



National Transportation Safety Board

Washington, D.C. 20594

Marine Accident Brief

Accident No.: DCA-09-LM-021
Vessel *Fire Island Belle*
Accident Type Engineroom fire
Location: Fair Harbor, New York
Date: September 20, 2009
Time: 1010 eastern daylight time¹
Owner/Operator: Fire Island Ferries
Property Damage: \$490,000
Injuries: None

Summary

On September 20, 2009, at 1010 eastern daylight time, the passenger ferry *Fire Island Belle* (figure 1), with 100 passengers, the vessel master, and two deckhands on board, experienced an engineroom fire in the Great South Bay between Long Island and Fire Island, New York (figure 2). The vessel had departed Ocean Beach, Fire Island, 10 minutes earlier, and was approximately 300 yards from the dock at Fair Harbor, Fire Island, when the fire broke out. No passengers or crewmembers were injured, and no pollution resulted.

The cost of repairing the vessel was \$490,000. The U.S. Coast Guard was the lead investigative agency in the accident. The National Transportation Safety Board (NTSB) provided assistance with fire investigation and metallurgical analysis.

Accident Narrative

At 0925 on September 20, the *Fire Island Belle* departed Bay Shore, Long Island, on its regularly scheduled route, which included stops on Fire Island at Ocean Beach, Fair Harbor, and Saltaire before returning to Bay Shore. About 0950, the vessel reached Ocean Beach, where arriving passengers and cargo were offloaded and departing passengers and cargo were loaded. According to their statements to the Coast Guard, the vessel master and one of the deckhands reported smelling fuel while the cargo was being loaded. They checked the passenger baggage to determine if that was the source of the odor but found nothing.

¹ Times are given according to the 24-hour clock.



Figure 1. *Fire Island Belle* before the fire.



Figure 2. Accident location.

The master then entered the engineroom through the forward port access hatch. The engineroom contained three engines, port, center, and starboard, and four access hatches, two forward and two aft (figure 3). The master discovered fuel leaking from the pipe nipple connection to a T-fitting on top of the secondary fuel filter on the center engine. All three engines had experienced fuel leaks at that connection. As a result, the pipe nipples had been replaced on all three engines, most recently on the center engine, about 30 days before the fire.

