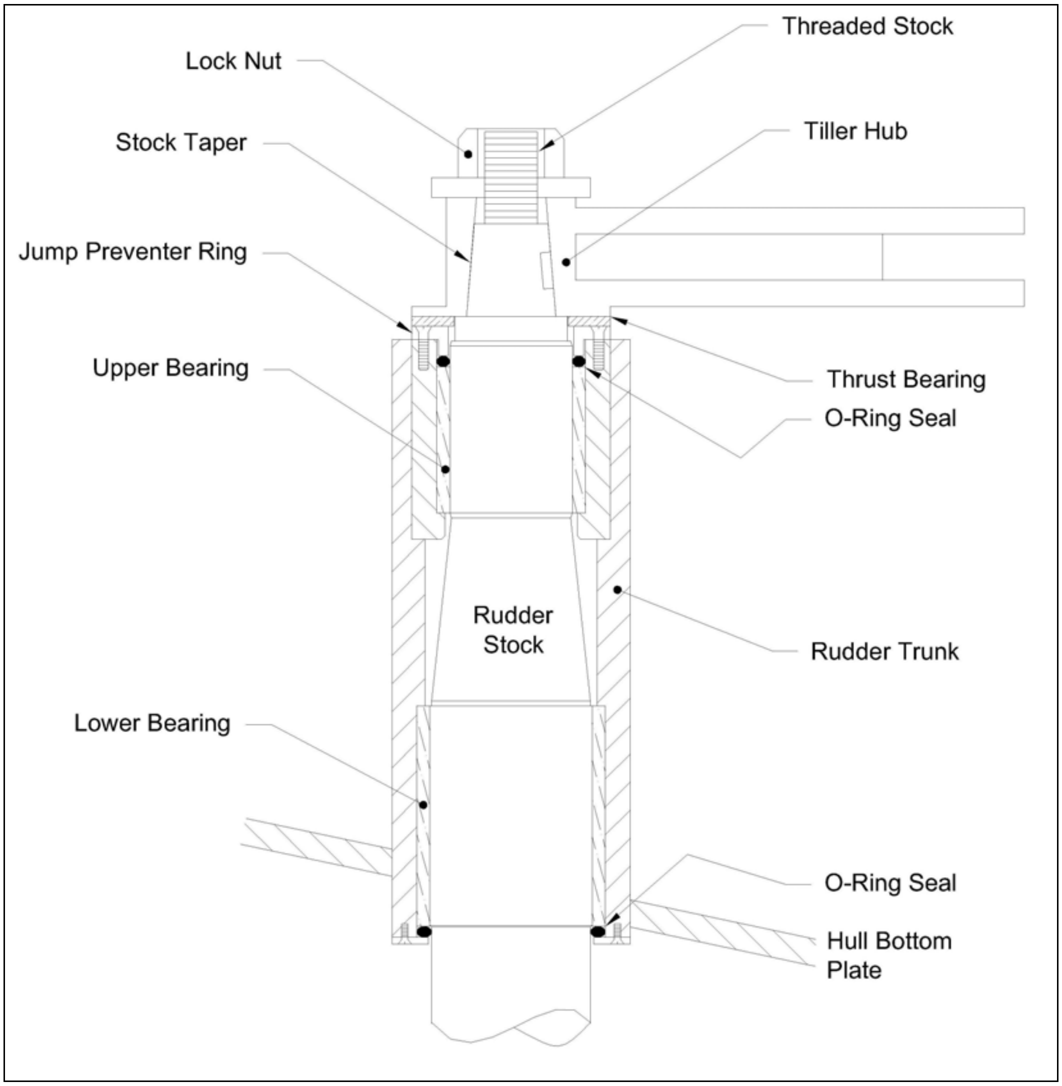


Figure 7. Section view of *Alaska Ranger* rudder assembly, developed from original ship's drawings. The rudder assembly extended about 5 feet above the hull bottom plate.

The vertical weight of the rudder assembly was supported by a thrust bearing consisting of two plates. A lock nut maintained the shrink fit as well as holding the bearing plates and tiller arm securely to the rudder stock. The owner of the company's engineering services firm stated that the tiller on the starboard rudder had come loose in 1990, but that the problem had not recurred. He said that if the shrink fit on the taper of the tiller had been compromised, the lock nut would have been strong enough to hold the rudder at sea in calm water (static conditions), but that in heavy weather (dynamic conditions), a compromised shrink fit could have caused the rudder "to just flap . . . eventually we will have a problem."

Crewmembers reported that the rudders leaked seawater before the accident. The day-watch assistant engineer estimated the leakage at a gallon a minute, but he stated that the leakage was "pretty much regular." The port engineer stated that leakage from the rudder thrust bearing was normal, but "you wouldn't expect to see it gushing out." He further stated that the thrust bearing was greased "at least once or twice" per shift "to keep the water leakage down." The main function of the grease was, however, to lubricate the contact between the bearing plates.

The rudders were last removed, visually inspected, and checked for bearing clearances in 2005, while the *Alaska Ranger* was in drydock[30] (see "Maintenance and Inspection" section). According to testimony, the steering system was largely replaced during the drydocking because the vessel's rudder response was slow. During the drydocking**,** the upper part of the starboard rudder stock (below the taper) was lowered (machined off) to correct the clearance between the rudder stock and the tiller arm. The taper on the port rudder had been shortened before Fishing Company of Alaska acquired the vessel.

Maintenance and Inspection

Regular Maintenance. Federal regulations contain no preventive maintenance requirements for fishing industry vessels. Fishing Company of Alaska provided investigators with maintenance records for the *Alaska Ranger* going back to its conversion in 1987–1989 and continuing into 2008. The records included purchase orders and invoices for engineering, electrical, and welding work; service records for the vessel's controllable-pitch propeller system; year-end worklists; marine surveys for insurance purposes; drydock records from 2002, 2005, and 2007; and other items.

The routine maintenance schedule for the *Alaska Ranger* included the following:

- Twice yearly underwater (diver) hull inspection: sea chests (underwater recesses in the hull that house intake pipes for seawater), general hull condition, propellers, rudders, hull appendages.
- Annual general electrical engineering service: machinery alarms, bilge alarms, machinery shutdown switches, communication systems, batteries, main switchboard.
- Annual service of controllable-pitch propeller system.
- Annual service of refrigeration machinery; twice-yearly rebuild of compressors.

[30] A drydock is a dock in or on which a vessel lies entirely out of water for inspection, repairs, or maintenance.

Nonroutine repairs were made when necessary. Records for 2005 show, for example, that the centerline bulkhead between the aft ballast tanks was repaired, and weld repairs were made to the bosun lockers on the trawl deck. According to Fishing Company of Alaska, the vessel's main engines operated about 5,000 hours a year, and the starboard engine was overhauled in late 2007 or early 2008. The Caterpillar auxiliary generators were used less frequently than the shaft generators and had between 11,000 and 12,000 operating hours at the time of the accident. The harbor generator was overhauled in 2007 and had less than 300 operating hours at the time of the accident, according to the company.

Drydockings. Fishing Company of Alaska scheduled drydockings of the *Alaska Ranger* a minimum of every 3 years. In the 6 years before the accident, the *Alaska Ranger* had undergone three drydockings—in 2002, 2005, and 2007. Fishing Company of Alaska sent its vessels to Japan for drydocking. Attendees were typically port engineers, inspectors, insurance representatives, operations personnel, and equipment technicians, according to the company. The regular drydocking work included the following:

- Cleaning and painting of hull.
- Visual examination and gauging of hull.
- Opening, cleaning, and inspection of sea chests.
- Opening and servicing of valves for overboard pipes.
- Examination of propeller shafts and rudders.

During the 2002 and 2005 drydockings, the vessel's propeller shafts and rudders were pulled, dye-checked (a nondestructive method of testing for cracks), and inspected. In 2005, the blades of the controllable-pitch propellers were repaired, polished, and inspected, and the hubs of the propellers were overhauled. Steel plates and internals in the bow area were also renewed.

In October and November 2007, 4 months before it sank, the *Alaska Ranger* underwent a drydock examination in Isinimiki, Japan, to establish compliance with requirements of the Coast Guard's voluntary Alternate Compliance and Safety Agreement (ACSA) program.[31] The chief Coast Guard examiner for uninspected fishing vessels in Seattle, a qualified marine inspector, traveled with another examiner to Japan to conduct the examination, along with two Coast Guard marine inspectors stationed in Japan. The examination included a hull gauging, using the standard ultrasonic technique. According to the chief Coast Guard examiner, the gauging was in accordance with the standards of the classification society American Bureau of Shipping.[32] The chief examiner said that he had no as-built plate thicknesses to compare with the 2007 readings, and that he therefore averaged the various gaugings for a given plate to estimate the plate thickness.

[31] See the "Safety Measures Targeted to Alaska Fleet" section for further information.

[32] Classification societies are private, independent organizations that establish and apply technical standards for the design, construction, and survey (inspection) of ships. The standards developed by classification societies are published in documents known as the classification society's rules.

The stern, including the wear plates and the interior plates next to the void spaces, was not gauged during the drydock examination, according to the chief Coast Guard examiner. Nor was gauging done on the interior or exterior plates of the stern ramp. Vessel drawings show that the interior plates of the stern were accessible from the aft ballast tanks. The ACSA examination booklet used in the drydock examination states that "gauging shall include . . . internals of the fore and after peak tanks." The Coast Guard examiner who conducted the examination told the Marine Board, "There's no reason to take shots [do audio gauging] on the stern because there's a wear plate back there. . . . from visually what [the other inspectors] said, there was no excessive corrosion on the inside of the aft bulkhead, or fracturing."

The rudders, propellers, and shafts were visually examined but were not removed from their mounts for a more detailed scrutiny in the 2007 ACSA drydock examination. The Coast Guard granted the vessel an extension for removing and examining the rudders, propellers, and shafts until its next drydocking (required before 2010), based on the work done during the 2005 drydocking (see above).

The 2007 ACSA drydock examination resulted in a 31-item list of corrective work for the *Alaska Ranger*. While the vessel was in drydock, weld repairs were made to the wear plates at the vessel's stern and temporary repairs were made to the forward ballast tanks. At the time of the accident, the following items remained on the list of corrective work, according to Fishing Company of Alaska: (1) provide two-way communication from each fixed fire-pull station and wheelhouse; (2) replace halon activation bottles in engineroom; (3) update fire control plan; (4) naval architect to calculate and provide addendum to stability booklet identifying all watertight and weathertight doors and openings, all sea valves, and calculations for dewatering sump pumps in factory area (also, have naval architect calculate location of waterline mark and then repaint mark); (5) free port and starboard engineroom intake covers; (6) remove cam lock fitting on No. 3 port fuel tank cover in factory; (7) install visual and audio indicators in wheelhouse for factory high-water alarms; (8) repair bulkhead separating port and starboard aft ballast tanks[33]; (9) install flame arrestor bowls for all fuel filters on the main engines, generators, and bow thruster.

Dockside Examination. The *Alaska Ranger* participated in the Coast Guard's voluntary dockside examination program.[34] The vessel's last voluntary dockside examination was conducted on January 17, 2008, by a civilian Coast Guard commercial fishing vessel examiner in Dutch Harbor. A summary of the examination indicated that all items were satisfactory.[35] The vessel was issued a decal signifying its safety compliance "with currently applicable laws and regulations." The decal's expiration date was January 31, 2010.

[33] This work had been done in 2005 and was listed erroneously.

[34] For more information, see the "Voluntary Dockside Examinations" section.

[35] The systems listed as "inspected satisfactory" were communications, deck/cargo, documentation, electrical, engineering, firefighting, lifesaving, operations/management, personnel, pollution prevention/response, stability, accommodation/occupational safety, and navigation.

Wreckage

The *Alaska Ranger* sank in the Bering Sea at latitude 53° 53.4′ north and longitude 169° 58.4′ west. The wreck of the vessel lies on the floor of the Bering Sea at a depth of approximately 6,000 feet. The wreckage was not examined.

Waterway Information

The Bering Sea covers 885,000 square miles in the north Pacific Ocean, bordered by Russia (Siberia), the Bering Strait, mainland Alaska, the Alaska peninsula, and the Aleutian Islands (refer to figure 2). The average depth of the sea is about 5,000 feet,[36] although the largest submarine canyon in the world, Zhemchug Canyon (8,500 feet deep, 60 miles wide), runs northwest of the Pribilof Islands.

Whether vessels can traverse the Bering Sea depends largely on ice conditions. Sea ice usually begins forming in November and moves southward, covering two-thirds of the continental shelf in the eastern Bering Sea by late March.[37] The *United States Coast Pilot* states[38]:

> At no time is the sea one solid sheet of ice, and in the winter, when it is forming, the ice is more scattered than in the spring, when the N movement begins and packs it closer together. . . . As a rule, no heavy ice will be encountered S of the Pribilof Islands and the ice in their vicinity is likely to be nothing more than detached fields.

As noted earlier, the *Alaska Ranger* had returned to Dutch Harbor 2 days before the accident because of ice in the Bering Sea fishing grounds where it had been working. The National Weather Service publishes a Marine Weather Service Chart of Alaskan waters showing ice limits, forecast areas, and radio stations that transmit marine weather and other information of interest to mariners. The National Weather Service's significant sea-state analysis for the north Pacific on the afternoon before the sinking shows the edge of the sea ice extending over the northeast Bering Sea, from the Alaska peninsula to the north of Dutch Harbor (figure 8).

---

[36] "Bering Sea," *North Pacific Theme Page*, <www.pmel.noaa.gov/np/pages/seas/bseamap.html> (accessed May 28, 2009).

[37] *Alaska Groundfish Fisheries*, Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries, section 3.3.3.4, "Effects of Sea Ice" (Juneau, Alaska, and Seattle, Washington: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, June 2004).

[38] *United States Coast Pilot*, vol. 9, *Alaska: Cape Spencer to Beaufort Sea* (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, 2004), p. 433.

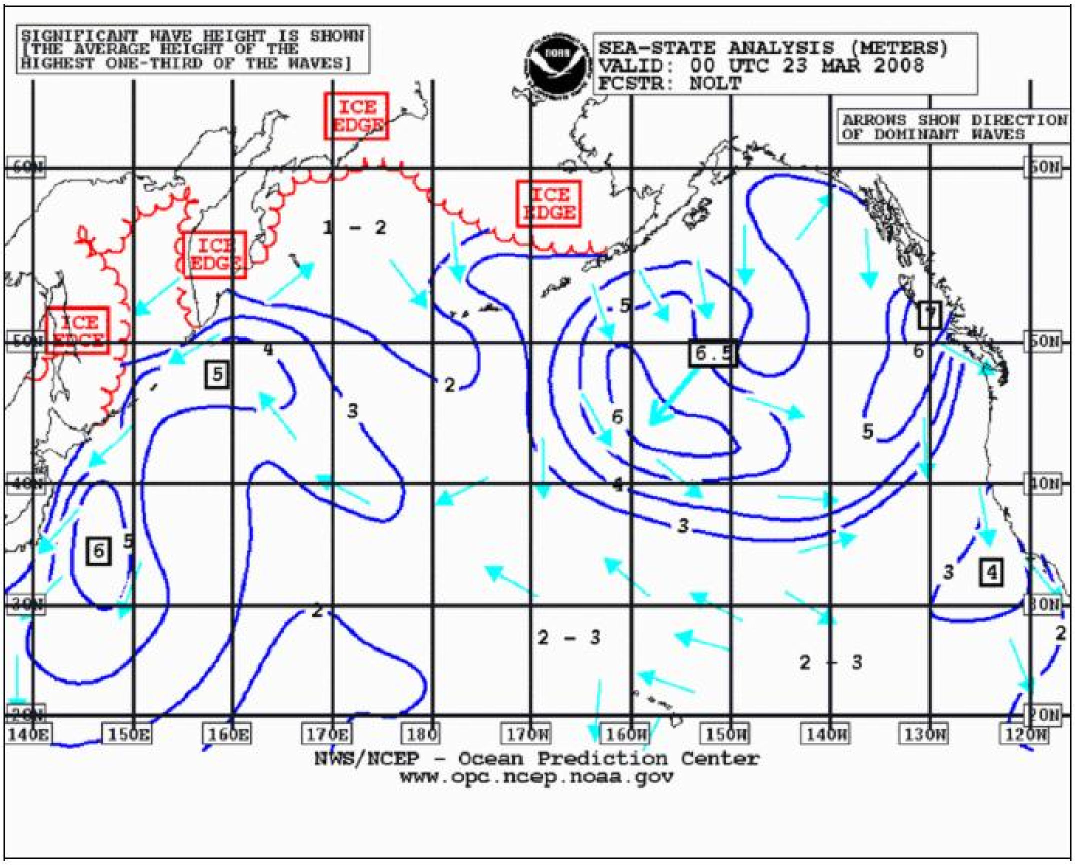


Figure 8. Extent of sea ice in Bering Sea at 1600 on day before sinking (March 22, 2008). Sea ice, which forms when the ocean's saltwater freezes (at about 29° F), differs from icebergs, which are freshwater chunks of ice shelves or glaciers that break off into the ocean.

Meteorological Information

The *United States Coast Pilot* describes the weather in the Bering Sea as "generally bad and very changeable."[39] According to data from a marine weather buoy about 95 miles northwest of the accident site, at the time of the *Alaska Ranger*'s Mayday call, sustained winds were from the northwest at 26 knots, with gusts to 34 knots, and the average wave height was 8 feet, with individual waves as high as 16 feet. The air temperature was 24.8° F, and the water temperature at a depth of 10 feet was 35.6° F.

The closest land-based weather observation station was an Automated Weather Observing System (AWOS) unit at Unalaska Airport in Dutch Harbor. According to the National Weather Service, the unit reported at 20-minute intervals and did not record precipitation between 2230 and 0730. At 1236 on March 22, approximately when the *Alaska Ranger* departed Dutch Harbor, the AWOS unit reported wind from the northwest at 15 knots, gusting to 27 knots. Visibility was 2 miles in light snow showers and blowing snow, and the temperature was 25° F. Snow and blowing snow continued to be reported until 2236.

[39] *United States Coast Pilot*, vol. 9, p. 432.

At roughly the time of the sinking (0436) on March 23, the AWOS unit reported wind from the northwest, sustained at 27 knots and gusting to 36 knots, and visibility 5 miles; temperature data were missing. At 0736, the AWOS unit reported a visibility of 2 1/2 miles in light snow and blowing snow and an air temperature of 25° F. Snow continued to be reported through 1236 on March 23.

The National Weather Service issued gale and freezing spray warnings on March 22 for the accident area through Sunday night (March 23), with northwest winds at 40 knots, gusting to 55 knots, seas of 13 feet, snow showers, and heavy freezing spray.[40] Gale warnings were in effect for the offshore Bering Sea east of longitude 171° west through the night of March 23, with a forecast for northwest winds of 35 knots and snow showers.

Survival Factors

Emergency Response

As soon as it received the Mayday call from the *Alaska Ranger* (at 0246), the Coast Guard began search and rescue operations. The Coast Guard cutter *Munro*, on patrol in the Bering Sea, diverted to the *Alaska Ranger*'s location after receiving the Mayday call. Carrying an HH-65 Dolphin helicopter,[41] the *Munro* made best speed (30 knots) toward the accident site, about 130 nautical miles away. At 0254, the RCC instructed Air Station Kodiak, about 800 nautical miles from the accident site, to launch aircraft. The air station had a C-130 Hercules transport plane in ready status, as well as an HH-60 Jayhawk helicopter[42] based during the winter on St. Paul, Pribilof Islands, 197 nautical miles from the *Alaska Ranger*'s position (refer to figure 2).[43] Both aircraft were in the air by about 0400.

Also moving toward the accident site was the Fishing Company of Alaska vessel *Alaska Warrior*, which had been about 40 nautical miles behind the *Alaska Ranger* when its crew received word of the accident from the *Alaska Spirit*. Since that time (0242), the *Alaska Warrior* had been traveling to the *Alaska Ranger*'s location at its maximum speed of 10 knots.

[40] Heavy freezing spray is an accumulation of freezing water droplets on a vessel at a rate of 2 centimeters per hour or greater caused by a combination of cold water, wind, cold air temperature, and vessel movement.

[41] The HH-65 Dolphin is a medevac (medical evacuation)-capable short-range recovery helicopter that normally carries a crew of four (pilot, copilot, flight mechanic, and rescue swimmer).