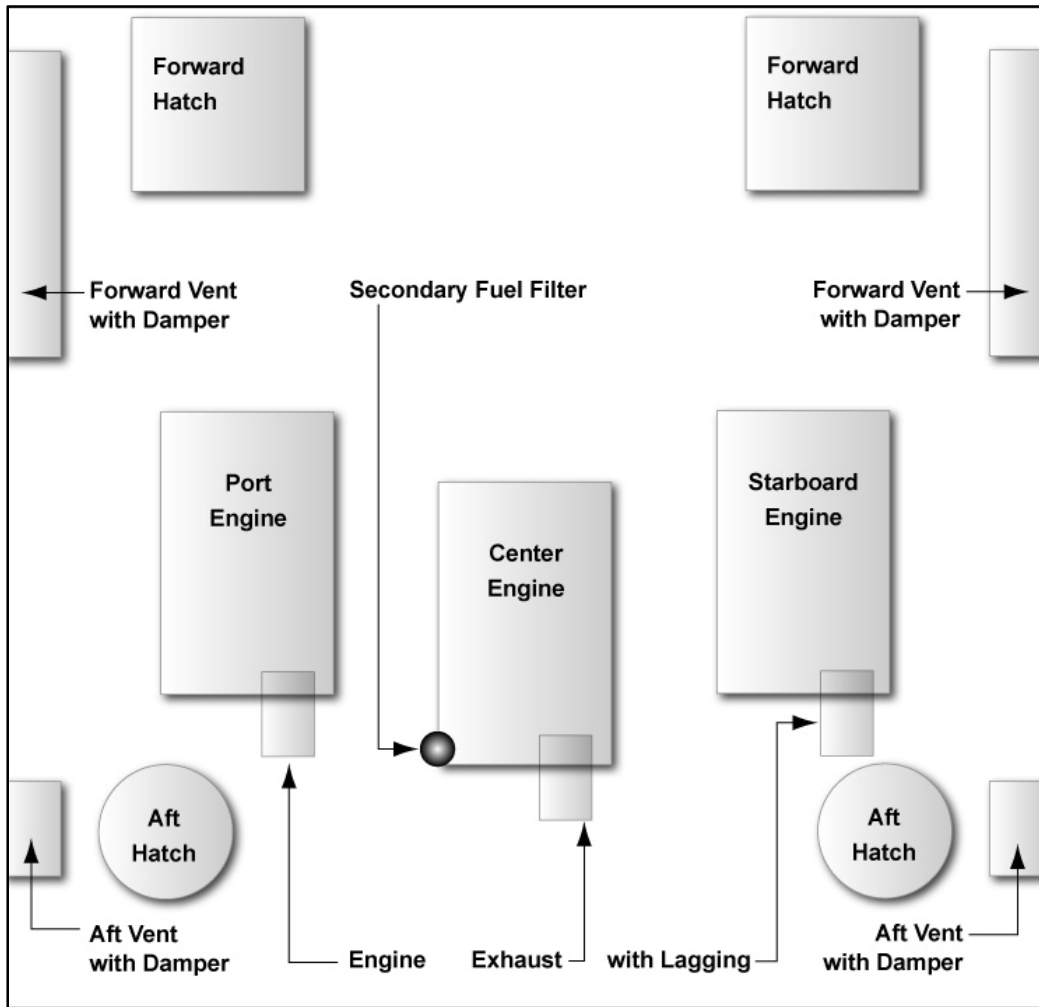


Figure 3. Schematic of engineroom layout on *Fire Island Belle* (not to scale).

The master stated that he did not see any fuel around the area of the filter on the center engine or on the surface below it. He left the engineroom and went to the pilothouse to shut down the center engine because of the fuel leak at the pipe nipple. (The engines had been at idle while the ferry was docked at Ocean Beach.)

About 0959, after the master had shut down the center engine and loading was complete, the vessel left Ocean Beach. As the vessel rounded the channel marker into Fair Harbor, passengers reported thick black smoke coming from the port and starboard engineroom vents. About the same time, the alarm from the engineroom heat detectors sounded in the pilothouse.

The deck crew was directed to inform the passengers that they would all disembark at Fair Harbor. The master directed the ferry into the mooring slip at Fair Harbor, where it was secured by a springline to the dock.

The master saw that the ferry was still too far from the dock to disembark passengers and tried to start the port engine to move it closer. The engine had shut down because of the fire and would not restart. The master and a few passengers then manually pulled the vessel to the dock. After securing the vessel, the master and crew safely disembarked all passengers. The master then pulled the emergency fuel shut-off valve and activated the engineroom's fixed carbon dioxide (CO₂) fire suppression system. The master heard the alarm that sounded 30 seconds before the system activated and the sound of pressurization in the lines, which confirmed system activation.

At the master's request, a member of the Fair Harbor Fire Department (FHFD) who was on the dock notified the nearby fire department of the fire. (The dock was about 100 feet from the FHFD headquarters.) According to the FHFD incident report, two firefighters from the FHFD had noticed the *Fire Island Belle* exhausting a large volume of dense black smoke as it neared Fair Harbor. One of the firefighters dialed 911 to report the fire and began helping the passengers evacuate the ferry. At 1015, Suffolk County Fire Rescue and Emergency Services began dispatching vehicles to the scene. The FHFD had two 1-3/4-inch hose lines, one supplied with foam, on the dock within minutes of the *Fire Island Belle* disembarking its passengers. An FHFD assistant chief assumed command of the firefighting effort until the FHFD chief arrived.

The first firefighters on scene noticed thick black smoke pouring from the engineroom vents, the heaviest smoke coming from the starboard vent. The master notified the fire chief that the vessel's CO₂ fire suppression system had been activated. The master also told him that approximately 700 gallons of diesel fuel were on board. Firefighting began with an inspection of the aft deck hatches that allowed access to the engineroom. According to firefighters, the area around the aft port hatch was extremely hot and painful to the touch, even with gloves. The deck paint around the hatch was burned, and the decking around the hatch was warped from the heat. When the firefighters opened the hatch, fire and heavy gray-and-black smoke poured out. One foam line was sprayed down the rear port hatch into the engineroom for 15 to 20 minutes to suppress the fire. Firefighters entered the engineroom from the forward starboard access hatch, but according to the FHFD incident report, thick smoke kept them from going farther than the bottom of the ladder to avoid becoming lost in the confined space.