[42] The HH-60 Jayhawk is a twin-engine, medium-range search and rescue helicopter. Its fuel capacity is 6,460 pounds and its rescue hoist can lift 600 pounds. The helicopter's maximum speed is 180 knots and its range is 700 nautical miles.

[43] The Coast Guard established a forward operating base on St. Paul in support of search and rescue operations. The base normally operates from January to April, when conditions are dangerous for fishing vessels operating in the Bering Sea.

The Jayhawk helicopter reached the accident site at 0505, 4 hours before sunrise.[44] The helicopter crew[45] saw lights in the sea, which they recognized as strobe lights on the immersion suits of crewmembers who had entered the water.[46] The helicopter crew also saw liferafts and made radio contact with an *Alaska Ranger* crewmember in one of them, who reported that those in the liferaft were in good condition. According to the Coast Guard situation report on the accident, winds at the scene were 26 knots, the air temperature was 16° F (with a windchill temperature of minus 24° F), and the water temperature was 32° F. The Jayhawk pilot reported seas of 20 to 25 feet and "heavy snow squalls."

Beginning at 0521, the Jayhawk helicopter lowered a rescue swimmer and retrieved from the water what it reported to the *Munro*'s combat information center as 13 survivors. The Jayhawk then flew toward the *Alaska Warrior*, which by then was within 10 nautical miles of the accident site. At 0610, after determining that the sea conditions and layout of the *Alaska Warrior* made it unsafe to lower the survivors from the helicopter, the Jayhawk pilot diverted to the *Munro*, now about 80 nautical miles from the accident site. The Jayhawk reached the *Munro* at 0644 and began lowering survivors.[47] The *Munro*'s bridge team recorded 12 survivors and noted the discrepancy from the Jayhawk's earlier report of 13 rescued, but the team did not report the discrepancy to the combat information center on the *Munro*, which was coordinating on-scene operations.

Earlier (0555), the *Munro* had launched its Dolphin helicopter. The Dolphin reached the accident site at 0644, lowered a rescue swimmer, and recovered three crewmembers from the water. The next crewmember that the Dolphin crew attempted to recover exhibited symptoms of hypothermia and was minimally responsive. The rescue swimmer reported difficulty in placing the crewmember in the rescue basket because of the weather conditions and the crewmember's unresponsiveness. As he was lifted, the crewmember began to slip from the basket. The flight mechanic could not pull the crewmember into the helicopter because the crewmember's immersion suit was weighed down with water, and the crewmember fell about 40 feet back into the water. He did not survive.

The Dolphin crew recovered two additional survivors. Then, because the aircraft was low on fuel, the crew dropped a small liferaft and left it and the rescue swimmer with a group of three survivors in the water before returning to the *Munro* to refuel. The Dolphin, with its five survivors, reached the *Munro* at 0812. Meanwhile, the Jayhawk returned to the scene and picked up the three survivors left behind by the Dolphin and the rescue swimmer from the Dolphin, then located and retrieved the body of the *Alaska Ranger* mate. After conducting a sector search for other survivors, at 0900 (sunrise) the Jayhawk headed for the *Munro*, arriving at 0940. The mate

[44] According to data from the U.S. Naval Observatory in Washington, DC, sunrise was at 0900 on March 23. The moon rose at 2318 on March 22 and was nearly full (97 percent illuminated) at the time of the accident.

[45] Like the Dolphin, the Jayhawk helicopter carried a pilot, copilot, flight mechanic, and rescue swimmer.

[46] As provided by 46 CFR 25.25-13 and 161.012-9, each immersion suit carried on a commercial fishing vessel must have a personal flotation device light attached to the front shoulder area that is visible from a distance of at least 1 nautical mile on a dark, clear night. The immersion suits on the *Alaska Ranger* were fitted with a brand of strobe light that is visible for 2 nautical miles under good conditions.

[47] The Jayhawk was too large to land on either the fishing vessel or the *Munro*.

was declared dead on board the *Munro*. At 1000, the Dolphin, carrying the Jayhawk's rescue swimmer, flew from the *Munro* back toward the accident site to conduct a second search.

By 1010, the *Alaska Warrior* had recovered 22 survivors from two liferafts and 3 bodies from the water, including that of the dropped crewmember. At 1012, the combat information center on the *Munro* reported to the RCC that all 47 people on board the *Alaska Ranger* were accounted for. The RCC ordered the Dolphin back to the *Munro*, and at 1057, directed the *Munro* to rendezvous with the *Alaska Warrior*, which was already en route, and escort it to Dutch Harbor. At 1100, the Jayhawk helicopter left for its base on St. Paul.

After comparing the company's crewlist for the *Alaska Ranger* with the names of the survivors, RCC personnel realized that one crewmember, the fishmaster, was unaccounted for. At 1230, about 90 minutes after the search ended, the RCC ordered the *Munro* back to the accident site to search for the fishmaster. The search continued through the night of March 23 and most of March 24. Three Fishing Company of Alaska vessels—the *Alaska Spirit*, the *Alaska Juris*, and the *Alaska Victory*—assisted. No sign of the fishmaster was found, and the search was called off at 2112 on March 24. The *Alaska Warrior* delivered 22 survivors and 3 bodies to Dutch Harbor on March 23. The *Munro* arrived in Dutch Harbor with 20 survivors and 1 body on March 24.

The captain of the *Munro* told the Marine Board that the reason the *Munro*'s combat information center had used the Jayhawk's reported number of survivors was that they knew they "had recovered all survivors from the helicopter." As a result, RCC personnel thought that all persons from the *Alaska Ranger* were accounted for. The captain said that personnel on the *Munro* passed the names of the survivors to the RCC as soon as they could, but that some survivors could not respond immediately because of their physical condition. Once RCC personnel had all the names, they realized that the fishmaster had not been recovered and reopened the search.

After the accident, officers on the *Munro* and other Coast Guard officials reviewed the ship's search and rescue operation. No changes were made to policy or procedures as a result, but lessons learned were passed to other Coast Guard cutters and search and rescue units.

Lifesaving Equipment

The *Alaska Ranger* was required by 46 CFR Part 28 to carry lifesaving equipment including liferafts, immersion suits, and an EPIRB. The vessel's three 20-man inflatable liferafts were new when installed on August 24, 2007. Its EPIRB performed as designed during the accident.

Liferafts. Before the *Alaska Ranger* sank, the crew secured Jacob's ladders[48] to each side of the vessel and deployed the liferafts. The vessel was moving astern. The liferafts were attached to the vessel, two on the starboard side, one on the port side, by painters (securing lines). The crew had rigged the painters so that the vessel's forward motion would pull the

[48] A Jacob's ladder is a rope ladder, usually with wooden rungs, used to board vessels at sea.

liferafts alongside the Jacob's ladders. Because the *Alaska Ranger* was going backward, it moved away from the liferafts after they were launched and left them trailing off the bow. Two of the painters broke, allowing the liferaft on the port side and one of those on the starboard side to drift away from the vessel. Under the circumstances, crewmembers had to enter the water to reach a liferaft. Twelve crewmembers entered the liferaft that remained attached to the starboard side; 10 crewmembers eventually reached one of the free-floating liferafts. The rest remained in the water until help arrived.

Immersion Suits. The vessel was required by Coast Guard regulations (46 CFR 28.110) to carry at least one immersion suit "of the proper size for each individual on board." According to testimony, all 47 persons on board had time to don immersion suits before the vessel sank.[49] The NMFS observers brought their own suits. The previous master of the *Alaska Ranger* estimated that the vessel carried as many as 55 immersion suits. The Coast Guard examiner who conducted the voluntary dockside examination on January 17, 2008, told the Marine Board that the vessel had more than the required number of immersion suits on board at that time. The equipment was found satisfactory during the examination.

Immersion suits are designed to protect against the loss of body heat. Coast Guard–approved immersion suits must provide the wearer with sufficient thermal insulation to ensure that his or her body core temperature does not fall more than 3.6° F after 6 hours of immersion in calm, circulating water measuring between 32° and 35.6° F (46 CFR 160.171-11[c][2]). Approved immersion suits must also turn an unconscious person face up in the water and be fitted with retroreflective material and a light. Immersion suits are required to prevent "undue ingress of water . . . following a period of flotation in calm water of one hour" (46 CFR 160.171-11[f]) but are not required to be watertight.

Expected survival time in cold water is affected by several factors, including proper use of survival equipment, weather conditions, time in water, body type, health, and knowledge of survival techniques. Without immersion suits, the expected survival time for a person in calm, 32.5° F water is between 30 and 90 minutes.[50] With immersion suits, the expected survival time under the same conditions ranges from 2 1/2 to 5 1/2 hours, depending on whether the suit leaks or stays dry.[51] The first survivor was pulled from the water after about 50 minutes. The four deceased *Alaska Ranger* crewmembers were the last people pulled out of the water, where they had been for upwards of 5 hours.

The *Munro* and the *Alaska Warrior* turned over 44 immersion suits to investigators (33 universal-size suits, 7 adult suits, 3 oversize adult suits, and 1 jumbo suit). Twelve suits had damage such as holes in the arms and gloves, holes in the air bladders, and cuts in the legs. The damage, according to testimony, occurred either during the evacuation, when, for example, crewmembers tore their gloves while attempting to pull the liferafts closer to the vessel, or

[49] Coast Guard regulations at 46 CFR 160.171-11(d) require immersion suits to be designed so that wearers can don them in 2 minutes after reading the instructions.

[50] "The Facts on Hypothermia and Cold Weather," Personal Flotation Device Manufacturers Association, Chicago, Illinois <http://www.pfdma.org/choosing/hypothermia.aspx> (accessed August 12, 2008).

[51] *Survival in Cold Waters: Staying Alive*, report TP13822E (Ottawa, Ontario: Transport Canada, 2003), p. 14. A leaking suit is assumed to contain 1 liter of water.

during the rescue effort, when some suits had to be cut open. The immersion suits on the four deceased crewmembers appeared to be appropriately sized for the wearers, free from major damage, and worn properly. The suits of both survivors and victims contained varying amounts of water.

Toxicological Testing

Coast Guard regulations at 46 CFR 4.06 require that after a serious marine incident,[52] "each individual engaged or employed on board the vessel who is directly involved in the incident" be tested for alcohol within 2 hours and for illicit drug use[53] within 32 hours "unless precluded by safety concerns directly related to the incident." Alcohol testing is not required more than 8 hours after a serious marine incident. The marine employer is required to determine which individuals are directly involved in a serious marine incident, although a law-enforcement officer may determine that additional individuals should be tested (46 CFR 4.06-1[c]).

The three senior officers on the *Alaska Ranger*—master, mate, and chief engineer—all died in the sinking. The blood and vitreous[54] of their bodies, plus those of the fish processor who died, were sent to the Civil Aerospace Medical Institute laboratory in Oklahoma City for testing.[55] The laboratory detected no ethanol (alcohol) in the vitreous. The chief engineer's blood tested positive for Diltiazem, a prescription medication used to treat high blood pressure and other cardiovascular conditions. The other bodies tested negative for drugs.

None of the survivors were tested for drugs or alcohol after the sinking. Both the *Munro* and the *Alaska Warrior* carried the proper equipment for alcohol testing. The *Alaska Warrior* also carried the proper equipment for drug testing, but the *Munro* did not.

The manager of vessel operations for Fishing Company of Alaska, who was responsible for administering the company's drug and alcohol program, stated that it was his responsibility to call the *Alaska Warrior* master and instruct him to conduct the required postaccident tests. The operations manager said that he did not do so because he was distressed over the loss of the vessel and of crewmembers who were friends of his.

---

[52] A serious marine incident is defined at 46 CFR 4.03-2 as (a) a marine casualty or accident that results in any of the following: (1) one or more deaths, (2) injury that requires medical treatment beyond first aid and renders the individual unfit to perform routine duties, (3) property damage exceeding $100,000, (4) actual or constructive total loss of an inspected vessel, or (5) actual or constructive total loss of any uninspected vessel that exceeds 100 gross tons; (b) discharge of 10,000 or more gallons of oil into U.S. waters; or (c) the release of a reportable substance into the environment of the United States.

[53] Regulations at 46 CFR 16.113 specify testing for marijuana, cocaine, opiates, phencyclidine, and amphetamines.

[54] The vitreous (also known as the vitreous humor) is the transparent, colorless, gelatinous mass that fills the space between the lens of the eye and the retina. The vitreous is used to test specimens from accident victims for alcohol because it does not normally support the postmortem production of ethanol, as do the blood, liver, and other tissues.

[55] Autopsies were not conducted. The victims' death certificates listed the cause of death as probable hypothermia, and in the chief engineer's case, drowning and hypothermia.

Company Information

Operations

At the time of the accident, Fishing Company of Alaska operated seven vessels (table 3). The company and its vessels were owned by a holding company, which in turn was owned by a trust in Washington state.

Table 3. Fishing Company of Alaska fleet at the time of the accident.

Vessel	Tonnage	Horsepower
Alaska Patriot	1,129	2,750
Alaska Spirit	1,418	3,000
Alaska Pioneer	1,450	4,800
Alaska Ranger	1,577	7,000
Alaska Warrior	1,578	3,000
Alaska Victory	1,610	5,800
Alaska Juris	1,658	3,500

The company had about 250 employees at the time of the accident, most of them processors on its fishing vessels. The company employed one operations manager, who was responsible for hiring and firing officers and for overseeing the licensing and permitting required to engage in fishing operations. Hiring of processors and deck crew was done by the company's personnel department through newspaper advertisements and word of mouth.

The operations manager told investigators that officers commonly worked their way up through the ranks and gained experience on various company vessels. He himself had sailed as master on Fishing Company of Alaska vessels since 1989, including 14 years on the *Alaska Ranger*, before joining management in 2006. The operations manager stated that hiring officers involved a review of qualifications and an interview. He also said that it was common for Fishing Company of Alaska to hire from within the Alaska H&G fleet. In those cases, the company would have word-of-mouth knowledge about the abilities and performance of a prospective employee.

Fishing Company of Alaska's engineering and maintenance work was contracted to Transmarine Propulsion Systems of Seattle. The company's port engineer, who had served in that position for 11 years at the time of the accident, was a Transmarine employee. His work required regular communication with vessel engineers. He reported to the Fishing Company of Alaska operations manager. The port engineer told the Marine Board that he typically spent three-quarters of a year in Dutch Harbor coordinating maintenance and repair of company vessels.

Drug and Alcohol Program

According to its employee handbook, Fishing Company of Alaska had a "zero tolerance" policy that stated:

> No illegal drugs, controlled substances, alcohol, paraphernalia, or firearms will be allowed aboard an FCA [Fishing Company of Alaska] vessel at any time. *THIS MEANS NOT ONE SHRED, GRAIN, PILL OR TRACE*.

Employees acknowledged having received and read a copy of the handbook by signing and dating a form. Nevertheless, the night-watch assistant engineer told the Marine Board that he drank alcohol "maybe twice a week" while on the *Alaska Ranger*, though he denied drinking while on duty. Other survivors testified that it was common for the crew to drink alcohol during transits to the fishing grounds. Survivors were asked about drug use on board the *Alaska Ranger*. None was reported.

In April 2008, a NMFS observer on the Fishing Company of Alaska vessel *Alaska Spirit* filed a safety violation report stating that he smelled marijuana on several occasions while under way. During the same month, a NMFS observer on another company vessel, the *Alaska Warrior*, reported suspicions of crewmembers drinking while transiting to the fishing grounds.

Fishmaster

As noted earlier, the fishmaster on the *Alaska Ranger* was not an employee of Fishing Company of Alaska but worked for North Pacific Resources, a subsidiary of the fish buyer, which sold the company's catches in Japan. North Pacific Resources sent some 36 Japanese "specialized employees" to serve on U.S. fishing vessels operated by Fishing Company of Alaska, with one fishmaster per vessel. The company's operations manager stated: "The Japanese market [is] very picky about appearance and the way things are packed" and "probably we would not have as much a market for a lot of our products if we didn't have some of these guys on board."

Some survivors, primarily members of the processing crew, testified that although the master was the licensed officer in charge, the fishmaster actually ran the vessel. The company operations manager stated, however, that the fishmaster's authority in no way exceeded that of the master. Some survivors told the Marine Board that the fishmaster and the previous master had disagreed about vessel operations. The previous master testified that in March 2008, he left the *Alaska Ranger* because he could not work with the fishmaster. He stated that the fishmaster "directed the vessel" and "decided where to set the net to catch fish," but that he, as master, "was in control at all times." The previous master stated: "Sometimes I was observing what he did and if I deemed it not proper, I would step in." He said that he had occasionally slowed the vessel when he determined that the fishmaster was directing it unsafely.

The NTSB surveyed other vessel owners in the Alaska fleet to determine the extent to which fishmasters were used. Only one other vessel belonging to one other company was found to carry a fishmaster on board, although others had done so in the past. According to the survey, foreign technicians commonly worked in the factories to oversee quality control, as on the *Alaska Ranger*.

Fishing Operations

During the fishing season, the *Alaska Ranger* traveled to and from the fishing grounds in the eastern Bering Sea, the Aleutian Islands, and the Gulf of Alaska, with Dutch Harbor as its base of operations (refer to figure 2). According to the Fishing Company of Alaska operations manager, most fishing trips lasted less than 30 days, although when fishing for mackerel, the trips could be longer. The fishing season began on January 20 and generally lasted until October. Different species were targeted as the year progressed. As described in the "Management of Alaska Fisheries" section, NMFS regulates when the fisheries open and close, which species can be caught, and how much vessels are allowed to catch.

Witnesses at the Marine Board stated that the *Alaska Ranger* operated in ice throughout its 18 years of fishing in the Bering Sea. The company's operations manager said he believed that the vessel's hull had been certified for operation in ice (ice-classed) during the original classification survey in 1973. He also stated that the hull had "a reinforced band above and below the waterline." The company's port engineer testified that the vessel "was built as an ice-classed hull" and that it had a "thick piece of steel that goes two-thirds of the length of the vessel from the bow back . . . close to three-fourths of an inch thick." Investigators found no documentation of ice-classing for the *Alaska Ranger*.

Stability Information

Stability Concepts

A vessel that is floating upright in still water will heel when an off-center force, or heeling moment, is applied. Stability is the tendency of the vessel to return to its original upright position when the force is removed. The properties of stability are usually expressed as the magnitude of a heeling moment necessary to heel the vessel to a certain angle, the angle a vessel may heel to before capsizing, and other parameters that can be calculated. The specific stability characteristics of a vessel are calculated based on the design drawings of its hull form and an inclining experiment in which precise measurements are taken on board the vessel to determine its displacement and center of gravity. Stability analysis generally requires the services of a naval architect.

Stability criteria, established by regulators, are generally recognized as providing an adequate level of safety for vessels that are operated prudently, which means not overloaded and not operating in dangerous conditions such as violent storms. A margin of safety is built into the stability criteria that is intended to accommodate everything that can happen to a vessel, such as rolling in waves, heeling due to wind, or listing as people or cargo move from side to side. The only way to tell if a vessel meets the stability criteria is through calculations. If something changes about the vessel, such as a structural modification that might affect its stability, new stability calculations should be done.

Stability Booklet

A stability booklet describes a vessel's stability characteristics and contains operating instructions and worksheets for use in calculating the vessel's weight and centers of gravity (longitudinal and vertical) under various loading conditions. The booklet is thus a tool for the master to use in determining a vessel's maximum safe load and in controlling the vessel under different conditions.

The stability booklet carried on the *Alaska Ranger* at the time of the accident was issued on January 11, 2006,[56] and was based on an inclining experiment conducted in Dutch Harbor on June 10, 2005.[57] The vessel also carried a software program for calculating stability.[58] The stability booklet and software program could be used to calculate only intact, not damage, stability.[59] The booklet identified the vessel's critical downflooding points (the lowest points that could not be closed watertight) as the port and starboard engineroom air inlets on the trawl deck (refer to figure 5). According to Fishing Company of Alaska, the *Alaska Ranger* master at the time of the accident received initial training in use of the vessel's stability information from the naval architecture firm that prepared it.

Postaccident Stability Analysis

After the accident, the Coast Guard Marine Safety Center conducted a stability analysis of the *Alaska Ranger* to assess the vessel's inherent stability characteristics and to help determine what might have caused it to sink.[60] The Marine Safety Center reviewed the calculations used by the naval architecture firm to develop the vessel's 2006 stability booklet and found that "all the applicable intact stability criteria were met for each loading condition listed."[61] However, the Marine Safety Center engineers noted "discrepancies" in the stability test and calculations. The most serious was that an "inappropriate" amount of fishing gear and other items had been on the vessel during the stability test. The engineers concluded that if the stability test results had been

[56] Elliot Bay Design Group, *F/V Alaska Ranger, Trim and Stability Booklet*, prepared for Fishing Company of Alaska (Seattle, Washington: January 11, 2006).

[57] According to Fishing Company of Alaska, after the first stability test performed when the *Alaska Ranger* was converted, new inclining tests were conducted every 4 to 5 years.

[58] Creative Systems, Inc., General HydroStatics (GHS) Load Monitor (onboard trim and stability calculator).

[59] Intact stability is a naval architecture term referring to how an intact, or undamaged, vessel will respond when heeled over in calm conditions. Damage stability is an assessment of the effects of opening various combinations of watertight compartments to the sea.

[60] Commanding Officer, Coast Guard Marine Safety Center, memorandum 16710/POI4035 (regarding "Post Sinking Stability Analysis for the Alaska Ranger, O.N. 550138") to Chairman, Coast Guard Marine Board of Investigation, December 22, 2008.

[61] Intact stability criteria are found at 46 CFR 28.500 through 28.575.

submitted to the Marine Safety Center, the Coast Guard would probably have returned them for revision.

The Marine Safety Center found that its results correlated well with those of the naval architecture firm as far as the intact stability analysis was concerned. Because the vessel's stability booklet did not evaluate damage stability, the Marine Safety Center conducted an independent damage stability analysis based on the damage stability criteria at 46 CFR 28.580[62] and the loading conditions listed in the *Alaska Ranger*'s stability booklet. The vessel model used in the analysis was subdivided by watertight bulkheads, decks, and doors as documented and described to the Marine Board. The model failed every loading condition, based on the assumptions made by the Marine Safety Center engineers. The engineers concluded that the *Alaska Ranger* "probably would not have met the damage stability requirements in any condition of loading" because of "the lack of watertight subdivision on the processing [factory] deck."

The Marine Safety Center also conducted a casualty analysis of the sinking by performing two stepwise analyses of the sinking scenario using the same model (not considering the effects of wind and sea conditions). The analysis found that the draft at the aft perpendicular, corresponding to the longitudinal location of the rudder posts, was approximately 19 1/2 feet under the vessel's assumed loading condition before the sinking. Modeling of the sinking based on the loss of one rudder post showed that the rudder room would have flooded completely in about 5 minutes (assuming a 9-inch hole at the top of the rudder trunk and that the tiller arm was completely clear of the rudder stock). The casualty analysis found that "flooding in the rudder room alone should not have resulted in capsize or sinking" of the *Alaska Ranger*.

In accordance with testimony from the Marine Board, the first modeled casualty scenario successively flooded the rudder room, ramp room, harbor generator room, workshop, aft machinery alley, engineroom, aft fish bin, and forward fish bin (refer to figure 5). The modeling showed that after the engineroom had completely flooded, "the trawl deck would have been awash, greatly increasing the risk of catastrophic downflooding." The scenario did not, however, "predict any significant listing."

To explain the hard list to starboard described by survivors, the Marine Safety Center developed a second scenario that modeled flooding on the factory deck above the engineroom, with the engineroom assumed flooded to 10 feet at frame 50 (the bulkhead between the engineroom and the auxiliary machinery space; refer to figure 3) and held at that maximum height. With 100 long tons (224,000 pounds) of water on the factory deck, the modeled vessel heeled 36° to starboard, the trawl deck was awash, and the downflooding points to the engineroom (the air intake vents on the trawl deck) were submerged. The *Alaska Ranger* "could not have survived" that scenario, according to the study. The Marine Safety Center concluded: "Ultimately, a lack of effective watertight subdivision probably allowed the progressive flooding which sank the *Alaska Ranger*."

[62] The damage stability criteria list conditions, such as maximum angle of equilibrium, under which a vessel can be presumed to survive damage of an assumed character and extent (46 CFR 28.580[d–f]]). The Marine Safety Center's report states that the engineers could not determine whether the *Alaska Ranger* should have been required to comply with damage stability criteria, which depend on the date and extent of vessel modifications.

U.S. Commercial Fishing Industry

Losses and Fatalities

Commercial fishing is regarded as one of the most dangerous professions in the world. The International Labour Organization estimates that 24,000 fatalities occur per year in fisheries, and that in the United States in 1996, the death rate in fisheries was over 40 times the national average.[63] The U.S. Bureau of Labor Statistics reports that for 2007, fishermen and related fishing workers had the highest fatality rate in the country—111.8 deaths per 100,000 workers.[64] A recent study by the Centers for Disease Control found that during the period 2000–2006, the states of California, Oregon, and Washington combined had an average annual commercial fishing fatality rate of 238 deaths per 100,000 fishermen—approximately double the national average.[65]

In 2008, the Coast Guard published an analysis of fishing vessel accidents that occurred in the United States between 1992 and 2007.[66] Altogether, 1,903 vessels were lost, with 934 fatalities. Vessel flooding accounted for 36 percent of the losses (fires were the second leading cause of loss), and hull or equipment failures accounted for 67 percent of the floodings. Fifty-seven percent of the losses occurred in Coast Guard District 17 (Alaska). The study found that most vessel losses and crewmember deaths were not directly related to fishing operations but to other activities, such as traveling to or from port. The study's executive summary stated: "Most fishermen are dying because their vessel sank and they entered the water."

Laws and Regulations Applicable to Fishing Industry Vessels

Title 46 U.S.C. contains the U.S. shipping laws. Title 46 CFR delineates the regulations applicable to U.S. vessels. The Commercial Fishing Industry Vessel Safety Act of 1988 was the first safety legislation enacted in the United States that applied specifically to commercial fishing industry vessels. The act gave the Coast Guard the authority to prescribe safety regulations for commercial fishing industry vessels. Given that authority, the Coast Guard established basic requirements for lifesaving and firefighting for commercial fishing industry vessels and placed them (as Part 28) in the regulations for uninspected vessels (46 CFR subchapter C). The regulations became effective on September 15, 1991.

---

[63] *Report on Safety and Health in the Fishing Industry* (Geneva: International Labour Organization, 1999). Quoted in *Safety at Sea as an Integral Part of Fisheries Management* (Rome: Food and Agriculture Organization of the United Nations, 2001), p. 1.

[64] "National Census of Fatal Occupational Injuries in 2007," *News*, August 20, 2008 (Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics), p. 5.

[65] J. Lincoln, "Commercial Fishing Fatalities—California, Oregon, and Washington, 2000-2006," *MMWR* [*Morbidity and Mortality Weekly Report*], vol. 57, no. 16 (April 26, 2008), pp. 426–429.

[66] *Analysis of Fishing Vessel Casualties: A Review of Lost Fishing Vessels and Crew Fatalities, 1992–2007* (Washington, DC: U.S. Department of Homeland Security, U.S. Coast Guard, Office of Investigations and Analysis, October 2008).

U.S. law (46 U.S.C. 2101) and Coast Guard regulations (46 CFR 28.50) distinguish between fishing vessels, fish processing vessels, and fish tender vessels:

> Fishing vessel: a vessel that commercially engages in the catching, taking, or harvesting of fish or an activity that can be reasonably be expected to result in the catching, taking, or harvesting of fish.
>
> Fish processing vessel: a vessel that commercially prepares fish or fish products other than by gutting, decapitating, gilling, skinning, shucking, icing, freezing, or brine chilling.
>
> Fish tender vessel: a vessel that commercially supplies, stores, refrigerates, or transports fish, fish products, or materials directly related to fishing or the preparation of fish to or from a fishing, fish processing, or fish tender vessel or a fish processing facility.

The regulatory framework is complex. The following paragraphs summarize the regulations that apply to commercial fishing industry vessels in general. The requirements that applied specifically to the *Alaska Ranger* are described later, in the "Class and Load Line History of *Alaska Ranger*" subsection.

Vessels Subject to Inspection. Fishing vessels, as defined above, are exempt from Coast Guard inspection (46 U.S.C. 3302). Only fish processing vessels over 5,000 gross tons and fish tender vessels over 500 gross tons must be inspected and issued a Coast Guard certificate of inspection (COI) before they may legally operate (46 U.S.C. 3301). The Coast Guard has identified just one fish processing vessel as subject to inspection.

Coast Guard vessel inspections typically address design, construction, equipment, stability, manning requirements, documentation, condition, route, and service (that is, trades in which the vessel may operate). Plans for new vessels are required to be approved by the Coast Guard before construction, and once construction is complete, additional tests are conducted on systems such as steering, propulsion control, and fire control. Stability testing is also conducted. The COI issued after a vessel meets all applicable regulations generally describes the vessel, the route it may travel, the minimum manning requirements, the safety equipment and appliances on board, the total number of persons that may be carried, and the names of the owners and operators. Inspected vessels are subject to periodic reinspection and recertification. As long as a vessel continues to meet requirements, its COI remains valid.

Vessels Requiring Certification or Classification. Fish processing vessels not subject to inspection (those under 5,000 gross tons) are required by 46 CFR 28.710(a) to be examined every 2 years for compliance with 46 CFR subchapter C. Compliance must be certified in writing by the classification society American Bureau of Shipping, by another organization designated by the Coast Guard, or by a marine surveyor of an accepted organization.[67] In addition, fish processing vessels built or converted after July 27, 1990, must meet all the survey (inspection) and classification requirements of the American Bureau of Shipping or another classification

[67] Marine surveyors conduct inspections, surveys, or examinations of marine vessels to assess, monitor, and report on their condition and the products on them. Surveyors can work for classification societies, for the government, or privately.

society and carry on board a certificate of class (46 CFR 28.720). A certificate of class is valid for 5 years and requires periodic surveys and inspections to maintain validity.

Vessels Subject to Load Line Requirements. Load lines are marks at the midpoint along each side of a vessel's hull that establish a safe minimum freeboard (distance between the waterline under a full load and the uppermost continuous watertight deck). The purpose of a load line is to ensure the seaworthiness of an intact (undamaged) vessel and prevent overloading. As a vessel is loaded, its draft (distance from hull bottom to waterline) increases. To prevent overloading or vessel instability, the load line mark should not be allowed to go below the waterline.

Compulsory load line marks were first established by the United Kingdom in 1876, in response to a high number of ship losses. The United States enacted its first load line laws in 1929, and the first convention establishing international standards for load lines was passed in 1930. The convention applied only to merchant vessels of 150 gross tons or over. The United States acceded to the 1930 convention and established relevant regulations. A second international convention was held in 1966, which superseded the 1930 convention. The 1966 convention entered force in 1968. It applies to all new vessels of 79 feet or longer and to all existing vessels of 150 gross tons or over that engage in foreign voyages, with the exception of five classes of ships, including fishing vessels. The convention is administered by the International Maritime Organization, a specialized agency of the United Nations, and is periodically amended by the Load Line Protocol of 1988.

Load line regulations for U.S. vessels operating solely on domestic routes are established by the Coast Guard (46 CFR Parts 42-47 [subchapter E]). Most commercial U.S. vessels 79 feet or longer must have a valid load line certificate when sailing outside the U.S. boundary line (the baseline of the U.S. territorial sea, normally the low-water line along the coast). Coast Guard regulations designate the American Bureau of Shipping as the prime authority for issuing domestic load line certificates. The placement of load line marks is calculated, and attested to, by the issuing authority.

Vessel owners are responsible for obtaining load line certificates. Obtaining a load line certificate requires obtaining a stability letter from the Coast Guard (46 CFR 42.09-1), which entails having a vessel tested for stability and then submitting a stability booklet. A load line certificate, valid for 5 years, is subject under 46 CFR 42.09 to annual verification surveys, in which the issuing authority visits the vessel to verify that its watertight integrity is maintained and that the vessel's hull openings, valves, fittings, and freeing ports (openings in the bulwark close to the deck that allow water to drain overboard), as well as the access to crew quarters, are kept in good general condition and that the vessel has not been altered in ways that might affect the position of the load line marks.

Fishing vessels are exempted from the load line requirements by 46 U.S.C. 5102(b)(3). Fish tender vessels and fish processing vessels 79 feet or longer are subject to load line regulations and associated inspection requirements (except where grandfathered) to ensure the integrity of the hull and all watertight and weathertight closures (46 U.S.C. chapter 51). Fish processing vessels of not more than 5,000 gross tons that are not on a foreign voyage are excluded from the load line requirements if they were constructed before August 16, 1974, or were converted for use as a fish processing vessel before January 1, 1983 (46 U.S.C. 5102[4]). Owners, charterers, managing operators, agents, masters, and individuals in charge of a vessel who violate the load line laws or regulations are each liable for civil penalties of not more than $5,000, with each day of a continuing violation counting as a separate violation (46 U.S.C. 5116).

History of U.S. Fishing Vessel Safety Regulations[‡]

The earliest Federal maritime safety laws date from 1838, when legislation was enacted requiring inspection of steam vessels and protection of their passengers. In 1852, Congress passed the Steamboat Act, which established the Federal Steamboat Inspection Service and required all vessels to be inspected and both pilots and engineers to be licensed by the local inspectors of the Service.[68] Some vessels, such as ferries and tugboats, were exempted, but not fishing vessels.[69] Later legislation required that most passenger and commercial vessels be inspected, regardless of the means of propulsion. The Officers' Competency Certificates Convention of 1936 required licensing of masters, mates, and engineers on all documented vessels over 200 gross tons operating on the high seas (see 46 U.S.C. 8304).

In the 1930s, Congress adopted legislation subjecting seagoing motor vessels of 300 gross tons and over to the regulations applicable to steam vessels. Fishing vessels were exempted. No legislation specifically applicable to fishing vessels would be adopted for 50 years, although several bills were introduced after 1941 that specifically addressed commercial fishing vessel safety.

In 1968, the Coast Guard conducted a comprehensive study of fishing vessel safety in the United States that recommended the licensing of masters, the full inspection and certification of new vessels, and mandatory and voluntary standards for existing vessels.[70] The Secretary of Transportation did not support the recommendations.

In 1978, the Coast Guard established a voluntary dockside examination program for uninspected vessels, but the program was terminated a few years later because of budget cuts. In February 1983, the vessels *Americus* and *Altair* (referred to as the A-boats), both loaded with crab traps, capsized in the Bering Sea between the Pribilof Islands and Unalaska Island, with the loss of 14 fishermen. The Coast Guard and the NTSB, after a joint investigation of the A-boat

‡ The history summarized in this section owes much to a paper by Richard C. Hiscock, "Fishing Vessel Safety in the United States: The Tragedy of Missed Opportunities," *Proceedings of International Fishing Industry Safety and Health Conference, Woods Hole, Massachusetts, October 23-25, 2000,* pp. 99–121.

68 In 1932, the Steamboat Inspection Service merged with the Bureau of Navigation, which, after reorganization in 1936 as the Bureau of Marine Inspection and Navigation, was transferred to the U.S. Coast Guard in 1942.

69 Vessels exempted from the 1852 law were made subject to the laws for inspection and licensing in 1871. Lloyd M. Short, *Steamboat-Inspection Service: Its History, Activities and Organization*, Institute for Government Research, service monographs of the United States government, no. 8 (New York: D. Appleton and Company, 1922), p. 9.

70 Planning Office of Merchant Marine Safety, *A Cost Benefit Analysis of Alternative Safety Programs for U.S. Commercial Fishing Vessels* (Washington, DC: U.S. Coast Guard, 1971). Cited in Hiscock, p. 104.

accidents, recommended that the Coast Guard require stability analyses of new or modified vessels, adopt a modified load line system, and seek authority to impose minimum competency standards and license fishing vessel masters.[71] The Commandant of the Coast Guard preferred a voluntary approach that "would require no legislation and would have no disruptive effect on industry."[72]

In August 1983, a House subcommittee held hearings on marine safety, during which it was suggested that the laws for uninspected vessels be amended to permit the Coast Guard to develop comprehensive regulations for all uninspected vessels. Although no action was taken on that suggestion, in 1984 Congress amended the statutes by defining the three types of commercial fishing industry vessels noted earlier (fishing vessel, fish processing vessel, and fish tender vessel),[73] exempting fish processing vessels of less than 5,000 gross tons and fish tender vessels of less than 500 gross tons from inspection (46 U.S.C. 3302), and adopting a new chapter (chapter 45) setting forth requirements for fish processing vessels.

Also in 1984, the Coast Guard Office of Merchant Marine Safety established a voluntary fishing vessel safety program, consisting of standards issued in a navigation and vessel inspection circular (NVIC 5-86) and a safety manual developed jointly by the Coast Guard and the North Pacific Fishing Vessel Owners' Association.[74]

In 1986, the *Western Sea*, a 70-year-old purse-seiner with a crew of six, disappeared in the Bering Sea. The body of one crewmember was recovered. The crewmember's parents campaigned for mandatory safety standards for commercial fishing vessels, and by 1987, bills were introduced to address fishing vessel safety and insurance liability. In 1988, Congress passed the Commercial Fishing Industry Vessel Safety Act. As a result, the Coast Guard published new regulations that required safety and emergency equipment on uninspected fishing industry vessels. For example, all fishing vessels operating at least 3 nautical miles from the U.S. coastline were required to have EPIRBs on board. Compliance with the regulations depended on

[71] See *Fishing Vessel* Americus, *O.N. 595758, Capsizing and Sinking—Fishing Vessel* Altair, *O.N. 618390, Disappearance on or about 14 February 1983 in the Bering Sea with Presumed Multiple Loss of Life*, Marine Casualty Report USCG 16732/0002 HQS 83 (Washington, DC: U.S. Department of Transportation, U.S. Coast Guard, 1985); and *Capsizing of the U.S. Fishing Vessel* Americus *and Disappearance of the U.S. Fishing Vessel* Altair, *Bering Sea North of Dutch Harbor, Alaska, February 14, 1983*, Marine Accident Report NTSB/MAR-86/01 (Washington, DC: National Transportation Safety Board, 1986).

[72] Quoted in Hiscock, p. 105.

[73] The law was amended in the Commercial Fishing Industry Vessel Act of 1984. According to a Coast Guard document, Congress defined the three types of commercial fishing industry vessels because "fishing vessel owners were concerned that the definition of fish processing vessel being crafted in 46 U.S.C. 2101 (11b) would include their vessels that catch and process. . . . Certain preparations conducted on fishing vessels were excluded from the definition of a fish processing vessel." (Commandant, U.S. Coast Guard, letter [regarding Fish Processor and Fish Tender Vessels Load Line Issue] to Commander, Thirteenth Coast Guard District, June 12, 1990.)

[74] *Voluntary Standards for U.S. Uninspected Commercial Fishing Vessels*, NVIC-5-86 (Washington, DC: U.S. Department of Transportation, U.S. Coast Guard, 1986). The North Pacific Fishing Vessel Owners' Association *Vessel Safety Manual*, now in its 5th edition, is available from <http://www.npfvoa.org/pages/materials.html>.

vessel length, documentation (state vs. federal), number of persons on board, operating criteria (cold water, operating beyond the boundary line), and major conversion.[75]

As mandated by the Commercial Fishing Industry Vessel Safety Act, the National Research Council conducted a study on fishing vessel safety and the need for vessel inspections. Its report, *Fishing Vessel Safety—Blueprint for a National Program*, was published in 1991.[76] The Coast Guard endorsed several of its recommendations, including the establishment of an inspection program for commercial fishing industry vessels, and in November 1992, submitted a report to Congress calling for the inspection of commercial fishing industry vessels.[77] The plan recommended a three-tiered, risk-based inspection program based on the length of the vessel, rather than on whether it was defined as a fishing vessel, fish processing vessel, or fish tender vessel:

1. Self-examination for all commercial fishing industry vessels, new and existing, less than 50 feet long. The existing requirements of the fishing vessel safety regulations at 46 CFR Part 28 would apply.
2. Third-party inspection for all commercial fishing industry vessels, new and existing, of length greater than or equal to 50 feet but less than 79 feet. The vessels would be examined for compliance with the fishing vessel regulations at 46 CFR Part 28.
3. Coast Guard inspection and load line assignment for all commercial fishing industry vessels, new and existing, greater than or equal to 79 feet in length. The vessels would be required to meet fishing vessel safety regulations at 46 CFR Part 28, load line requirements, and additional hull and machinery standards, which for new vessels would include design and construction to classification society standards. Existing vessels would have to meet similar requirements, including having load lines within 10 years.

When the Coast Guard submitted the inspection plan to Congress, it indicated that voluntary measures were not sufficient to ensure that vessels were fit for their intended service and that the tiered mandatory approach would increase safety and be less onerous to owners and operators. Congress did not grant legislative authority to the Coast Guard for its inspection plan.