After the foam line was shut off, a high-power fan was installed to vent the engineroom. After 20 minutes of venting, firefighters entered the engineroom through the forward starboard hatch. Smoke had abated and visibility was good. Firefighters noted that foam had coated the bottom 12 inches of the engineroom and that fire damage was limited to the top of the space. Conditions at floor level were cool. Smoke was still coming off wiring on the ceiling, as well as from the top of the port engine and from the insulation, also known as lagging, around the exhaust duct from the port engine. Some of the lagging around the port engine exhaust was removed while firefighters checked for hot spots. Firefighters sprayed those areas with foam for several minutes to ensure that the fire was out.

About 1045, Coast Guard Sector Long Island Sound was notified of the fire. At that point, the FHFD vacated the engineroom and turned it over to an assistant chief from the Kismet Fire Department. The assistant chief oversaw members of his department and the Saltaire Fire Company while they performed a secondary examination and assessment of the engineroom using a thermal imaging camera (Kismet and Saltaire are both on Fire Island; refer to figure 2). The fire was reported extinguished and ground operations were terminated at 1110. Ground operations were witnessed by members of the Suffolk County Police Department, the Ocean Beach Police Department, the Town of Islip Harbor Police, and the Fire Island National Seashore rangers.

By the time firefighting operations ended, the owners of Fire Island Ferries had arrived to take possession of the vessel. At 1221, the vessel departed Fair Harbor under tow to Bay Shore by the vessel *Eagle*. At 1243, Coast Guard investigating officers boarded the *Fire Island Belle* while it was under way. Within 10 minutes of arriving on board, a qualified member of the Coast Guard Station Fire Island boat crew conducted drug and alcohol tests, as required by 46 *Code of Federal Regulations* (CFR) 4.06.² The *Fire Island Belle* moored at the Fire Island Ferry terminal in Bay Shore at 1415.

Vessel Information

The Fire Island Belle was an 85-foot, double-deck, single-hull aluminum vessel built in 2009 by Blount Boats, Inc., of Warren, Rhode Island. The vessel was delivered to Fire Island Ferries on June 18, 2009. According to its certificate of inspection, the vessel was inspected under 46 CFR, subchapter K (applicable to small passenger vessels carrying more than 150 passengers or with overnight accommodations for more than 49 passengers), and operated in ferry service on rivers including Great South Bay on runs not to exceed 30 minutes. On the day of the fire, the vessel operated with three crewmembers—one master and two deckhands. The number of deckhands varied with the number of passengers. The vessel had a passenger capacity of 382, of whom 178 were allowed on the upper deck.

The enclosed pilothouse was forward on the upper deck. The engineroom was directly below the main passenger deck, with access hatches in each corner. The forward hatches provided access through doors and stairs that led to the engineroom. The rear hatches had floor-level covers that, when lifted, provided access to the aft engineroom by way of ladders.

² Regulations at 46 CFR 4.06 require that after a serious marine incident, “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 within 32 hours “unless precluded by safety concerns directly related to the incident.” Regulations at 46 CFR 16.113 specify testing for marijuana, cocaine, opiates, phencyclidine, and amphetamines. Alcohol testing is not required more than 8 hours after a serious marine incident. 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.

The vessel was powered by three Detroit Diesel Series 60 Tier II engines.³ Alternators were located forward of each engine. The fuel tank, immediately forward of the engineroom, was stocked with ultralow sulfur No. 2 diesel fuel.⁴ Fuel went from the tank to each engine through a primary fuel filter, then through a fuel pump and a secondary fuel filter to the back of the cylinder head, and from there to the engine injector ports (fuel gallery).

A second fuel gallery captured returned fuel. Unused, heated fuel was first cooled in the heat exchanger, then returned to the tank. Each engine was equipped with a Puradyn® filtration system for the lubricating oil.⁵ Sensors serving the alternator and the Puradyn system were attached to the secondary fuel filters. The fuel pressure going into the secondary fuel filter was 82 to 90 pounds per square inch, depending on engine speed.