Voluntary Dockside Examinations

Lacking the authority to inspect commercial fishing industry vessels, the Coast Guard began an outreach and education program that included voluntary dockside examinations. (The Coast Guard has the authority to board fishing vessels at sea, but not at the dock, and examine their safety arrangements, regardless of whether the vessels participate in the dockside

[75] Major conversion is defined at 46 CFR 28.50 as "a conversion that (1) substantially changes the dimensions or carrying capacity of the vessel; (2) changes the type of vessel; (3) substantially prolongs the life of the vessel; or (4) otherwise so changes the vessel that it is essentially a new vessel, as determined by the Commandant."

[76] Washington, DC: National Academy Press.

[77] *Report to Congress for the Inspection of Commercial Fishing Industry Vessels* (Washington, DC: U.S. Coast Guard, November 12, 1992).

examination program.) Safety equipment such as liferafts and fire extinguishers are checked during a dockside examination,[78] but the examination does not address a vessel's material condition or watertight integrity. Vessel operators are advised in writing of deficiencies noted during a voluntary dockside examination, but no citations are issued during an examination, and vessels are not targeted for at-sea boardings if deficiencies are noted during a voluntary dockside examination.[79]

Vessels that successfully complete a voluntary dockside examination are issued an examination decal to be installed on a wheelhouse window, provided that any deficiencies are rectified. The decals, which are valid for 2 years, are not required by law or regulation. In the Alaska groundfish fisheries, NMFS requires a vessel that carries fishery observers to have a current decal verifying that it has passed a dockside safety examination. A NMFS observer is not allowed to ride the vessel unless it has a decal. Without a NMFS observer, the vessel is not allowed to fish. Requirements for carrying NMFS observers are discussed in the next section.

Nationally, according to the Coast Guard, 12.4 percent of fishing vessels measuring 5 tons or greater took part in the voluntary dockside examinations in 2008, up from 11 percent in 2007. In Alaska, participation was higher (about 80 percent, according to the commercial fishing vessel examiner in Dutch Harbor) because of the NMFS requirement for a decal.

Management of Alaska Fisheries

Alaska's four main commercial fisheries—salmon, shellfish, groundfish, and herring—fall under various state and Federal management jurisdictions. After the United States purchased Alaska from Russia in 1867, the Federal government assumed regulatory power over Alaska's fisheries. In 1959, when Alaska became a state, it took control of its fisheries but had no authority outside the 3-mile U.S. territorial limit.[80]

In 1966, the United States established an exclusive fishery zone that stretched from 3 to 12 miles offshore. By that time, the commercial fishing industry in the Bering Sea and Gulf of Alaska was dominated by foreign fleets, primarily those of Japan and the Soviet Union. Since the 1950s, the United States had entered into agreements with those and other nations to prevent overfishing but had no authority to enforce catch limits and other provisions. The foreign fleets employed stern trawlers and large factory ships that in 1971 caught and processed nearly 2 million tons of groundfish off Alaska.[81]

In 1976, Congress passed the Fishery Conservation and Management Act, later renamed the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.),

[78] See appendix B for a list of items examined by Coast Guard District 17 (Alaska).

[79] Commandant Instruction 16711.13B, "Implementation of the Commercial Fishing Industry Vessel Regulations" (Washington, DC: U.S. Department of Transportation, U.S. Coast Guard, August 17, 1995).

[80] In December 1988, President Reagan extended the U.S. territorial sea to 12 nautical miles.

[81] *Alaska Groundfish Fisheries*, appendix B, "History of Alaska Groundfish Fisheries and Management Practices," p. B-14.

whose purpose was "to provide for the conservation and management of the fisheries." The act gave the Federal government authority over fisheries in a fishery conservation zone (later designated an exclusive economic zone, or EEZ) extending outside coastal state waters[82] to 200 miles offshore. The Federal government manages all Alaska groundfish fisheries in the EEZ, with management authority vested in NMFS.

The Alaska Department of Fish and Game is the primary state fisheries management agency, directed by the Alaska Board of Fisheries. The state has management authority for the salmon, herring, and shellfish fisheries and also manages the groundfish fisheries between the EEZ and the shore. Halibut, which are not considered groundfish, are managed by the International Pacific Halibut Commission, established in 1963. The Marine Mammal Protection Act and the Endangered Species Act, under NMFS management, restrict Alaska fisheries to protect seals and sea lions, sea birds, and migrating salmon.[83] Treaties between the United States and Canada regulate fisheries for salmon and halibut that cross international boundaries.

Amendment 80 Vessels. The North Pacific Fishery Management Council, one of eight regional councils established under the Magnuson-Stevens Fishery Conservation and Management Act, creates fishery management plans for the EEZ. The groundfish fishery management plan for the Bering Sea/Aleutian Island management area (groundfish in the Gulf of Alaska are managed under a separate plan) was originally implemented in 1982 and has been amended numerous times. In September 2007, NMFS published a final rule implementing Amendment 80 to the groundfish fishery management plan for the Bering Sea and Aleutian Islands (50 CFR Part 679). One provision of the rule identified and limited the vessels that would be eligible for a license to fish for certain species of groundfish (Amendment 80 species[84]) in the fishery. Title 50 CFR Part 679 lists 28 Amendment 80 vessels that are permitted to fish in the EEZ (table 4).

The goal of Amendment 80 was to reduce the high rates of discard and waste associated with the groundfish fisheries by limiting access and encouraging the formation of fishing cooperatives, which offer benefits such as more efficient harvesting and lower operational costs. The Amendment 80 vessels were apportioned a quota share for each species, based on the vessels' historical catch. The quota share can be used only on an Amendment 80 vessel, and "cannot be divided or transferred separately from that Amendment 80 vessel."[85] Amendment 80 contains no provision for replacement of a vessel that sinks or is otherwise considered a total loss. However, a provision allows owners of lost vessels to use the catch history of those vessels to apply for participation in an Amendment 80 cooperative.

[82] The coastal waters of states bordering the Atlantic and Pacific oceans extend 3 miles offshore. The boundaries of states along the Gulf of Mexico also extend 3 miles offshore, except for Texas and the west coast of Florida, where the state waters extend 9 nautical miles offshore.

[83] *Commercial Fisheries of Alaska*, Special Publication no. 05-09 (Anchorage, Alaska: Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services, June 2005).

[84] The Amendment 80 species for the Bering Sea/Aleutian Island regulatory area are as follows: Aleutian Island Pacific ocean perch, Atka mackerel, flathead sole, Pacific cod, rock sole, and yellowfin sole. Pollock, the most abundant fishery resource in the area, are managed under separate legislation—the American Fisheries Act, enacted in October 1998.

[85] *Federal Register*, vol. 72, no. 178 (September 14, 2007), p. 52672.

Table 4. Amendment 80 vessels, with year built and age in 2009.

Vessel	Year Built	Age in 2009 (years)
Alaska Juris	1975	34
Alaska Ranger (sank 2008)	1973	--
Alaska Spirit	1974	35
Alaska Voyager (inactive)	1971	38
Alaska Victory	1975	34
Alaska Warrior	1978	31
Alliance	1980	29
American No. 1	1979	30
Arctic Rose (sank 2001)	1988	--
Arica	1973	36
Bering Enterprise (inactive)	1979	30
Cape Horn	1983	26
Constellation	1981	28
Defender	1984	25
Enterprise	1983	26
Golden Fleece (inactive)	1979	30
Harvester Enterprise (inactive)	1977	32
Legacy	1983	26
Ocean Alaska	1980	29
Ocean Peace	1984	25
Prosperity (inactive)	1979	30
Rebecca Irene	1986	23
Seafisher	1976	33
Seabreeze Alaska	1968	41
Tremont	1970	39
U.S. Intrepid	1979	30
Unimak	1981	28
Vaerdal	1979	30
Average age, 21 active vessels		30.38

To date, two of the vessels on the Amendment 80 list have sunk. One is the *Alaska Ranger*. The other is the *Arctic Rose*, which in 2001 sank in the Bering Sea with the loss of all 15 crewmembers.[86] After the sinking, the owner purchased another vessel and sued the U.S.

[86] The *Arctic Rose* was placed on the Amendment 80 list, although it had already sunk, so that the owner could retain the vessel's quota share permit to fish for Amendment 80 species.

Department of Commerce to allow it to replace the *Arctic Rose*. In May 2008, the U.S. District Court for the Western District of Washington issued a decision invalidating the regulatory provisions that limited the vessels used in the Amendment 80 program, describing the regulations as “arbitrary, capricious, and otherwise not in accordance with law.” The decision concluded: “The Amendment 80 regulations shall be vacated and remanded to NMFS to the extent they have been found unreasonable.”

In October 2008, NMFS determined to comply with the court’s ruling by permitting the replacement of an original Amendment 80 vessel that has suffered an “actual total loss, constructive total loss, or permanent ineligibility of that vessel to receive a fishery endorsement under 46 U.S.C. 12108.”[87] The replacement vessel will be considered an Amendment 80 vessel. The court did not specify the size or capacity of the replacement vessel. The North Pacific Fishery Management Council is scheduled to meet in February 2010 to consider revisions to the regulations for Amendment 80 vessels.

Observer Program. NMFS uses fishery observers to collect catch and bycatch[88] data from U.S. commercial fishing and processing vessels. The observers collect data on the species and weights of the catch as well as on fishing positions and fishing effort. The data are used to help sustain and rebuild protected species.[89]

NMFS began placing observers on foreign fishing vessels off Alaska in 1973.[90] Originally, the countries had to request observers, but the Magnuson-Stevens Act required that foreign vessels accept observers. In 1978, American fishermen began fishing for groundfish in joint ventures with foreign processing vessels. By 1986, all foreign fishing operations were halted, and by 1991, all foreign joint-venture processing in the EEZ of the Bering Sea and Gulf of Alaska was terminated.

NMFS began placing observers on domestic vessels in 1986. The current domestic observer program was authorized in 1989 by Amendments 13 and 18 to the groundfish fish management plans for the EEZ, and the North Pacific Groundfish Observer Program was implemented in February 1990. Under the plan, groundfish vessels under 60 feet long are not required to carry observers, those longer than 60 feet but shorter than 125 feet are required to carry observers 30 percent of their fishing time, and vessels 125 feet and longer are required to carry observers 100 percent of their fishing time.

---

[87] Reported in “Implementation and [sic] of Amendment 80 Vessel Replacement Provisions, *Arctic Sole Seafoods v. Gutierrez*, NMFS Alaska Region, Presented at the October NPFMC Meeting, 2008” <www.fakr.noaa.gov/sustainablefisheries/amds/80/vesselreplaceprovisions08.pdf> (accessed November 20, 2008).

[88] “Bycatch” means fish or other marine life unintentionally caught while fishing for a target species.

[89] Information obtained from NOAA website <www.st.nmfs.noaa.gov/st4/nop/index.html> (accessed November 24, 2008).

[90] Information in this and the next paragraph obtained from “Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for a Fishery Management Plan Amendment to Establish a New Program for Observer Procurement and Deployment in the North Pacific,” preliminary draft (North Pacific Fishery Management Council, National Marine Fisheries Service, and Alaska Fisheries Science Center, November 22, 2004).

Amendment 80 vessels in the Bering Sea/Aleutian Island fisheries are required to have at least two NMFS observers on board each day that they harvest, receive, or process groundfish (50 CFR 679.50[c][6][i]). Processors in the Gulf of Alaska are required to have at least one NMFS observer during groundfish operations (50 CFR 679[c][6][ii]). Processors on shore are also required to have observers on days when they receive or process groundfish. In 2002, according to the draft environmental assessment cited earlier, 340 individual observers served on board 312 vessels and 20 processing facilities. Vessel and plant owners pay for the cost of the observers; the costs of managing the program are covered by the Federal government.

Safety Measures Targeted to Alaska Fleet

Interim Enforcement Program. In March 1990, the 162-foot-long vessel *Aleutian Enterprise* capsized and sank while trawling for fish in the Bering Sea. Nine of the 31 persons on board were missing after the accident and presumed drowned. After the sinking, the Coast Guard determined that "a significant number of similar vessels" in the Alaska fleet met the definition of fish processor but did not meet the requirements (at that time, for load line only) for that type of vessel.[91] The Coast Guard responded by creating an interim enforcement program for those vessels. According to the program implementation document, vessels were allowed to enter the program, and therefore continue fish processing, if they showed a "good faith" effort to acquire a load line by applying to a classification society.

Alternate Compliance and Safety Agreement. In 2006, the Coast Guard announced the formation of ACSA, a voluntary examination program that was intended to provide a level of safety for the Alaska fleet that would be equivalent to that resulting from compliance with the requirements for class and load line certification. ACSA resulted from the Coast Guard's investigation of the sinking of the fishing vessel *Arctic Rose*[92] in 2001, which, as noted earlier, resulted in 15 deaths, and the 2002 explosion, fire, and sinking of the fishing vessel *Galaxy* in the Bering Sea, which resulted in 3 deaths. The Coast Guard concluded after those investigations that the Alaska H&G fleet was engaged in fish processing by definition and thus was subject to the requirements for third-party examinations at 46 CFR 28.710 and 28.720 and to the load line requirements at 46 CFR subchapter E. In August 2006, the Coast Guard announced in the *Federal*

[91] *Program for the Interim Operation of Fishing Industry Vessels Requiring Load Lines* (Washington, DC: U.S. Department of Transportation, U.S. Coast Guard, July 1990).

[92] In its report on the *Arctic Rose* accident, the Coast Guard Marine Board of Investigation concluded that "the exact cause of this casualty is not known," but that "[t]he loss of the *Arctic Rose* was most likely caused by progressive flooding from the aft deck into the processing space." The Marine Board recommended, among other actions, that the Coast Guard "seek a legislative change and require fishing vessels and fish processors (including Head and Gut operations) over 79 feet long to meet the stability requirements in 46 CFR Part 28, Subpart E, or remove the exemption for fishing vessels in 46 CFR subchapter E and require load line assignment." The Coast Guard Commandant favored a voluntary compliance approach, using an updated version of NVIC 5-86. (*Investigation into the Circumstances Surrounding the Sinking of the Uninspected Fishing Vessel* Arctic Rose, *Official Number 931446, in the Bering Sea on April 2, 2001, with One Person Deceased and Fourteen Persons Missing and Presumed Dead* [Washington, DC: U.S. Department of Homeland Security, U.S. Coast Guard, December 19, 2003; amended May 20, 2004]).

Register its determination that vessels in the H&G fleet "constitute fish processing vessels for regulatory purposes."[93]

The Coast Guard's ACSA policy document[94] identified the operations of the H&G fleet as presenting significant safety risks because of "fleet-wide deficiencies in vessel stability, watertight integrity, and maintenance . . . [and in] emergency training, drills, and crew safety competencies." The policy document also noted that

> H&G operations require a sizeable crew, processing and freezing machinery, hazardous gases (anhydrous ammonia or Freon), and large amounts of packaging materials on board. Additionally, because of their ability to freeze, package and store frozen catch, these vessels can operate in the most remote areas of the Bering Sea, far from search and rescue support.

The Coast Guard considered several options for improving the safety of the H&G fleet. One was to require vessels operating without being classified or having load line certificates to stop activities considered fish processing. The Coast Guard rejected that option on the grounds that it would not improve the safety of those vessels, because even if they stopped fish-processing activities, they could continue fishing without meeting stricter safety requirements. Another option was to bring the entire fleet into compliance with the classification and load line safety requirements. That option was deemed impractical because of the time and cost involved in bringing the aging fleet up to class standards.

A third option was to exempt the H&G fleet from the survey and classification requirements of 46 CFR 28.720 and the load line requirements of 46 CFR subchapter E, using the Coast Guard's exemption authority at 46 CFR 28.60. In selecting that option, the Coast Guard established ACSA, as stated in its policy document, "to achieve an equivalent level of safety to classification and load line requirements." Vessel owners wishing to participate in the ACSA program were required to submit an application (technically, an application for exemption from the class and load line requirements) by July 15, 2006. According to Coast Guard guidance,[95] applicants were to provide documentation of "good cause" for the exemption and details of how they would provide an equivalent level of safety. Vessels that did not enter the program would be required to suspend fishing activities considered processing, as monitored by NMFS catch records.

Before the ACSA program was launched, the Coast Guard identified 64 vessels as constituting the H&G fleet. Coast Guard documents indicate that all those vessels submitted applications**.** Not all remained in the program, however, for various reasons. For example, some had already been classed and load lined. Some vessels were accepted for the program even though the operating company submitted only a brief application that did not include the

[93] *Federal Register*, vol. 71, no. 162 (August 22, 2006), p. 48932.

[94] "Alternative Compliance and Safety Agreement (ACSA) for the Bering Sea/Aleutian Island and Gulf of Alaska Freezer Longliner and Freezer Trawler Fishing Fleets," signed by Commander, Thirteenth Coast Guard District, and Commander, Seventeenth Coast Guard District, June 15, 2006.

[95] U.S. Coast Guard Commandant, "Exemption Letters for Existing Fish Processing Vessels," policy letter 06-03, July 1, 2006.

documentation required by the Coast Guard guidance document. All examinations and correction of deficiencies were supposed to have been completed by January 1, 2008 (with the possibility of a 6-month extension). A Coast Guard document dated January 2008 lists only seven vessels as being in full compliance with the ACSA requirements.

The program was administered from Seattle, the home port of the H&G fleet, and the examinations were conducted primarily by a marine inspector from Coast Guard Sector Seattle. Tracking and managing all the vessels that were attempting to meet the ACSA requirements proved too much for one person, and the Coast Guard did not know the status of most vessels well after the compliance deadlines had passed. At the end of February 2008, the Coast Guard issued a 30-day blanket extension to vessels that had applied to the program but had not yet met the requirements, with a request that the owners inform the Coast Guard about the status of outstanding work. According to the Coast Guard, 53 vessels had completed the ACSA requirements and were enrolled in the program as of the date of this report.

Class and Load Line History of *Alaska Ranger*

According to documentation supplied by the American Bureau of Shipping, when the *Alaska Ranger* went into service in 1973 as the offshore supply vessel *Ranger*, it was issued a certificate of class attesting to its compliance with classification society standards relating to design, construction, and equipment. American Bureau of Shipping records show that the vessel's certificate of class was maintained through September 1984. No certificate of class was issued after 1984.

The American Bureau of Shipping issued a load line certificate to the *Ranger* in 1974. The *Ranger*'s last load line certificate was issued in 1979. That certificate expired in 1984.

After it was converted to a fishing vessel in 1989, the *Alaska Ranger* was not required to be surveyed by a classification society or to possess a load line certificate. However, in October 1990, Fishing Company of Alaska had a fillet line (a conveyor belt or table at which workers hand-fillet fish) installed on the *Alaska Ranger*, which changed the vessel's status to that of fish processor and required it to have a load line.

The Coast Guard affirmed that the vessel required a load line because of the fillet line.[96] At the time, the Coast Guard was operating the interim enforcement program, described earlier, that required fish processors to acquire load lines. Fishing Company of Alaska's naval architecture firm had conducted the required stability tests in October 1990. The firm prepared a stability booklet for the *Alaska Ranger*, which was approved by the American Bureau of Shipping in April 1991 but which the Coast Guard rejected. A fixed ballast keel was added to the vessel in November 1991, and the naval architect submitted an updated stability booklet to the

[96] Initially, the Coast Guard determined that because the "conversion" from fishing vessel to fish processing vessel occurred after July 27, 1990, the *Alaska Ranger* would be required to "meet all survey and classification requirements prescribed by the American Bureau of Shipping." Coast Guard policy then changed, according to the chief of the Coast Guard inspection department in Seattle at the time, and reclassifying the vessel from a fishing vessel to a fish processor was not considered a major conversion. Therefore, the Coast Guard did not require the *Alaska Ranger* to meet classification society requirements.

Coast Guard in January 1992. The Coast Guard approved the booklet and issued a stability letter to the *Alaska Ranger* in May 1992. The American Bureau of Shipping issued a provisional load line certificate to the vessel in December 1992, then issued a full-term certificate in May 1993.

The American Bureau of Shipping issued another load line certificate to the *Alaska Ranger* in June 1996. Fishing Company of Alaska maintained the load line certificate through annual surveys until December 1998, after which the certificate expired. The *Alaska Ranger* operated without a load line certificate from then on. In 2006, the *Alaska Ranger* was accepted into the Coast Guard's ACSA program. As discussed earlier, vessels that met the requirements of the ACSA program were exempted from the classification and load line requirements applicable to fish processing vessels.

Previous NTSB Recommendations Regarding Certification and Inspection

In 1987, the NTSB published a study addressing the safety of uninspected commercial fishing vessels.[97] The study reviewed 203 fishing vessel accidents investigated by the NTSB over an 18-year period. The study was prompted by Coast Guard data indicating a dramatic rise in fatalities from such accidents. In its study, the NTSB addressed licensing requirements for masters, training requirements for masters and crewmembers, minimum standards for vessel stability, requirements for basic safety equipment, alcohol and drug use in commercial fishing vessel operations, and oversight of fishing vessel safety. The study concluded that "the commercial fishing vessel industry is one of the highest risk industries in the world and has the poorest safety record of any industry in the United States."

A year after the NTSB published its safety study, Congress passed the Commercial Fishing Industry Vessel Safety Act of 1988. The Coast Guard's new regulations for commercial fishing vessels incorporated many of the recommendations in the NTSB's safety study, including requirements for commercial fishing vessels to have basic lifesaving equipment and EPIRBs on board. According to the Coast Guard, fatalities among fishermen have decreased from an average of 120 per year before the act was passed to about 42 per year.[98]

In its 1987 safety study, the NTSB asked the Coast Guard to seek legislative authority to require that all uninspected commercial fishing vessels be certified and periodically inspected by the Coast Guard or its recognized representative to ensure that the vessels met all applicable Federal safety standards (Safety Recommendation M-87-64). The NTSB reiterated the recommendation four times, as a result of its investigations of a series of fatal accidents involving uninspected vessels in the Alaska fishing fleet: the sinking of the *Uyak II* in 1987, the

[97] *Uninspected Commercial Fishing Vessel Safety*, Safety Study NTSB/SS-87/02 (Washington, DC: National Transportation Safety Board, 1987).

[98] Statement by Coast Guard Assistant Commandant for Prevention to Subcommittee on Coast Guard and Maritime Transportation, Committee on Transportation and Infrastructure, U.S. House of Representatives, April 25, 2007, p. 8.

sinking of the *Wayward Wind* in 1988, the sinking of the *Aleutian Enterprise* in 1990, and the sinking of the *Sea King* in 1991.[99]

- In November 1987, the 115-foot-long fishing vessel *Uyak II* capsized and sank in the Gulf of Alaska while its crew was attempting to correct a 3° to 4° list to starboard. Four of the persons on board died. The NTSB determined that the probable cause of the accident was the relief captain's failure to determine the cause of the list and to take proper corrective action. Contributing causes were the failure to repair a small opening that allowed water to enter the lazarette,[100] an inoperative high-water alarm, the relief captain's fatigue, and the lack of stability training. A former chief engineer had disconnected the high-water alarm for the lazarette because of its noise. The NTSB concluded that the disconnecting of the alarm illustrated the need for regular maintenance and periodic inspection on fishing vessels and reiterated Safety Recommendation M-87-64.
- In January 1988, the 86-foot-long vessel *Wayward Wind* flooded and sank in the Gulf of Alaska while fishing for crabs. It was the fourth in a fleet of six similar vessels to be lost by sinking. Four of the six *Wayward Wind* crewmembers died in the accident. The NTSB determined that the probable cause of the sinking was undetected flooding of the lazarette and subsequent flooding of the aft fish hold. Among the contributing causes was the failure to inspect the vessel and to install bilge alarms in the lazarette and aft fish hold. The NTSB concluded that the design of the bilge drainage system most likely provided a path for progressive flooding, which would not have been allowed by existing Coast Guard regulations for bilge systems on inspected vessels. The accident illustrated the need for regular maintenance and inspection of fishing vessels, and the NTSB reiterated Safety Recommendation M-87-64 for the second time.
- In March 1990, the 162-foot-long fish processing vessel *Aleutian Enterprise* capsized and sank while trawling for fish in the Bering Sea. Nine of the 31 persons on board were missing after the accident and presumed drowned. The NTSB determined that the probable cause of the capsizing and sinking was the company's failure to provide adequate crew training, operating procedures, maintenance, and safety oversight of its vessels and the master's "imprudent" decision to continue hauling in a loaded net while the vessel was listing to port. In its report, the NTSB stated its opposition to a self-inspection program for uninspected commercial fishing industry vessels, as the Commercial Fishing Industry Vessel Advisory Committee had recommended to the Coast Guard, and reiterated Safety Recommendation M-87-64 for the third time.

---

[99] C*apsizing and Sinking of the U.S. Fishing Vessel* Uyak II *in the Gulf of Alaska Near Kodiak Island, Alaska, November 5, 1987*, Marine Accident Report NTSB/MAR-88/08 (Washington, DC: National Transportation Safety Board, 1988); *Sinking of the U.S. Fishing Vessel* Wayward Wind *in the Gulf of Alaska, Kodiak Island, Alaska, January 18, 1988*, Marine Accident Report NTSB/MAR-89/01 (Washington, DC: National Transportation Safety Board, 1989); *Capsizing and Sinking of the Fish Processing Vessel* Aleutian Enterprise *in the Bering Sea, March 22, 1990*, NTSB/MAR-92/03 (Washington, DC: National Transportation Safety Board, 1992); and *Capsizing and Sinking of the U.S. Fishing Vessel* Sea King *Near Astoria, Oregon, January 11, 1991*, Marine Accident Report NTSB/MAR-92/05 (Washington, DC: National Transportation Safety Board, 1992).

[100] The lazarette is a belowdecks storeroom, usually the farthest aft compartment.

- In January 1991, the 76-foot-long fishing vessel *Sea King* capsized and sank while being towed by the Coast Guard across the Columbia River bar between Oregon and Washington. The vessel had reported that it was taking on water and needed assistance. Of the seven persons on board, two crewmembers and one Coast Guardsman drowned. The *Sea King* had flooded at least twice in the 3 months before the accident. The NTSB determined that the probable cause of the sinking was the Coast Guard's failure to identify the source and scope of the flooding and to dewater the vessel before attempting to tow it across the bar, and the operator's failure to inform the Coast Guard of the status of the vessel's drainage system. The NTSB further determined that had the *Sea King* been an inspected vessel, its watertight integrity would probably have been maintained and the effectiveness of its bilge system improved, which could have prevented the accident. As a result, the NTSB reiterated Safety Recommendation M-87-64 for the fourth time.

In November 1992, the Coast Guard, stating that "the material condition of the vessel and equipment was a direct cause for over 85 percent of the known vessel-related casualties," submitted a plan to Congress to require inspection of all commercial fishing industry vessels.[101] As noted earlier, Congress failed to grant legislative authority to the Coast Guard for its inspection plan. On August 20, 1993, the NTSB classified Safety Recommendation M-87-64 "Closed—Acceptable Alternate Action," on the grounds that the Coast Guard's submittal of the plan had fulfilled the intent of the recommendation. The Board noted that it considered the Coast Guard's action "an important first step" toward improving commercial fishing vessel safety and further, that "an effective validation or oversight program is the only way to ensure that fishing vessels meet the intended safety standards."

The NTSB's report on the *Aleutian Enterprise* sinking noted that "similar vessels with equal numbers of persons on board and operating under the same hazards at sea are held to significantly different safety standards only because one may fillet the fish or preserve roe while the other does not."[102] The NTSB therefore recommended that the Coast Guard seek legislation to require load lines for fishing vessels not according to the type of vessel but according to the hazards and risks involved, such as the number of persons on board and the area of operation (Safety Recommendation M-92-25). The Coast Guard submitted legislative proposals to Congress, without success. On September 19, 2001, the NTSB classified Safety Recommendation M-92-25 as "Closed—Acceptable Action," on the basis of the Coast Guard's action in seeking the requested legislative authority, although it was not granted.

Proposed Legislation

In 2008, the recognized need for improved safety of uninspected commercial fishing vessels led to the introduction of a bill in the 110th Congress, House Resolution (H.R.) 2830, Coast Guard Authorization Act of 2008. Section 307 of the bill sought to amend the fishing vessel safety laws. The bill passed the House on April 24, 2008, and was placed on the Senate

[101] The plan is described in the "History of U.S. Fishing Vessel Safety Regulations" section.

[102] Marine Accident Report NTSB/MAR-92/03, p. 37.

legislative calendar on April 28. No action was taken before the 110th Congress adjourned on January 3, 2009.

In June 2009, the House introduced H.R. 2652, the Maritime Safety Act of 2009, into the 111th Congress. The legislation is similar to that proposed in section 307 of the Coast Guard Authorization Act of 2008. It calls for amending the statutes to require dockside examinations at least once every 2 years for uninspected commercial fishing industry vessels to which 46 U.S.C. 4502(b) applies, that is, vessels that (1) operate beyond 3 nautical miles from the baseline from which the territorial sea of the United States is measured, (2) operate with more than 16 individuals on board, or (3) in the case of a fish tender vessel, engage in the Aleutian trade. The bill proposes to modify the vessels to which survey and classification requirements apply, removing the exemption from load line requirements for new or newly converted fishing vessels (those built or undergoing major conversion after July 1, 2010) and requiring new commercial fishing industry vessels 50 feet or longer (those constructed after July 1, 2010) to be classed. In addition, it would require that after January 1, 2020, vessels described in 46 U.S.C. 4502(b) comply with "an alternate safety compliance program" (similar to ACSA) if they are (1) at least 50 feet long, (2) built before July 1, 2010, and (3) 25 years of age or older.

No licensing changes were proposed, but the bill would require masters of commercial fishing industry vessels to pass a training program in seamanship, stability, collision prevention, navigation, firefighting and fire prevention, damage control, personal survival, emergency medical care, emergency drills, and weather. Masters would be required to hold a valid certificate issued under that program and to complete refresher training at least every 5 years. Other provisions would establish programs to fund training in commercial fishing safety and research on methods of improving the safety of the commercial fishing industry.

On September 22, 2009, H.R. 3619 (Coast Guard Authorization Act of 2010) was introduced into Congress. H.R. 3619 includes as section 804 the same maritime safety provisions in H.R. 2652 that are described above. As of the date of this report, both bills were pending.

Other Information

Coast Guard Actions After Accident

ACSA Implementation. After the *Alaska Ranger* accident, the Coast Guard met with representatives of the commercial fishing vessel industry in Alaska to discuss ACSA implementation. A plan was developed to hold annual meetings for 5 years with Coast Guard personnel, industry representatives, and vessel owners and operators. As a result of the *Alaska Ranger* sinking, the Coast Guard also updated the ACSA examination criteria (for example, adding a requirement to inspect rudders on the same interval as for inspected vessels and in compliance with American Bureau of Shipping standards), created written guidelines for use by Coast Guard units involved in administering the program and by industry, and clarified the qualifications for those who conduct ACSA examinations. In addition, the Coast Guard established an oversight position for the ACSA program to track the status of enrolled vessels, conduct administrative duties such as correspondence, and assist in vessel examination. A marine inspector was added to assist Sector Seattle in examining vessels enrolled in ACSA.

The written guidelines for conducting ACSA examinations[103] contain a checklist related to belowdecks watertight integrity, plus instructions stating: “The importance of maintaining internal subdivision watertight integrity cannot be overemphasized.” The instructions further state:

> Prior to the first renewal of exemptions [from class and load line requirements] under 46 CFR 28.60, the OCMI [officer in charge, marine inspection] must be satisfied that all reasonable means have been taken by the operator to ensure the original condition of watertight integrity of all bulkheads below the main deck.

The Coast Guard provided the NTSB with a list of vessels participating in ACSA and the dates of their last exemption letter. The dates range from March 26, 2008, to July 17, 2009. Exemption letters are issued every 2 years.

Safety Alerts. The Coast Guard issued two marine safety alerts as a result of the *Alaska Ranger* sinking (appendix C). Marine safety alert 1-08, titled “Maintaining Vessel Watertight Integrity,” appeared on May 9, 2008. The safety alert, which did not name the *Alaska Ranger*, referred to the loss of a fishing vessel in the Bering Sea whose flooding “might have been exacerbated due to open or leaking watertight doors and other compartmental deficiencies which impacted the vessel’s overall watertight integrity.” The alert urged owners and operators to periodically inspect watertight decks and bulkheads; to ensure that crewmembers are familiar with the location of watertight doors; to ensure that watertight doors and hatches are closed while at sea; to implement an inspection and maintenance program for watertight doors; to regularly examine watertight hatches and other access holes; to inspect and maintain ventilation ducts with hinged covers; and to inspect and maintain cables, pipes, and other components that penetrate watertight bulkheads, decks, and compartments.

On July 2, 2008, the Coast Guard issued marine safety alert 3-08, titled “Controllable Pitch Propeller Systems and Situational Awareness.” which emphasized the need for owners, operators, and masters of vessels with controllable-pitch propeller systems to understand the design and operation of the systems, including their primary and emergency sources of power. The safety alert, without naming the *Alaska Ranger*, recounted the difficulty the crew had in launching the liferafts because the vessel was moving astern, and that as a consequence, two of the liferafts “traveled forward of the bow” and out of reach.

Company Actions After Accident

To comply with requirements of the ACSA program, Fishing Company of Alaska had a naval architecture firm examine its remaining six vessels (*Alaska Spirit*, *Alaska Warrior*, *Alaska Pioneer*, *Alaska Victory*, *Alaska Juris*, and *Alaska Patriot*) in June 2008. The naval architect used the Coast Guard’s ACSA checklist to inspect the vessels and issued reports documenting the

[103] *Guidance for Implementation of the Alternate Compliance and Safety Agreement Program* (Washington, DC: U.S. Department of Homeland Security, U.S. Coast Guard, February 2009).

findings and proposed repairs. Recommended repairs related to watertight integrity are summarized in table 5. According to Fishing Company of Alaska, repairs were completed between the 2008 and 2009 fishing seasons, and all vessels passed the Coast Guard ACSA examination before the 2009 season began.

Table 5. Partial ACSA examination results for Fishing Company of Alaska vessels, June 2008.

Recommended Repair	***Alaska Spirit***	***Alaska Warrior***	***Alaska Pioneer***	***Alaska Victory***	***Alaska Juris***	***Alaska Patriot***
Watertight Doors						
Service dogs (tighten, grease, seat)/replace broken or missing dogs	X	X	X	X	X	X
Replace bolts	X	X		X		X
Service hinges	X		X	X		X
Replace/repair sealing gaskets	X	X	X	X	X	X
Replace nonwatertight doors with quick-acting watertight type			X		X	X
Replace standard watertight doors with quick-acting type		X	X	X		X
Add “TO BE CLOSED WHILE AT SEA” labels	X	X	X	X	X	X
Watertight Hatches						
Service dogs/replace broken or missing dogs	X		X	X		X
Replace bolts	X	X	X	X		X
Service hinges	X					
Replace/repair sealing gaskets	X	X	X	X		X
Install hydraulically operated closures /dogs on nonwatertight hatches [make hatch watertight]	X			X		X
Make offal [discharge] chutes watertight	X		X	X		X
Add “TO BE CLOSED WHILE AT SEA” labels	X	X	X	X	X	X
Watertight Bulkheads						
Ensure that cable and pipe penetrations are packed, make watertight	X		X	X	X	X
Pack or install threaded plugs in caulked or open penetrations (holes)		X		X		
Decks						
Seal open penetrations in main deck		X				X

Manning Requirements Applicable to Uninspected Vessels

Manning requirements for U.S. vessels are contained in 46 CFR Part 15. The manning regulations "apply to all vessels which are subject to the manning requirements contained in the navigation and shipping laws of the United States, *including uninspected vessels*" [emphasis added] (46 CFR 15.103). All documented vessels of 200 gross tons and over that operate beyond the baseline of the territorial sea must have a Coast Guard–licensed master, mate, and engineers (46 U.S.C. 8304). Requirements for masters are found at 46 CFR 15.805 and for mates, at 46 CFR 15.810. Uninspected vessels over 200 gross tons are not required by Coast Guard regulations to employ a chief engineer. If a chief engineer is employed, however, that officer is required to be properly licensed (46 CFR 15.820[b]).

Fish processing vessels are required to have two watches if they entered service after December 31, 1987, do not measure more than 5,000 gross tons, and have more than 16 individuals on board involved in fish preparation (46 CFR 15.705[e][2][ii]). Coast Guard regulations at 46 CFR 15.825(a) require crewmembers in charge of an engineering watch on a documented vessel of 200 gross tons or over to "hold an appropriate license authorizing service as an assistant engineer." Coast Guard OCMIs determine the minimum number of licensed engineers required for the safe operation of inspected vessels (46 CFR 15.825[b]). The required manning is listed on an inspected vessel's COI. The Coast Guard does not issue written instructions for the manning of uninspected vessels.

Licensing Requirements for Engineers on Uninspected Fishing Industry Vessels

The Coast Guard licensing requirements for engineers on uninspected fishing industry vessels are found at 46 CFR 10.530. To qualify for a license as a chief engineer on such a vessel, a mariner must have served at least 4 years in the engineroom of vessels, with 1 year of service as an assistant engineer or in an equivalent supervisory position. To qualify for a license as an assistant engineer, a mariner must have served at least 3 years in the engineroom of vessels. For both licenses, two-thirds of the required service time must be on motor-powered vessels.

After meeting the requirements for service time, an applicant for either a chief engineer's or an assistant engineer's license on uninspected fishing industry vessels must pass an examination (46 CFR 10.903[a][29,30]). Subsequent license upgrades can be issued without further written examination, providing the Coast Guard OCMI who issued the original license considers further examination unnecessary (46 CFR 10.503[d]).

The horsepower limitation placed on an engineer's license is based on the applicant's qualifying experience, considering the total horsepower of each vessel on which the individual has served, using formulas found at 46 CFR 10.503(b). Once the limitation on a chief or assistant engineer's license exceeds 10,000 horsepower, the Coast Guard will issue an unlimited horsepower license.

The Fishing Company of Alaska operations manager told the Marine Board that he thought the *Alaska Ranger* needed only a licensed chief engineer and that having a licensed assistant engineer on board exceeded the Coast Guard requirements.

Analysis

General

The analysis first examines the flooding of the *Alaska Ranger*. It then discusses the safety issues identified in the accident investigation:

- Vessel's movement astern.
- Company operations.
- Postaccident drug and alcohol testing.
- Emergency response.
- Implementation of ACSA program.
- Oversight of U.S. commercial fishing industry vessels.

Flooding

At 0246, the *Alaska Ranger* broadcast a Mayday call. The master or mate then reported to the Coast Guard that the vessel was taking on water in the rudder room. The crew had been alerted to the flooding in the rudder room by a high-water bilge alarm. At 0300, the *Alaska Ranger* reported that the flooding had spread to the ramp room, which was above the rudder room on the factory deck. As the emergency progressed, other areas in the aft portion of the factory deck flooded, including the harbor generator room and the tool room. Survivors described the stern of the vessel as steadily sinking. At 0330, the vessel lost electrical power, indicating that water had probably risen high enough in the engineroom to flood the main switchboard, which stood on the engineroom deck behind the generators.

The event that initiated the flooding cannot be known with certainty because the vessel's wreckage lies in 6,000 feet of water and was not examined. However, after the *Alaska Ranger* began taking on water in the rudder room, the crew reported to the Coast Guard that they had lost steering and thought the vessel had lost a rudder. Possible reasons for a rudder loss include design or manufacturing flaws, poor maintenance, improper installation, mechanical failure, metal fatigue, or vessel operations.

If a rudder stock fell out of its mounting on the night of the accident, it would have left a hole 8 5/8 inches in diameter (corresponding to the inside diameter of the locking ring at the top of the rudder trunk; refer to figure 7). According to the postaccident stability analysis by the Coast Guard's Marine Safety Center (see "Stability Information" section), a 9-inch hole, approximately the diameter of each locking ring, would have flooded the rudder room in less than 5 minutes, assuming that the tiller arm was completely clear of the rudder trunk and that the rudder stock had fallen away. Five minutes corresponds roughly to the night-watch assistant engineer's testimony that he heard the rudder room bilge alarm and then quickly secured the rudder room door when he saw water pouring toward him. Investigators estimated that the modifications made to the vessel in converting it for fishing use had increased its draft by about 2 1/4 feet,[104] which would have caused the upper lip of the rudder trunks to sink below the loaded waterline. If the top of a rudder trunk was below the waterline, the trunk would have provided a conduit for water to flood the rudder room once the rudder was gone. The NTSB therefore concludes that the flooding of the *Alaska Ranger* appears to have begun in the rudder room, likely as the result of the physical loss of a rudder.