Fire Damage

Smoke and other fire damage was limited to the engineroom and adjacent structures such as ventilation ducts and the aft access hatches. The only exterior damage was around the engineroom vent openings. Soot was visible on the outside of the hull above the dampers, with more soot on the starboard side than on the port side (figure 4). The Coast Guard–approved polyvinyl chloride (PVC) weather covers over the vents had melted. The starboard cover, which exhibited more melting than the cover on the port side, fell out of position and came to rest on top of the ventilation damper (figure 5). The cover did not interfere with the ventilation damper because the dampers had closed automatically when the fire suppression system was activated (see “Fire Protection System,” below).

The engineroom showed varying degrees of fire damage. Damage in the forward section was limited to heavy sooting and some light thermal damage, particularly to plastic components, in the overhead forward of the engines. Damage was more severe near the engines, especially on the overhead between the center and port engines (figure 6). Thermal damage patterns extended 2 to 3 feet down from the overhead. One of the aluminum hangers for the fire suppression system piping had melted, and the hanger between the center and starboard engines had fractured. The lenses for the overhead lighting in the aft portion of the engineroom had melted away from the lights and dripped onto the surfaces below.

Almost all exposed surfaces on the engines exhibited heavy sooting. The air filters for all the engines were covered with soot, and the port and starboard filters had partially collapsed from the heat. Plastic components on the rear of the port and center engines were melted. Part of the wiring to the ignition box for the center engine was heavily fire-damaged. Most of the insulation had melted, but the wires were intact and did not exhibit signs of arcing.

³ The Series 60 is an inline, 6-cylinder, water-jacketed engine. According to the manufacturer, the engine’s maximum exhaust gas temperature at full power is 671° F.

⁴ This fuel is recommended by the engine manufacturer to avoid fouling the exhaust after-treatment system. According to the material safety data sheet, the fuel’s autoignition temperature is 489° F. Autoignition temperature is the lowest temperature at which a combustible material ignites in air without a spark or flame. The temperature of a heated surface required to ignite a combustible material is usually lower than the autoignition temperature.

⁵ According to the Puradyn manufacturer, a bypass filtration system is required to remove the wear-producing soot deposited in lubrication oil by modern, low-emission diesel engines.



Figure 4. Soot damage to vent opening on starboard side of vessel.



Figure 5. Closeup of damaged starboard vent cover (viewed from inside vent).



Figure 6. Damage to overhead wiring in engine room.

A Detroit Diesel engine technician downloaded data from each engine's computer. The data showed that the center engine had not been running at the time of the fire. According to the computer data, the port and starboard engines, both running at full power at the time of the fire, showed elevated air intake temperatures about the same time as the engine room alarm sounded in the pilothouse.

The only mechanical engine damage was a fractured pipe nipple connection on the center engine's secondary fuel filter (figure 7). The fractured nipple and adjoining fittings were removed and retained by the NTSB for further examination. The insulation on the wiring to the sensors attached to the T-fitting had melted, but the sensors were otherwise intact.

The lagging for the port engine exhaust duct, which was about 19 inches above the center engine's secondary fuel filter, was charred (figure 8). As noted earlier, parts of the lagging were removed by firefighters while searching for hot spots. Another section of lagging was removed to assess the condition of the duct underneath. The surface of the duct showed evidence of resolidified plastic, most likely from the lens of the overhead light. The duct hanger was not lagged.