As an uninspected commercial fishing industry vessel, the *Alaska Ranger* was subject to no requirements for watertight compartments or doors. Nevertheless, the vessel had numerous watertight doors that, if secured, should have prevented water from passing from one compartment to another during the flooding event. According to Marine Board testimony, the crew secured all the watertight doors on the factory deck except those between the ramp room and the harbor generator and tool rooms. Those doors remained open throughout the accident sequence and would have allowed the harbor generator and tool rooms to flood with water from the ramp room.

In the hold, a watertight door separated the rudder room from the auxiliary machinery space in the aft part of the engineroom. The watertight door was the only means of access to the rudder room from the engineroom. The night-watch assistant engineer testified that he opened the door to the rudder room after hearing the bilge alarm, then closed it when he saw water coming toward him. However, according to the day-watch assistant engineer, who had been on the vessel since January, the door to the rudder room was always hooked open. If the watertight door was open when the flooding began, water from the rudder room would have easily reached the engineroom, especially because the bulkhead between the auxiliary machinery space and the engineroom was not watertight.

The night-watch assistant engineer reported that after the electrical power went out, he and the master went to check the flooding. He stated that the master told him that the engineroom was dry and there was no water in the engineroom bilges. It is difficult to credit that testimony. One of the Japanese crewmembers reported before the loss of electrical power that water was within 1 meter of the engineroom deck plates. Further, the loss of electrical power indicates that before the night-watch engineer and the master went to check the flooding, water in the engineroom had probably risen high enough to short out the main switchboard.

Even if the *Alaska Ranger* had been equipped with watertight doors in every bulkhead, the vessel's internal watertight integrity would have been compromised if the holes through which pipes and electrical cables penetrated the bulkheads and decks were not watertight. Fishing Company of Alaska's electrical engineering contractor told the Marine Board that the cables and wires that passed through the bulkheads were watertight. Although no drawings of the vessel's refrigeration piping were available and the wreckage could not be examined, evidence

[104] The vessel's freeboard in 1974, before conversion, was listed as 2 feet 4 1/2 inches, measured from the main deckline. In 1992, after the conversion, the vessel's freeboard was listed as 2 inches. Investigators assumed that the freeboard was measured from the same deckline, above which another deck, the trawl deck, had been added during the conversion. With the added deck, the vessel would not actually have sailed with only 2 inches of freeboard.

gathered by the Marine Board indicates that the passages for the refrigeration pipes were not all watertight. Crewmembers testified that after the watertight door between the auxiliary machinery space and the rudder room was secured, they saw water leaking above the door where refrigeration pipes penetrated the bulkhead. The pipes probably went from the refrigeration equipment in the auxiliary machinery space to the aft freezer on the factory deck above. If the openings where the pipes penetrated the factory deck were not watertight, they would have allowed water from the rudder room to flow up into the aft factory deck, which could account for the flooding reported in the ramp room. The vessel's refrigeration piping must have penetrated other bulkheads as well.

The Coast Guard's postaccident stability analysis determined that before the accident, the *Alaska Ranger* had adequate intact stability and that even in a damaged state, it would not have sunk if only the rudder room had flooded. The study further found that if the flooding had been contained in the compartments (ramp room, harbor generator room, tool room, aft machinery alley) isolated by the crewmembers when they secured the watertight doors, the vessel would not have foundered. Within an hour after flooding was discovered in the rudder room, however, flooding had progressed to the engineroom, most likely accounting for the vessel's loss of electrical power. An hour later, the vessel sank. Possible reasons for the progressive flooding include the following: (1) One or more watertight doors or bulkheads failed. (2) One or more watertight doors and bulkheads were not actually watertight. (3) The flooding was worse than initially reported (for example, if the rudder room door was open when flooding began). The NTSB therefore concludes that a lack of internal watertight integrity allowed the progressive flooding that eventually sank the *Alaska Ranger*.

There can be no argument about the critical importance of internal watertight integrity in protecting a vessel against catastrophic flooding. The ACSA guidance published in February 2009 states: "The importance of maintaining internal subdivision watertight integrity cannot be overemphasized." After the *Alaska Ranger* sinking, as part of the voluntary ACSA program, a naval architecture firm examined the remaining six vessels in the Fishing Company of Alaska fleet and recommended repairs to watertight doors, hatches, and bulkheads, among other things. Before the 2009 fishing season began, Fishing Company of Alaska repaired its vessels according to the naval architect's recommendations, and all vessels passed their 2009 ACSA examination.

The ACSA guidance requires that before the first renewal of a vessel's exemptions [from class and load line requirements] under 46 CFR 28.60, "the OCMI must be satisfied that all reasonable means have been taken by the operator to ensure the original condition of watertight integrity of all bulkheads below the main deck." A list of vessels participating in ACSA shows that their first exemption letters were issued in March, April, June, September, October, or December 2008, or in May or July 2009. Assuming that examinations performed in 2009 conformed to the February 2009 ACSA guidance and given that exemption letters are issued every 2 years, all participating ACSA vessels will have undergone a Coast Guard examination that addresses watertight integrity by the end of 2010. If the schedule is met, all vessels enrolled in the ACSA program will have been examined for watertight integrity within about a year of this report. The NTSB therefore makes no recommendations on this issue.

Vessel's Movement Astern

About an hour after the high-water bilge alarm sounded, the *Alaska Ranger* lost electrical power. Within minutes, according to survivors, the vessel was traveling backward. On two previous occasions, the *Alaska Ranger* had traveled astern without being commanded to do so, once while at the dock when the hydraulic pumps to the controllable-pitch propellers had not been engaged and once during a sea trial after the hydraulic pumps were deliberately shut down.

The vessel's controllable-pitch propellers depended on high-volume hydraulic pumps to direct the pitch of the propeller blades. At the time of the accident, all the high-volume pumps were powered by the main switchboard. Therefore, when the *Alaska Ranger* lost electrical power, the pumps would have lost hydraulic pressure. Without hydraulic pressure, the pumps could not have acted on signals from the control system, which would have continued operating because it had an independent battery power supply. The propeller blades would still have been turning because the engines continued to drive the main propulsion shafts after the electrical power went out.[105] The propeller blades would have repositioned themselves in response to the hydrodynamic forces unique to the vessel and the centrifugal forces imparted by the spinning shaft and the lack of hydraulic pressure.

According to testimony, the position taken by controllable-pitch propeller blades in the absence of hydraulic pressure differs from vessel to vessel. The history of the *Alaska Ranger* demonstrates that its propeller blades would move to an uncommanded astern pitch when hydraulic pressure failed. Thus, in the accident sequence, when the hydraulic pumps lost pressure, the turning blades would have moved from the "ahead pitch" ordered by the wheelhouse to an uncommanded "astern pitch" that propelled the vessel backward. The NTSB therefore concludes that a loss of electrical power caused the pumps that controlled the pitch of the vessel's propellers to lose hydraulic pressure, which allowed the propeller blades to move to an astern pitch (contrary to the ordered position) and, because the main engines were running, propelled the *Alaska Ranger* backward.

As originally configured, each propeller shaft had a main hydraulic pump powered by the main electrical switchboard, plus a standby pump driven by a reduction gear off the main propulsion shaft. In 1989, Fishing Company of Alaska's marine engineering firm replaced the shaft-driven hydraulic pumps with electrically driven pumps. Thus, at the time of the accident, though each propeller shaft still had two hydraulic pumps, the propeller system no longer had a backup source of hydraulic pressure. The NTSB has concluded that the loss of hydraulic pressure caused the propeller blades to shift to an uncommanded astern pitch. When the vessel lost electrical power, the engines continued to run because they were diesel-powered and did not depend on electricity. Therefore, if each propeller had still been equipped with a backup hydraulic pump driven by the main engines, those pumps would have maintained hydraulic pressure to the propeller system when the vessel lost electrical power. If the pumps had maintained hydraulic pressure, the propeller blades would not have reversed pitch, and the vessel would not have traveled astern. The NTSB therefore concludes that the *Alaska Ranger* would not

[105] Combustion in mechanically controlled diesel engines, such as those propelling the *Alaska Ranger*, results from fuel ignited by compressed air rather than by an electric spark. Diesel engines can therefore run in the absence of electrical power.

have traveled astern if the vessel's controllable-pitch propeller system had been equipped (as it originally was) with hydraulic pumps driven off the main propulsion shafts.

The *Alaska Ranger* was traveling backward when the crew deployed the liferafts. The vessel's astern motion caused it to move away from the liferafts. Two liferafts detached from the vessel, and crewmembers had to enter the water to reach the liferaft that remained attached. Crewmembers who could not reach a liferaft had to stay in the water. Had the liferafts come alongside as intended, crewmembers would have had only to climb down one of the ladders that had been placed on either side of the vessel and into a liferaft to escape the sinking ship. Crewmembers were able to enter two of the liferafts. All 22 of those who reached a liferaft survived. Four of the 24 crewmembers who evacuated the vessel but did not reach a liferaft perished (as noted earlier, whether the fishmaster, whose body was not recovered, evacuated the vessel is uncertain). The NTSB therefore concludes that the astern movement of the *Alaska Ranger* before the sinking caused the vessel to move away from the liferafts and prevented crewmembers from entering the liferafts from the vessel as intended.

Investigators found no evidence that the master or mate attempted to slow or stop the main engines during the accident sequence. As noted, the engines would not have stopped running when the vessel lost electrical power because they were diesel-powered. Thus, when the propeller blades changed to an astern pitch, the engines would have driven the vessel backward, pushing the stern (which crewmembers testified had already begun to sink) deeper into the water. The effect could have been to exacerbate the flooding and hasten exposure of the critical downflooding points identified in the vessel's stability booklet—the port and starboard engineroom air inlets on the trawl deck—to incoming seawater.

It is unknown why the master or mate failed to reduce engine speed during the emergency. The previous master told the Marine Board that he had told the master on the accident voyage that the vessel would travel astern if the controllable-pitch propeller system failed. Under the stress of trying to control the vessel's flooding and communicate with the Coast Guard, and in the severe weather and sea conditions, it is possible that the master and mate on the bridge did not immediately recognize that the vessel had begun moving astern (although it was obvious to the crew). Nevertheless, when the liferafts launched out of reach of the crew, it should have been clear to the master and mate that the vessel was traveling astern. Although stopping the engines would have left the vessel dead in the water (which the master reportedly told the night-watch assistant engineer he wanted to avoid) and at the mercy of gusting winds and heavy seas, leaving the engines running while traveling astern put the rafts out of reach for most of the crew. Under those circumstances, it would have been preferable to stop the engines.

Stopping the propulsion engines from driving the vessel astern could have slowed the flooding and helped preserve the hull as a refuge for the crew. Further, it could have prevented the liferafts from deploying out of reach of crewmembers once evacuation began. The engines could have been shut down either from the engineroom or from the wheelhouse, which was equipped with remote emergency engine shutdowns (the emergency shutdowns had a battery power source). According to testimony, in January 2008, before the start of the commercial fishing season, an outside contractor tested the emergency shutdown controls and found them operational. The NTSB therefore concludes that slowing or stopping the main engines would have arrested the vessel’s astern motion, which might have slowed the flooding as well as prevented the liferafts from deploying out of reach.

The NTSB is concerned that, like the *Alaska Ranger*, other U.S. vessels could be equipped with controllable-pitch propeller systems whose hydraulic pumps lack a fully redundant power system and could thus experience an uncommanded and potentially dangerous change in direction and speed if the pumps were to lose power. In July 2008, after the *Alaska Range*r sank, the Coast Guard issued a marine safety alert regarding controllable-pitch propellers. The alert advised owners, operators, and masters of vessels operating with controllable-pitch propeller systems of the need to understand the design and operation of the systems, including their primary and emergency sources of power. The NTSB makes no recommendation for further action.

Company Operations

Role of Fishmaster

The fishmaster on the *Alaska Ranger* worked for North Pacific Resources, a subsidiary of the fish buyer, and was not an employee of Fishing Company of Alaska. The fishmaster’s job was to direct the vessel to fishing sites and oversee quality control of the fish products, which were intended for the Japanese market. Similar arrangements exist in other marine industries. For example, specialized cable-laying ships carry engineers employed by telecommunications companies to direct the placement of underwater communication lines.

Survivors of the *Alaska Ranger* sinking told the Marine Board that the fishmaster actually ran the vessel. Most of that testimony came from members of the processing crew, who would not have been in a position to observe interactions between the master and fishmaster on the bridge. A master has ultimate authority over his vessel, and nothing relieves him of that authority, including the presence of a specialist whose job is to direct fishing operations. The previous master acknowledged that he had disagreements with the fishmaster, sometimes regarding safe vessel operation. However, that master also stated that he overruled the fishmaster whenever he felt that safety was in question, which included slowing the vessel. No credible testimony contradicted the previous master’s statements.

There is no evidence that the *Alaska Ranger* master at the time of the accident had conflicts with the fishmaster. Further, there is no evidence that the fishmaster impeded, interfered with, or otherwise affected the master’s response to the emergency. The NTSB therefore concludes that there is no evidence that the fishmaster compromised the *Alaska Ranger* master’s ability to exercise his command authority.

Operation in Ice

The Marine Board gathered evidence that the *Alaska Ranger* had regularly worked in ice. The Fishing Company of Alaska operations manager and the port engineer both testified that the *Alaska Ranger* had been ice-classed, or certified for operation in ice, citing a reinforced band on the hull as protection against ice.

Investigators determined, however, that the vessel had not been ice-classed. Drawings in the vessel's 1973 classification report and in the hull survey done after the vessel was converted for the fishing trade show a 1-1/4-inch-thick plate extending 4 feet below the factory deck. As the vessel was originally constructed, that plate was the sheer-strake.[106] After the vessel's conversion, when a deck was added, the plate was approximately at the waterline, where ice-strengthening plates would ordinarily be fitted. Thus, vessel operators and company personnel could have mistaken the sheer-strake for an ice-strengthening plate. The NTSB therefore concludes that Fishing Company of Alaska personnel were under the mistaken impression that the *Alaska Ranger* had been strengthened for operation in ice.

Licensing and Manning

In analyzing the licensing and manning requirements applicable to the *Alaska Ranger*, NTSB investigators consulted both the regulations pertaining to manning of uninspected vessels (46 CFR Part 15) and the regulations regarding licensing of deck and engineering officers (46 CFR Part 10, Subparts D and E). Investigators determined that both the master and the mate were properly licensed for their positions and that the *Alaska Range*r met the manning requirements for masters at 46 CFR 15.805 and for mates at 46 CFR 15.810.

Although the *Alaska Ranger* was not required by Coast Guard regulations to carry a chief engineer, because it did so, that officer was required to be properly licensed. The chief engineer was licensed to work on fishing vessels of not more than 6,000 horsepower. According to the *Alaska Ranger*'s documentation, its engines had a peak horsepower rating of 7,000, and company claims that the engine rating had been reduced to 6,000 horsepower were not substantiated (see "Vessel Information" section). The chief engineer's license therefore did not permit him to serve in that capacity on a vessel of the *Alaska Ranger*'s horsepower. However, the *Alaska Ranger* was the only vessel in the Fishing Company of Alaska fleet whose horsepower exceeded 6,000 (refer to table 3), meaning that the chief engineer's license would have allowed him to serve on any other company vessel.

The two assistant engineers stood the engineering watch rotation, which consisted of two 12-hour watches. Coast Guard regulations at 46 CFR 15.825(a) require crewmembers in charge of an engineering watch to "hold an appropriate license authorizing service as an assistant engineer." The day-watch assistant engineer was licensed to serve as assistant engineer of uninspected fishing industry vessels of not more than 4,000 horsepower. Because the *Alaska*

[106] Strakes are the plates that form the outside of a vessel's hull. The sheer-strake is the uppermost continuous strake of the hull and usually attaches to the main deck.

Ranger was rated at 7,000 horsepower, the day-watch assistant engineers' license was not appropriate for standing watch on that vessel.

The night-watch assistant engineer had worked for Fishing Company of Alaska for 17 years, was the officer with the most experience on the *Alaska Ranger*, and had substantially more than the 3 years of engineroom service required to obtain a Coast Guard license. The night-watch assistant engineer told investigators that he was in the process of applying for a license. Because he was not licensed, regulations did not authorize him to stand an engineering watch. However, his actions on the night of the accident indicate that he was well-versed in the *Alaska Ranger*'s engineroom equipment. The NTSB therefore concludes that Fishing Company of Alaska failed to ensure that its engineering officers met Coast Guard requirements for licensing and manning, but that there is no evidence that the qualifications of the engineering crewmembers played a role in the accident.

The same engineers were on board during the vessel's voluntary dockside examination in January 2008. The Coast Guard summary of the examination indicated that the "Documentation" and "Personnel" components passed inspection. Therefore, the NTSB concludes that during the *Alaska Ranger*'s January 2008 dockside examination, the Coast Guard failed to identify that the vessel's engineers were not properly certificated. As a result, the NTSB recommends that the Coast Guard conduct refresher training for its marine inspectors and commercial fishing vessel examiners on the licensing and manning regulations that apply to commercial fishing industry vessels.

Drug and Alcohol Policy

Fishing Company of Alaska claimed to have a zero-tolerance policy regarding the use of alcohol and illegal drugs on its vessels. Nevertheless, survivors told the Marine Board that crewmembers commonly drank alcohol while the *Alaska Ranger* was traveling to the fishing grounds, and the night-watch assistant engineer said that he regularly drank on board the vessel. NMFS observers on other Fishing Company of Alaska vessels suspected drug and alcohol use by crewmembers. Thus, the evidence indicates that some employees did not adhere to prescribed company policy on board the company's vessels, and that action was not taken to enforce the zero-tolerance policy. Therefore, the NTSB concludes that Fishing Company of Alaska failed to effectively implement and enforce its drug and alcohol policy.

The crew of the *Alaska Ranger* regularly encountered some of the most challenging conditions faced by mariners—exposure to arctic temperatures, severe winds and waves, and ice accretion on decks, ladders, and other exposed surfaces. In addition, the fish processors worked long hours—12 hours on duty and 6 hours off duty—with much of their duty time spent in arduous tasks made even more challenging by the environmental conditions. Further, the fish processors faced dangers unique to their tasks, such as regular use of sharp knives and exposure to icy surfaces. In such a work environment, it is not unexpected that some off-duty crewmembers consumed alcohol if available.

While no evidence was collected that linked drug or alcohol use to this accident, drug or alcohol use can constitute a workplace hazard, particularly for employees who perform safety-critical tasks and who must respond to emergencies. The master of each Fishing Company of Alaska vessel is ultimately responsible for his crew's conduct, and the company is responsible for enforcing policies that ensure that the crews on its vessels are not impaired by alcohol or drugs. Fishing Company of Alaska acted appropriately in prohibiting drug and alcohol consumption on board its vessels. However, postaccident testimony indicates that the company's policy was not enforced. The NTSB therefore recommends that Fishing Company of Alaska review and modify as necessary the procedures for enforcing its drug and alcohol policy to ensure full crew compliance.

Postaccident Drug and Alcohol Testing

No drug or alcohol testing was conducted after the sinking. According to Coast Guard regulations (46 CFR 4.06), the only crewmembers requiring testing were those directly involved in the accident. Regulations state that the marine employer is responsible for determining which crewmembers require testing after an accident, and that a law enforcement officer can designate additional crewmembers to be tested. The operations manager stated that he knew he was responsible for seeing that postaccident drug and alcohol testing was done but that he failed to do so because of his distress over the loss of life in the sinking.

Both rescue vessels, the *Munro* and the *Alaska Warrior*, carried the proper equipment for alcohol testing, but only the *Alaska Warrior* carried the proper equipment for drug testing. Personnel on the rescue vessels were fully occupied tending to survivors suffering from hypothermia, which would have made it difficult for them to conduct tests for alcohol within 8 hours of the accident, the regulatory time limit. The NTSB therefore concludes that under the circumstances of being occupied with rescuing survivors and treating them for hypothermia, it was reasonable that personnel on board the rescue vessels did not conduct postaccident testing for alcohol. However, samples for drug testing could easily have been drawn within the 32-hour regulatory time limit from survivors rescued by the *Alaska Warrior* while they were on the vessel or even after they reached Dutch Harbor. The NTSB therefore concludes that postaccident drug-testing requirements could have been met on board the *Alaska Warrior* or in Dutch Harbor, but they were not.