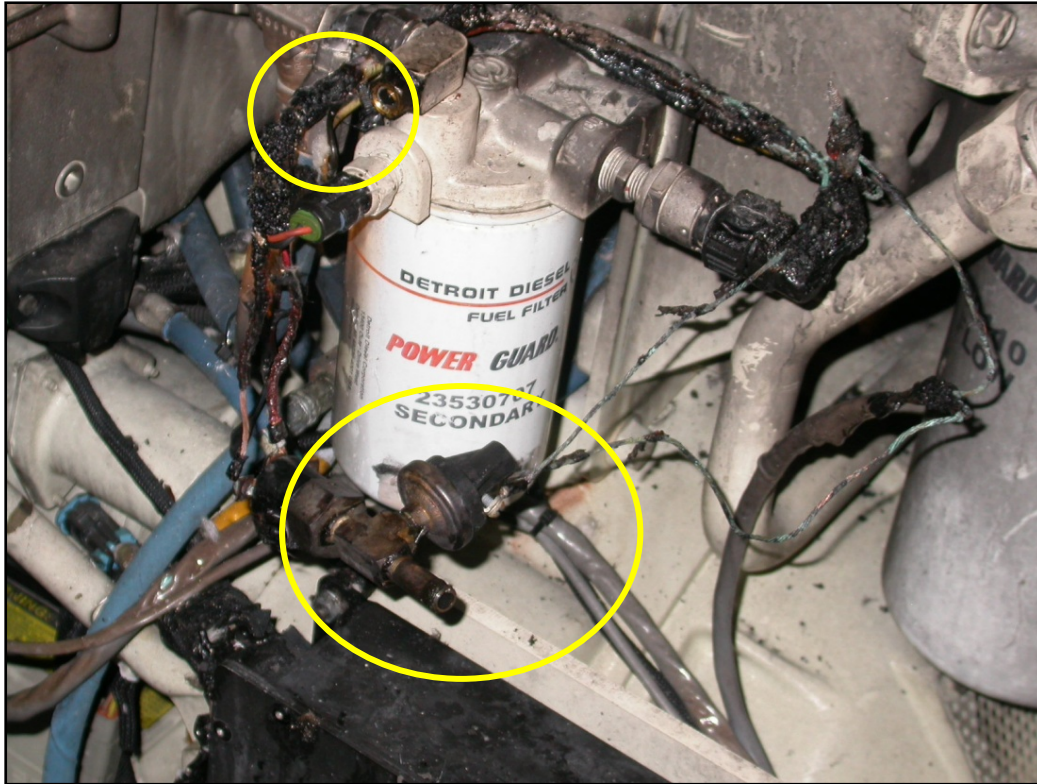


Figure 7. Fractured nipple (above) and associated fittings (below) on secondary fuel filter of center engine.



Figure 8. Charred lagging on port engine exhaust duct.

Fire Protection System

Title 46 CFR, Part 118, §400 requires a space that contains propulsion machinery to be equipped with an automatic fire detection system unless (1) the vessel was built before March 10, 1996, and (2) does not have a hull, machinery space boundary bulkhead, or deck that is composed of wood or fiber-reinforced plastic, sheathed on the interior with fiber-reinforced plastic, or is continuously manned. The space is also required by 46 CFR, Part 118, §400 to be equipped with a fixed gas fire-extinguishing system unless (1) it was built before March 10, 1996, and (2) does not have a hull, machinery space boundary bulkhead, or deck composed of wood or fiber-reinforced plastic or sheathed on the interior with fiber-reinforced plastic. Because the *Fire Island Belle* was built after 1996, it was required to have both an automatic fire detection system and a fixed fire suppression system (figure 9)

The engineroom contained five heat detectors manufactured by Notifier®. The remains of two detectors were found in the debris after the fire. The other three detectors were still in place in the engineroom overhead. Smoke detectors, also manufactured by Notifier, were located on the main passenger deck and forward engineroom access stairwells. A Notifier NFS2-640 fire alarm control panel was located on the bridge.

The fire suppression system was equipped with two 75-pound CO₂ cylinders, installed in a separate compartment forward of the engineroom. Galvanized piping connected the cylinders to the engineroom, where two discharge nozzles were installed (one in the forward portion of the engineroom and one in the aft portion near the center engine). A discharge alarm and a 30-second delay device allowed for evacuation of the engineroom if necessary. The system was remotely activated by a pull cable on the main deck near the forward port engineroom access hatch. The fire suppression system was configured so that the engineroom vents closed when the remote cable was pulled.

The cylinders, pipes, and nozzles were found intact during the postaccident examination. The servicing company for the fire suppression system reported that the cylinders were empty after the fire. The master said that the system actuated properly because he heard both the discharge alarm and the lines being pressurized.