The three senior officers on the *Alaska Ranger*—the master, mate, and chief engineer—all died in the accident. Blood and vitreous from their bodies tested negative for illegal drugs and alcohol. The NTSB has concluded that Fishing Company of Alaska did not enforce its policy against drug and alcohol use on board its vessels. However, whether any surviving crewmembers of the *Alaska Ranger* used drugs or alcohol before the accident is unknown because no postaccident testing was done. The NTSB therefore concludes that, although toxicology testing of specimens from the ship's master, mate, and chief engineer showed no evidence of alcohol or drug use, no conclusions can be reached regarding alcohol or drug use by surviving crewmembers because postaccident testing was not conducted.

Emergency Response

The *Alaska Ranger* sank in a remote area at a time when the weather and sea state were poor. Despite the severe conditions, the two Coast Guard helicopters sent to the scene recovered 20 survivors from the water. The Coast Guard's deployment of a Jayhawk rescue helicopter on the Pribilof Islands, close to the commercial fishing grounds, meant that the helicopter had to fly only 197 miles to reach the site of the sinking, rather than travel 800 miles from the main Coast Guard air station at Kodiak. All 20 of the survivors that the Coast Guard helicopters rescued from the water were transferred safely to the cutter *Munro*. The fishing vessel *Alaska Warrior* rescued another 22 survivors from liferafts.

After the search for survivors ended, Coast Guard RCC personnel discovered that the fishmaster was unaccounted for, and the search was reopened. The error occurred when the Jayhawk rescue helicopter mistakenly reported to the combat information center on the *Munro* that it had picked up 13 survivors, although it had actually retrieved only 12 people from the water. The *Munro* crew lowered 12 survivors from the Jayhawk but did not report that number to the combat information center. RCC personnel did not discover the error until they compared survivors' names with the crewlist. The NTSB therefore concludes that a communication error delayed the discovery that the fishmaster was missing. Nevertheless, in high seas, strong winds, below-freezing temperatures, and blowing snow, the search and rescue operation saved nearly all those on board the *Alaska Ranger*. The NTSB therefore concludes that the Coast Guard's search and rescue effort, carried out under adverse weather and sea conditions, was timely and effective and minimized the loss of life in the accident. The NTSB also concludes that the Coast Guard's seasonal basing of a rescue helicopter near the fishing grounds aided the rescue effort.

Implementation of Alternate Compliance and Safety Agreement

ACSA was a new and innovative approach to fishing vessel safety, and the Coast Guard official in charge stated that planners had not anticipated such a large response to the program. It is therefore not surprising that program implementation was not smooth. In the beginning, the Coast Guard failed to enforce a number of program requirements. For example, Fishing Company of Alaska and other companies were accepted for the program after submitting only a brief application that did not include the documentation described in the Coast Guard guidance document; program timelines were not enforced; and extension letters were not issued until nearly 2 months after the deadline for completing all program requirements.

The *Alaska Ranger*'s entrance into the ACSA program was also flawed. To establish compliance with the ACSA requirements, the vessel underwent a drydock examination 4 months before the sinking. The chief Coast Guard marine examiner from Sector Seattle, who led the examination, testified that he gauged the sides of the *Alaska Ranger*'s hull but not the stern because of the presence of wear plates, which had been installed to protect the stern from strikes by the trawl doors. Neither the exposed parts of the stern, the interior plates next to the void spaces at the stern, the wear plates, nor the stern ramp was gauged. Nor were the interiors of the aft ballast tanks gauged, which was a required item in the ACSA examination booklet.

Witnesses told the Marine Board that during operations, the trawl doors punctured the wear plates, and the evidence indicates that welding repairs were made to the wear plates during the 2007 ACSA drydocking. It is unknown whether tests for watertightness on the voids behind the wear plates were performed during the 2007 drydock examination or whether the insides of the voids had been treated to resist corrosion. If the voids were not watertight, corrosion accelerated by incoming seawater, coupled with fractures or cracks, could have compromised the hull's integrity below or near the waterline. The NTSB therefore concludes that the drydock examination of the *Alaska Ranger* performed as part of the ACSA program was inadequate because not all hull areas specified in the program guidance were gauged.

The implementation phase of ACSA is now complete, and the Coast Guard has addressed program issues both internally and in meetings with representatives of the Alaska commercial fishing industry. More importantly, the ACSA examinations subject participating vessels to a higher standard than the basic safety requirements for fishing industry vessels found at 46 CFR Part 28. Participating vessels, for example, must obtain new stability documents, must be drydocked twice every 5 years for examination of watertight integrity, must upgrade fire-prevention and firefighting equipment, and must increase emergency training for crewmembers. A forum representing most of the H&G catcher-processors in the Alaska fleet has expressed support of the program, stating: "The fleet is now operating safer vessels."[107] The NTSB therefore concludes that although the Coast Guard's initial implementation of the ACSA program was flawed, the program has provided a higher level of safety for the enrolled commercial fishing industry vessels than existed previously.

Oversight of U.S. Commercial Fishing Industry Vessels

The Commercial Fishing Industry Vessel Safety Act of 1988 was the first safety legislation enacted in the United States that applied specifically to commercial fishing vessels. As described earlier, the safety standards in the new regulations for commercial fishing vessels (46 CFR Part 28) incorporated many recommendations from the NTSB's 1987 study of uninspected commercial fishing vessel safety. As a result of the new regulations, commercial fishing vessels are now required to carry safety equipment such as immersion suits and EPIRBs that help save fishermen's lives.

However, the NTSB's recommendation that the Coast Guard seek legislative authority to inspect commercial fishing vessels (Safety Recommendation M-87-64) has not met with a similar success. Although in 1992, the Coast Guard submitted a plan to Congress that would require inspection of all commercial fishing industry vessels, Congress did not grant that additional authority. As a result, the commercial fishing vessel industry is still largely unregulated, and the Coast Guard must rely on voluntary programs (dockside examinations and ACSA) to examine the operating condition of commercial fishing vessels. Complicating the issue of fishing vessel safety in Alaska are the laws related to fishery management in the EEZ, specifically, the limitations placed on replacing what are known as Amendment 80 vessels.

[107] K.G. Down, executive director, Freezer Longline Coalition, and L. Swanson, executive director, Groundfish Forum, letter (regarding support of the Coast Guard's Alternative Compliance and Safety Agreement [ACSA]) to Director, Marine Safety, Security, and Stewardship, Office of the Commandant, U.S. Coast Guard, May 1, 2008.

Coast Guard Inspection Authority

The safety requirements resulting from the Commercial Fishing Industry Vessel Safety Act of 1988 have had a positive effect. In 2007, the Coast Guard assistant commandant for prevention told a House subcommittee that fatalities among fishermen had decreased from an average of 120 per year before the act was passed to about 42 per year.[108] Nevertheless, the commercial fishing vessel industry continues to have the worst safety record of all U.S. industries. The Coast Guard's 2008 study of fishing vessel casualties, cited earlier, found that over three-quarters of fishing vessel fatalities between 1992 and 2007 resulted from water exposure, and that the primary event leading to fatality from water exposure was vessel loss. The Coast Guard study concluded: "Factors leading to vessel loss will have to be addressed in order to reduce some fatalities below current levels, especially for incidents that occur suddenly, such as sinkings and capsizings."

Although Congress did not authorize the inspection plan submitted by the Coast Guard 17 years ago, the NTSB continues to believe that an inspection program is the best way to ensure that fishing vessels will be designed, constructed, equipped, maintained, and operated as intended. The NTSB is aware that other countries have implemented inspection programs for commercial fishing vessels (see appendix D). In the United States, the only types of commercial fishing vessels that current regulations require the Coast Guard to inspect and certificate are large fish processing vessels (over 5,000 gross tons) and certain fish tender vessels (over 500 gross tons). Certificated vessels already in service are inspected for a number of factors, including design, construction, equipment, stability, documentation, and condition. Plans for new vessels are required to be approved by the Coast Guard before construction, and once construction is complete, stability tests are performed and systems such as steering, propulsion control, and fire controls are tested. A COI is issued after a vessel satisfies the regulations, and the inspected vessel is periodically reinspected and recertified.

Commercial fishing industry vessels other than those discussed above are subject to no Federal requirements for their design and construction and do not require initial or recurrent inspection. All uninspected commercial fishing industry vessels are subject to the basic requirements for lifesaving and firefighting found at 46 CFR subchapter C. Certain fish processing vessels are subject to additional safety requirements. They are required (46 CFR Part 28, subpart F) to be examined every 2 years for compliance with 46 CFR subchapter C and to be certified as compliant by a classification society or a marine surveyor. Fish processing vessels built or converted after July 27, 1990, must meet all the survey and classification requirements of the American Bureau of Shipping or another classification society and carry on board a certificate of class. Further, fish processing vessels 79 feet or longer are subject by law to the load line regulations and associated inspection requirements of 46 CFR subchapter E (except where grandfathered).

The requirement that fish processors meet more stringent safety standards than other commercial fishing vessels is appropriate because of the risks associated with their operations: large crews, remote operations, and dangerous chemicals or machinery on board. After the

[108] Statement to Subcommittee on Coast Guard and Maritime Transportation, Committee on Transportation and Infrastructure, U.S. House of Representatives, April 25, 2007, p. 8.

sinking of the *Aleutian Enterprise* in 1990, the Coast Guard recognized that many fish processing vessels operating in Alaskan waters did not meet the applicable safety requirements, specifically, the load line regulations. As a result, the Coast Guard implemented an interim enforcement program to bring those vessels into compliance with the regulations. After the sinking of the *Arctic Rose* in 2001 and the explosion, fire, and sinking of the *Galaxy* in 2002, the Coast Guard again identified a large number of fish processors that were not in compliance with applicable safety requirements.

The Coast Guard faces an enforcement difficulty. Without legislative authority for inspection, the Coast Guard has no mechanism for tracking whether vessels comply with the regulations. Vessels conforming to the load line regulations, for example, are subject to annual verification surveys. The surveys are performed by third parties. The local Coast Guard office receives no information on the examinations, except that they were completed, and the load line certificates are sent to Coast Guard headquarters. Thus, the Coast Guard has only a limited ability to ensure that commercial fishing industry vessels meet the appropriate requirements.

In current circumstances, the Coast Guard must rely on voluntary programs (dockside examinations and ACSA) to examine the operating condition of uninspected commercial fishing vessels. While the NTSB finds that ACSA has improved the safety of the vessels enrolled in the program, the effectiveness of ACSA is limited because it is a voluntary program. Vessels can opt out of the program by abandoning certain operations that would classify them as fish processors. They can then continue to operate as fishing vessels but without the added safety provided by having to meet the ACSA requirements for stability, structural soundness (including watertightness), machinery standards and maintenance, safety equipment, and emergency preparedness.

By establishing the ACSA program, the Coast Guard addressed the safety deficiencies in the Alaska fleet that it identified in the wake of the *Arctic Rose* and *Galaxy* accidents—fleetwide deficiencies in vessel stability, watertight integrity, and maintenance of critical systems; and fleetwide deficiencies in emergency training, drills, and crew safety competencies. But because the ACSA program is voluntary, the Coast Guard can identify vessels in poor condition only if they participate in the program. Similarly, the dockside safety examination can identify safety deficiencies only if owners opt to have their vessels examined (although in Alaska a high degree of participation results from NMFS requirements for vessels that carry fisheries observers).

The NTSB cannot say whether inspection could have prevented the sinking of the *Alaska Ranger*. However, the NTSB continues to believe that mandatory inspection is essential for improving safety in the fishing industry and reducing loss of life. Under a Coast Guard inspection regime, fishing industry vessels could be subject to requirements for design, construction, machinery, safety equipment, and stability; could receive initial and periodic examinations; and could require prior approval before being modified. The NTSB therefore concludes that the Coast Guard's ability to address safety deficiencies in commercial fishing industry vessels is limited by its lack of statutory inspection authority. As a result, the NTSB recommends that the Coast Guard seek legislative authority to require that all commercial fishing vessels be inspected and certificated by the Coast Guard to ensure that the vessels provide an appropriate level of safety to those on board.

Most Coast Guard safety regulations, for example, those applying to passenger vessels, are based on risk factors such as number of persons carried, distance traveled from shore, and hours of operation. The Coast Guard regulations developed after passage of the Commercial Fishing Vessel Industry Safety Act of 1988 incorporate the distinction between fishing vessels, fish processing vessels, and fish tenders codified in 1984. As a consequence, the applicability of safety regulations to commercial fishing industry vessels is based on vessel type (fishing vessel, fish processing vessel, fish tender) rather than on degree of risk. Thus, a vessel determined to meet the definition of a fishing vessel does not have to meet the more-stringent requirements that apply to a fish processing vessel, even if both vessels have the same size crews, operate in the same area, and carry similarly dangerous machinery. The NTSB believes that when the Coast Guard develops inspection rules for commercial fishing industry vessels, as recommended in this report, the inspection criteria should be based on the degree of risk faced by a vessel rather than on a definition of its services. The NTSB thus agrees with an approach such as the Coast Guard took in 1992 when it proposed an inspection plan based on a risk factor rather than on vessel type.

Amendment 80 Vessels

The North Pacific Fishery Management Council develops fishery management plans for the EEZ off Alaska and recommends the plans to NMFS for implementation. Amendment 80 to the fishery management plan for groundfish of the Bering Sea/Aleutian Island management area, implemented in 2007, was instituted to increase resource conservation and improve economic efficiency in the area. The amendment limited access to the fishery to vessels that had caught more than a certain amount of Amendment 80 species over a defined period, and also encouraged the formation of fishing cooperatives.

Amendment 80 has addressed the conservation and sustainability goals of the Magnuson-Stevens Fishery Conservation and Management Act. However, the amendment’s effect on fishing vessel safety has received little consideration. The Alaska fishing fleet consists of old vessels operating in some of the world’s harshest conditions. The average age of the 21 active Amendment 80 vessels at the time of this report was 30 years.[109] Yet the regulations contain no provisions for replacing vessels in the fleet. As the regulations are currently written, vessel operators must continue to run older, less-safe vessels until they either sink or are no longer eligible to fish (cannot obtain a fishery endorsement). If an existing fish processing vessel were replaced by one built or converted after July 27, 1990, the new vessel would be inherently safer because it would have to be inspected and certified by a classification society and be periodically reinspected.

On May 19, 2008, the courts ruled in favor of the owner of an Amendment 80 vessel (the *Arctic Rose*, which sank in 2001) who wanted to use another vessel to fish for his quota share. NMFS has since indicated that it will allow the owner of an Amendment 80 vessel to replace that vessel, but only if the vessel can no longer fish because of “actual total loss, constructive total

[109] All the active Amendment 80 vessels participate in ACSA.

loss, or permanent ineligibility to receive a fishery endorsement." That is, not until a fishing vessel has broken down or sunk will NMFS allow the owner to replace it.

NMFS's decision to permit vessels to be replaced only if they are lost or deemed ineligible to fish runs contrary to the interests of safety. Replacing a vessel after it has sunk is too late. When the *Arctic Rose* went down, it took 15 lives. The *Alaska Ranger*'s sinking took 5 lives and would probably have taken more if not for the extraordinary rescue efforts of the Coast Guard and the crew of the *Alaska Warrior*. Fishing industry vessels should be replaced before a major problem arises, not after a catastrophic event that causes loss of life. The NTSB therefore concludes that by imposing a regulatory bar against replacing Amendment 80 vessels, the regulations that implement the fishery management plan for groundfish of the Bering Sea/Aleutian Island management area negatively affect safety by preventing vessel owners from replacing aging vessels that pose increased operating risks.

To comply with the order issued by the court in its May 2008 ruling against NMFS, the groundfish fishery management plan for the Bering Sea and Aleutian Islands must be amended. According to NMFS, the ruling

> suggests that the [Northwest Pacific Fishery Management] Council may have the discretion to allow an Amendment 80 vessel to be replaced for reasons other than actual total loss, constructive total loss, or permanent ineligibility of that vessel to receive a fishery endorsement under 46 U.S.C. 12108.[110]

The NTSB believes that it should be possible to replace aging or unsafe Amendment 80 vessels for reasons other than vessel loss or ineligibility to fish. The NTSB therefore recommends that NMFS amend the regulations at 50 CFR Part 679, Subpart H, to allow for replacement of an Amendment 80 vessel in situations other than vessel loss. The North Pacific Fishery Management Council is scheduled to meet in February 2010 to consider revisions to the groundfish fishery management plan. The NTSB therefore recommends that the North Pacific Fishery Management Council amend the fishery management plan for groundfish of the Bering Sea/Aleutian Island management area to allow for replacement of an Amendment 80 vessel in situations other than vessel loss.

Proposed Legislation

The legislation proposed in H.R. 2652 and H.R. 3619 (described earlier in the report) that would make dockside examinations and participation in an alternate safety compliance program mandatory for commercial fishing industry vessels rather than voluntary is a positive step toward improving the safety of those vessels. Further, extending required training and certification to masters of all commercial fishing industry vessels that operate on the high seas with more than 16 people on board, without regard for size (that is, whether a vessel is under or over 200 gross

[110] "Implementation and [sic] of Amendment 80 Vessel Replacement Provisions, *Arctic Sole Seafoods v. Gutierrez*, NMFS Alaska Region, Presented at the October NPFMC Meeting, 2008," p. 8, "Other Considerations for Potential Council Action" <www.fakr.noaa.gov/sustainablefisheries/amds/80/vesselreplaceprovisions08.pdf> (accessed November 20, 2008).

tons), is a positive step that should improve the general competency of vessel masters, particularly in coping with emergencies such as flooding. Changes to the classification and load line requirements (removing new or newly converted fishing vessels from the load line exemption and requiring new vessels 50 feet or longer to be classed) are also a positive step toward improving the safety of commercial fishing industry vessels.

The proposed legislation partially responds to the intent of previous recommendations the NTSB has issued to the Coast Guard to increase its oversight of the commercial fishing industry, but it falls short of the level of oversight the NTSB believes is necessary. The NTSB has long believed that licensing is necessary to ensure that masters and other officers have the knowledge to safety operate their vessels. On uninspected commercial fishing industry vessels, current regulations require licensing of masters and other officers only on vessels over 200 gross tons. Most fishing industry vessels are under that size. Thus, most masters, mates, and crewmembers of uninspected commercial fishing industry vessels are not subject to training requirements for skills or knowledge such as navigation, rules of the road, emergency medical care, firefighting, or stability.

Under the proposed legislation, unlicensed officers on vessels under 200 gross tons would continue to remain exempt from Coast Guard medical oversight. Mariners in safety-critical positions on most fishing industry vessels can thus continue to serve as watch officers despite having debilitating or impairing medical conditions or while under the influence of impairing prescribed medications. Coast Guard regulations currently contain no requirements limiting the hours employees on fishing industry vessels can legally work. In addition, the proposed regulations do not address random drug and alcohol testing. Currently, only vessels that employ licensed officers are subject to random drug and alcohol testing. Under the proposed legislation, therefore, personnel on most commercial fishing industry vessels will continue to be exempt from random drug and alcohol testing. Such testing is necessary on commercial fishing industry vessels, as illustrated by reports of alcohol use on the *Alaska Ranger*.

Without more complete and effective Coast Guard oversight, accidents such as the sinking of the *Alaska Ranger* are likely to recur, because their crews will continue to operate in some of the harshest conditions imaginable. Those vessels need more, not less, oversight than comparable vessels that operate in more benign conditions. In short, the NTSB believes that commercial fishing vessels should be given the same safety oversight as inspected vessels.

Conclusions

Findings

1. The flooding of the *Alaska Ranger* appears to have begun in the rudder room, likely as the result of the physical loss of a rudder.

2. A lack of internal watertight integrity allowed the progressive flooding that eventually sank the *Alaska Ranger*.

3. A loss of electrical power caused the pumps that controlled the pitch of the vessel's propellers to lose hydraulic pressure, which allowed the propeller blades to move to an astern pitch (contrary to the ordered position) and, because the main engines were running, propelled the *Alaska Ranger* backward.

4. The *Alaska Ranger* would not have traveled astern if the vessel's controllable-pitch propeller system had been equipped (as it originally was) with hydraulic pumps driven off the main propulsion shafts.

5. The astern movement of the *Alaska Ranger* before the sinking caused the vessel to move away from the liferafts and prevented crewmembers from entering the liferafts from the vessel as intended.

6. Slowing or stopping the main engines would have arrested the vessel's astern motion, which might have slowed the flooding as well as prevented the liferafts from deploying out of reach.

7. There is no evidence that the fishmaster compromised the *Alaska Ranger* master's ability to exercise his command authority.

8. Fishing Company of Alaska personnel were under the mistaken impression that the *Alaska Ranger* had been strengthened for operation in ice.

9. Fishing Company of Alaska failed to ensure that its engineering officers met Coast Guard requirements for licensing and manning, but there is no evidence that the qualifications of the engineering crewmembers played a role in the accident.

10. During the *Alaska Ranger*'s January 2008 dockside examination, the Coast Guard failed to identify that the vessel's engineers were not properly certificated.

11. Fishing Company of Alaska failed to effectively implement and enforce its drug and alcohol policy.

12. Under the circumstances of being occupied with rescuing survivors and treating them for hypothermia, it was reasonable that personnel on board the rescue vessels did not conduct postaccident testing for alcohol.

13. Postaccident drug-testing requirements could have been met on board the *Alaska Warrior* or in Dutch Harbor, but they were not.

14. Although toxicology testing of specimens from the ship's master, mate, and chief engineer showed no evidence of alcohol or drug use, no conclusions can be reached regarding alcohol or drug use by surviving crewmembers because postaccident testing was not conducted.

15. A communication error delayed the discovery that the fishmaster was missing.

16. The Coast Guard's search and rescue effort, carried out under adverse weather and sea conditions, was timely and effective and minimized the loss of life in the accident.

17. The Coast Guard's seasonal basing of a rescue helicopter near the fishing grounds aided the rescue effort.

18. The drydock examination of the *Alaska Ranger* performed as part of the Alternate Compliance and Safety Agreement program was inadequate because not all hull areas specified in the program guidance were gauged.

19. Although the Coast Guard's initial implementation of the Alternate Compliance and Safety Agreement program was flawed, the program has provided a higher level of safety for the enrolled commercial fishing industry vessels than existed previously.

20. The Coast Guard's ability to address safety deficiencies in commercial fishing industry vessels is limited by its lack of statutory inspection authority.

21. By imposing a regulatory bar against replacing Amendment 80 vessels, the regulations that implement the fishery management plan for groundfish of the Bering Sea/Aleutian Island management area negatively affect safety by preventing vessel owners from replacing aging vessels that pose increased operating risks.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the sinking of the *Alaska Ranger* was uncontrolled, progressive flooding due to a lack of internal watertight integrity and to a breach of the hull's watertight envelope, likely caused by a physical rudder loss. Contributing to the loss of life was the vessel's movement astern, which likely accelerated the flooding and caused the liferafts to swing out of reach of many crewmembers.

Recommendations

As a result of its investigation of the *Alaska Ranger* sinking, the National Transportation Safety Board makes the following recommendations.

To the U.S. Coast Guard:

> Conduct refresher training for your marine inspectors and commercial fishing vessel examiners on the licensing and manning regulations that apply to commercial fishing industry vessels. (M-09-9)
>
> Seek legislative authority to require that all commercial fishing vessels be inspected and certificated by the Coast Guard to ensure that the vessels provide an appropriate level of safety to those on board. (M-09-10)

To the National Marine Fisheries Service:

> Amend the regulations at 50 *Code of Federal Regulations* Part 679, Subpart H, to allow for replacement of an Amendment 80 vessel in situations other than vessel loss. (M-09-11)

To the North Pacific Fishery Management Council:

> Amend the fishery management plan for groundfish of the Bering Sea/Aleutian Island management area to allow for replacement of an Amendment 80 vessel in situations other than vessel loss. (M-09-12)

To Fishing Company of Alaska:

> Review and modify as necessary the procedures for enforcing your drug and alcohol policy to ensure full crew compliance. (M-09-13)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

DEBORAH A.P. HERSMAN
Chairman

ROBERT L. SUMWALT
Member

CHRISTOPHER A. HART
Vice Chairman

Adopted: September 30, 2009

(This page intentionally left blank)

Appendix A

Investigation

U.S. Coast Guard headquarters notified the NTSB of the *Alaska Ranger* accident about 1700 eastern daylight time (1300 Alaska daylight time) on March 23, 2008, approximately 8 1/2 hours after the sinking.[1] A four-person go-team was launched at noon on March 24 and arrived in Dutch Harbor, Alaska, about 1100 Alaska daylight time on Tuesday, March 25. The team consisted of specialists in engineering, deck operations, naval architecture, and survival factors. No Board Member traveled to the scene.

While in Alaska, the NTSB team joined the Marine Board of Investigation convened by the Coast Guard Commandant. Hearings opened in Dutch Harbor (March 28–April 3) and continued in Anchorage (April 5), Seattle, Washington (April 15–19, 21–22), and Boston, Massachusetts (June 4 and 6). In December 2008, NTSB investigators, accompanied by the chairman of the Coast Guard Marine Board, traveled to Seattle to interview officials of Fishing Company of Alaska, which was a party to the Coast Guard investigation.

[1] At the time of notification, Coast Guard search and rescue operations had reopened after the fishmaster was discovered missing.

Appendix B

Items in Voluntary Dockside Examinations

The following table lists safety equipment and other items examined during voluntary dockside examinations conducted by Coast Guard District 17, Alaska.

Item	Applicable Federal Regulation
Requirements for All Vessels	
Immersion suits, personal flotation devices	46 CFR 28.110
Personal marker light	46 CFR 25
Ring life buoy	46 CFR 28.115
Survival craft	46 CFR 28.120
Stowage of survival craft	46 CFR 28.125
Survival craft equipment	46 CFR 28.130
Visual distress signals	46 CFR 28.145
Emergency position indicating radio beacon (EPIRB)	46 CFR 28.150, 25.26 47 CFR 80.1061
Fire extinguishers	46 CFR 28.155, 28.160, 25.30
Sound signals	72 COLREGS
Backfire flame control	46 CFR 25.35-1
Ventilation	46 CFR 25.40
Lifesaving equipment markings	46 CFR 28.135
Lifesaving equipment readiness, maintenance, and inspection	46 CFR 28.140
Injury placard	46 CFR 28.165
Waste management plan, ocean-going vessels >40 feet	33 CFR 151.57
Marine sanitation device	33 CFR 159
Carriage of navigation rule book (inland waters only)	33 CFR 88.05
Rules of the Road	33 USC 1602, 33 CFR 81 (COLREGS)
Oil pollution placard for vessels >26 feet	33 CFR 155.450
Garbage placard for vessels >26 feet	33 CFR 151.59
FCC ship station license	47 CFR 80.405
Load lines (applies to fish processing vessels and fish tender vessels)	46 USC 5102-5112
Numbering	33 CFR 173
Documentation	46 CFR 6

Item	Applicable Federal Regulation
Additional Requirements for Documented Vessels That Operate Beyond the Boundary Line[1] or With More Than 16 Persons on Board	
Fireman's outfit and self-contained breathing apparatus	46 CFR 28.205
First aid equipment and training	46 CFR 28.210
Guards for exposed hazards	46 CFR 28.215
Navigational information	46 CFR 28.225
Compass	46 CFR 28.230
Anchor and radar reflectors	46 CFR 28.235
General alarm system	46 CFR 28.240
Communication equipment	46 CFR 28.245
High-water alarms	46 CFR 28.250
Bilge pumps, piping, and dewatering system	46 CFR 28.255
Electronic position-fixing device	46 CFR 28.260
Emergency instructions	46 CFR 28.265
Instruction, drills, and safety orientation	46 CFR 28.270
Additional Requirements for Fish-Processing Vessels	
Certificate of compliance	46 CFR 28.700
Certificate of class	46 CFR 28.720
Petroleum products, dispensing	46 CFR 105
Vessel response plans	33 CFR 155 Subpart D
Other Additional Requirements	
Navigation safety requirements for vessels ≥1,600 gross tons	33 CFR 164
Oil transfer procedures	33 CFR 155, 156
Fuel oil discharge containment	33 CFR 155.320
Certificate of financial responsibility for water pollution	33 CFR 138
Shipboard oil pollution emergency plan	33 CFR 151.26, MARPOL [International Convention on the Prevention of Pollution from Ships] 73/74 Annex I, reg. 26
Oil pollution, other	33 CFR 151, 155
Citizenship/licensing/manning	46 U.S.C. 8103, 8304, 8701, 8702 46 CFR 15
Manning	46 CFR 15.705

SOURCE: *Commercial Fishing Industry Vessel Safety Dockside Examiner Job Aid* (Juneau, Alaska: U.S Coast Guard District 17, rev. August 2004).

[1] The boundary line is the baseline of the U.S. territorial sea.

Appendix C

Coast Guard Marine Safety Alerts

UNITED STATES COAST GUARD
U.S. Department of Homeland Security

MARINE SAFETY ALERT

Assistant Commandant for Marine Safety, Security and Stewardship

May 9, 2008
Washington, DC

Alert 1-08

Maintaining Vessel Watertight Integrity

This Safety Alert addresses two issues: watertight integrity and high level bilge alarms.

Recently a marine casualty involving a fishing vessel in the Bering Sea resulted in multiple fatalities and complete loss of the vessel. A Marine Board of Investigation is currently examining the various circumstances surrounding the casualty. Although the investigation is not complete, testimony indicates the flooding of the vessel may have been exacerbated due to open or leaking watertight doors and other compartmental deficiencies which impacted the vessel's overall watertight integrity.

As a result of this and other similar casualties, the U. S. Coast Guard **strongly recommends vessel owners and operators:**

WATERTIGHT INTEGRITY

Ensure all watertight decks and bulkheads are inspected periodically to verify that there are no unprotected openings or improper penetrations that will allow progressive flooding and that closure devices (e.g. watertight doors, duct closures, etc.) are in place and in working order.

Ensure all crewmembers are familiar with the locations of the watertight doors (WTDs) and weather tight closures throughout their vessels. Knowing the locations of such WTDs and weather tight closures should be part of the crewmember vessel familiarization process.

Ensure WTDs and hatches are closed while at sea and as otherwise specified in the stability guidance provided to the master or individual in charge. The importance of keeping WTDs and hatches closed should be emphasized on a regular basis (e.g. at safety meetings). WTDs and hatches should be opened only briefly to allow passage and labeled appropriately to remind crewmembers to close them. If they must remain open to permit work, WTDs and hatches should be attended at all times so that they can immediately be closed. Any WTDs permitted to be open while the vessel is underway should be secured during drills to ensure they work properly.

Implement a WTD inspection program to ensure each WTD is regularly inspected and properly maintained. As part of the inspection of each WTD, the following should be examined: straightness of the knife edge; the door assembly for twisting or warp-age; evidence of loose, missing seized or damaged components; permanent set in gasket material, cracks in the gasket; gaps at gasket joints; paint, rust, or other foreign material on gaskets, knife-edges and working parts; binding and difficult operations; and loose or excessively tight dogs. Rotating spindles of the dog, handles and hinges, and other points of friction should be lubricated to prevent seizing and allow proper closure. If fitted, the spindle packing should also be examined.

Page 1 of 2

Ensure watertight hatches, dogged manholes, bolted manhole covers, and access plates are given similar examinations, focusing on the sealing surfaces and the method by which the hatch is secured. Gasket materials should be replaced whenever they are found insufficient. Regardless of the type of hatch or access, every component that secures the device, such as dogs, wing nuts, or bolts should be inspected, lubricated and free, and repaired or replaced as necessary to ensure they operate properly. As with watertight doors, hatches and accesses should be labeled to indicate they remain closed while underway. Most importantly, all securing devices must be used when the hatch or access is closed. Improper closure of a hatch will not prevent flooding.

Ensure compartments and external hull structures fitted with ventilation ducts that have hinged covers with gaskets, hinges, sealing surfaces and securing mechanisms are regularly inspected and properly maintained (see above for guidance).

Ensure electrical cables and conduits, piping runs, remote valve actuators, and other components that penetrate watertight bulkheads, decks, and compartments are inspected frequently and properly maintained. Each may have a unique sealing method involving glands with packing assemblies, penetration seals, or other methods. Frequent inspection and proper maintenance of these various fittings and assemblies will assist in minimizing the possibility of progressive flooding.

BILGE AND HIGH WATER ALARMS

Ensure water accumulation is minimized and all spaces are kept dry unless permitted by the stability instructions provided to the master or individual in charge.

Ensure bilge high level alarms are arranged to provide the earliest warnings of abnormal accumulation. The high level bilge alarms should be set as low as possible to the deck or bilge well and positioned along the centermost area of the compartment or in a location at which the fluids will gravitate to first. In areas where bilge water routinely accumulates, the bilge high level alarms should be placed just above the point where under normal working conditions the accumulation would be pumped to a holding tank, overboard, or through an oily water separation system if required. Alarms may be fitted with short time delays to prevent nuisance alarms caused by the rolling and pitching of the vessel.

Ensure all crewmembers understand the importance of minimizing water in the bilges.

Provide the funding, labor, spare parts, and vessel availability necessary to ensure leakages stemming from machinery, equipment and other components are kept to a minimum at all times in accordance with good marine practice.

This safety alert is provided for informational purposes only and does not relieve any domestic or international safety, operational or material requirement. Developed and distributed by the Office of Investigations and Analysis, United States Coast Guard Headquarters, Washington, DC.

****

UNITED STATES COAST GUARD

U.S. Department of Homeland Security

MARINE SAFETY ALERT

Assistant Commandant for Marine Safety, Security and Stewardship

July 2, 2008 Alert 3-08

Washington, DC

Controllable Pitch Propeller Systems and Situational Awareness

A marine casualty in March of 2008 involving a fishing vessel in the Bering Sea resulted in multiple fatalities and complete loss of the vessel. A Marine Board of Investigation is currently examining the various circumstances surrounding the casualty. Although the investigation is not complete, safety issues associated with casualty have been identified that merit immediate public dissemination.

Based on the survivors' testimony, the crew experienced difficulty with launching and entering the three liferafts because the vessel was making considerable sternway when the order to abandon ship was issued. Evidence indicates the main engines were still running and the vessel was backing with significant astern pitch. Consequently, two of the liferafts quickly traveled forward past the bow of the vessel when they were launched. Attempts to retrieve the liferafts using the painter lines were unsuccessful. As a result, the majority of the crew members were forced to jump into the 34°F water and attempt to swim to the liferafts. Ultimately, only 22 members of the vessel's crew made it into the liferafts. All of these crew members survived. Of the other 25 crew members who never made it into a liferaft, four died and one remains missing.

The Coast Guard ***strongly recommends*** that owners, operators, and masters of vessels with controllable pitch propellers understand the design and operation of the system. This includes the primary and emergency sources of power for both the control and main systems, the location and procedures for using alternate control stations, and the locations of the emergency shutdowns. While controllable pitch propeller systems are generally designed and constructed to fail in the "as is" position, in hydraulic CPP systems, the actual blade pitch may change. In this case the vessel was making considerable sternway. This was not a unique occurrence. The MS EXPLORER also experienced this problem before it sank in November of 2007. Vessel operators, masters and crew members must be prepared to respond accordingly.

In light of this incident, vessel owners, operators, masters and crew members should also be mindful of the following safety issues:

1. Vessel masters and officers must maintain situational awareness at all times and understand the effects of their actions and decisions on the safety of their crew, especially during emergency situations involving flooding. This includes understanding what impact the vessel's speed, heading, heel, and trim will have on the crew as it abandons ship.

2. The master or individual in charge must evaluate the particular circumstances of each emergency situation (weather, seas, experience of crew, condition of vessel, etc.) and adjust emergency procedures accordingly to provide for the safety of his crew, vessel, and the environment.

Page 1 of 2

3. All crew members should understand that immersion suits will affect their dexterity, limit mobility, and may make it more difficult to launch survival craft, particularly when the survival craft are covered with snow or ice. Crew members responsible for launching the survival craft should practice and be able to do so with their immersion suits on. Lifesaving gear should be kept free of ice and snow whenever possible.

4. When abandoning ship, crewmembers should make every effort to enter directly into a liferaft or lifeboat before entering the water. If crewmembers must enter the water, they should stay together and attempt to enter a liferaft, climb onto floating debris, or use any other means available to get themselves out of the water as soon as possible.

5. Emergency Drills should not be limited to routine procedures such as donning immersion suits. Emergency drills should ensure all crew members, including bridge and engine room personnel, understand and practice what to do in various emergency situations under actual conditions.

Additional information regarding emergency procedures for Commercial Fishing Vessels can be found at: http://www.fishsafe.info .

This safety alert is provided for informational purpose only and does not relieve any domestic or international safety, operational or material requirement. Developed and distributed by the Office of Investigations and Analysis, United States Coast Guard Headquarters, Washington, DC.

****

Office of Investigations and Analysis – http://marineinvestigations.us
To subscribe – Kenneth.W.Olsen@uscg.mil

Appendix D

International Standards for Fishing Vessel Safety

Other industrialized fishing nations (among them Australia, Denmark, Finland, Japan, New Zealand, Norway, Sweden, and the United Kingdom) have implemented safety programs for commercial fishing vessels. The United Kingdom, for example, has had fishing vessel safety provisions for vessels 12 meters (39.37 feet) or more in length since 1975. The requirements include watertight integrity, freeboard and stability, boilers and machinery, bilge pumping arrangements, electrical equipment and installation, and lifesaving and firefighting equipment. Fishing vessels 12 meters or more in length must be inspected every 4 years and meet the safety provision requirements. Each vessel must carry a United Kingdom fishing vessel certification indicating that the vessel meets the requirements and including information on the vessel's stability.[1]

Canada, whose commercial fishing industry is similar to the industry in northern U.S. waters, has adopted new legislation, the Canada Shipping Act of 2001, that governs safety in marine transportation as well as recreational boating and environmental protection. The legislation covers licensing and registration of vessels, certification of marine personnel, and seaworthiness of vessels. Current regulations include separate inspection requirements for large fishing vessels (at least 24.4 meters [80 feet] in length or 150 gross tons) and small fishing vessels (not exceeding 24.4 meters in length and not exceeding 150 gross tons). All vessels require inspection every 4 years. The regulations are being revised into one set of requirements for all commercial fishing vessels, with separate provisions for different sectors of the industry. New requirements for vessels over 24 meters will align with the Torremolinos Protocol of 1993.[2]

The Torremolinos Protocol grew out of the first international convention on fishing vessel safety adopted at a conference in Torremolinos, Spain, in 1977—the Torremolinos International Convention for the Safety of Fishing Vessels. The convention was not ratified and, in 1993, it was superseded by the Torremolinos Protocol. As of the date of this report, 17 nations had signed the protocol (not including the United States), but it had not yet entered into force. The protocol applies to new fishing vessels 24 meters (79 feet) or longer in length and includes fish processing vessels. The provisions include technical specifications for construction and

[1] National Research Council, *Fishing Vessel Safety—Blueprint for a National Program* (Washington, DC: National Academy Press, 1991).

[2] Government of Canada website, "Canada Business: Services for Entrepreneurs" <www.canadabusiness.ca/servlet/ContentServer?cit=1081944210261&lang=eng&pagename=CBSC_FE%2Fdisplay&c=Regs=CBSC_FE%2Fdisplay&c=Regs> (accessed December 2, 2008); Transport Canada website <www.tc.gc.ca/mediaroom/ backgrounders/b07-m007.htm> (accessed December 23, 2008); and telephone conversation with Transport Canada marine safety inspector (September 23, 2009).

stability and regulations for machinery spaces, lifesaving appliances, immersion suits, and components of the global maritime distress and safety system.[3]

The first international safety standards for fishing vessel personnel were developed in the 1995 International Convention on Standards of Training, Certification, and Watchkeeping for Fishing Vessel Personnel (STCW-F convention).[4] The convention addresses training and certification standards for masters and watchkeepers on fishing vessels 24 meters or more in length, for engineers on vessels of more than 750 kilowatts, and for crew in charge of radio communication. It also requires basic safety training for all fishing vessel personnel before they go to sea. The convention will enter into force 12 months after no fewer than 15 nations have signed it. As of the date of this report, 13 nations (not including the United States) had signed the convention.[5]

[3] International Maritime Organization website <www.imo.org/Conventions/> (accessed November 25, 2008, December 2, 2008, and April 28, 2009).

[4] Article III(b) of the 1978 International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW convention) explicitly excludes seafarers serving on fishing vessels.

[5] International Maritime Organization website <www.imo.org/Conventions/>; and *The Torremolinos Protocol and STCW-F Convention: Tools for Improved Fishing Vessel Safety*, brochure produced by Coastal Fisheries Programme, Secretariat of the Pacific Community <www.ffa.int/system/files/> (accessed December 2, 2008).