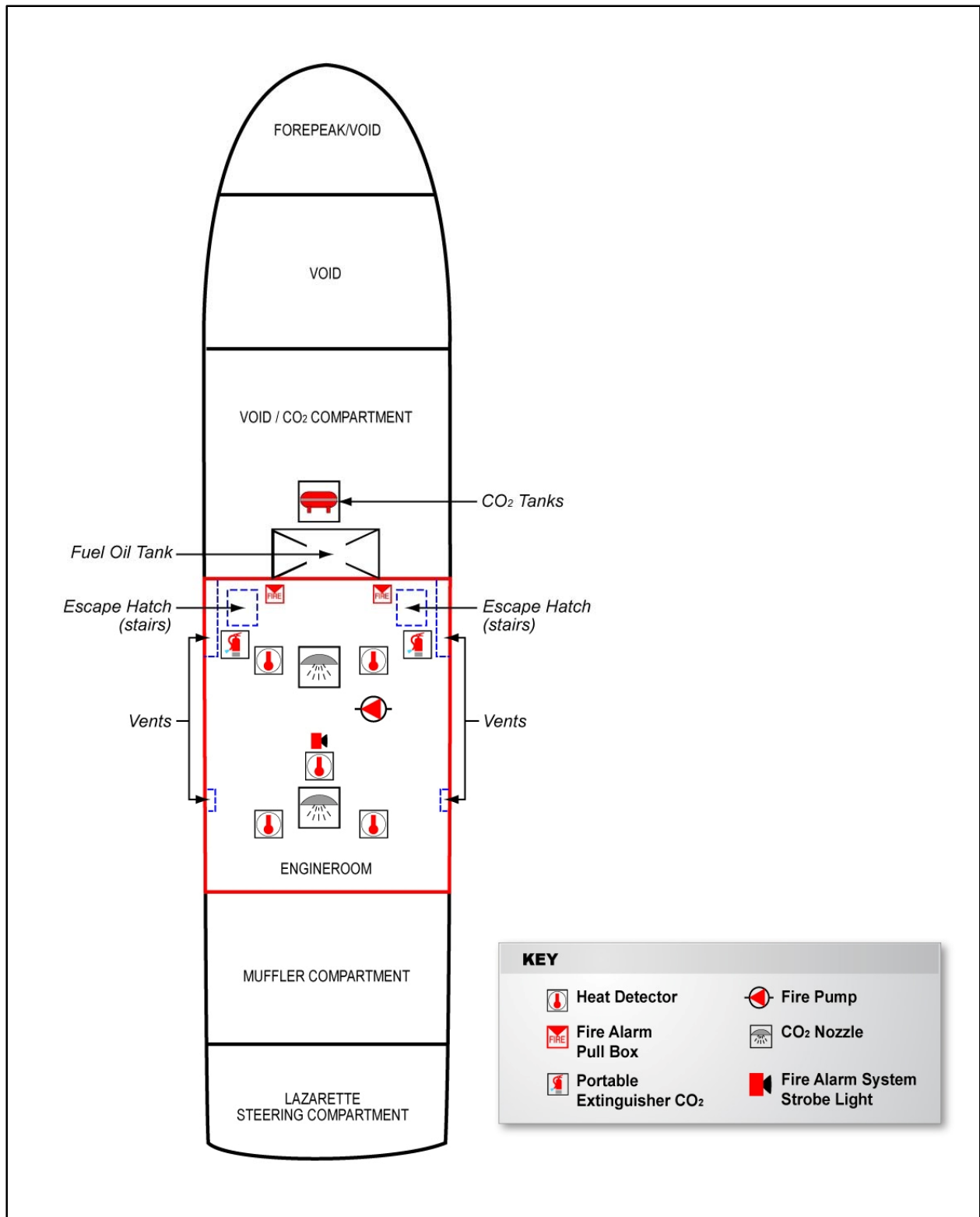


Figure 9. Diagram of engine room fire detection and suppression system on *Fire Island Belle*.

Metallurgical Examination

The NTSB materials laboratory in Washington, DC, examined the fractured pipe nipple from the secondary fuel filter on the center engine (figure 13). The nipple was constructed of 3/8-inch seamless steel pipe (1/8 American Standard pipe), commonly referred to as black steel. Examination by stereomicroscope and scanning electron microscope revealed a fatigue fracture (crack) that went through the wall of the pipe and part-way around it. The dimensions, chemistry, and hardness of the pipe nipple were measured and compared with appropriate standards for seamless steel pipe. The measurements were within specifications.

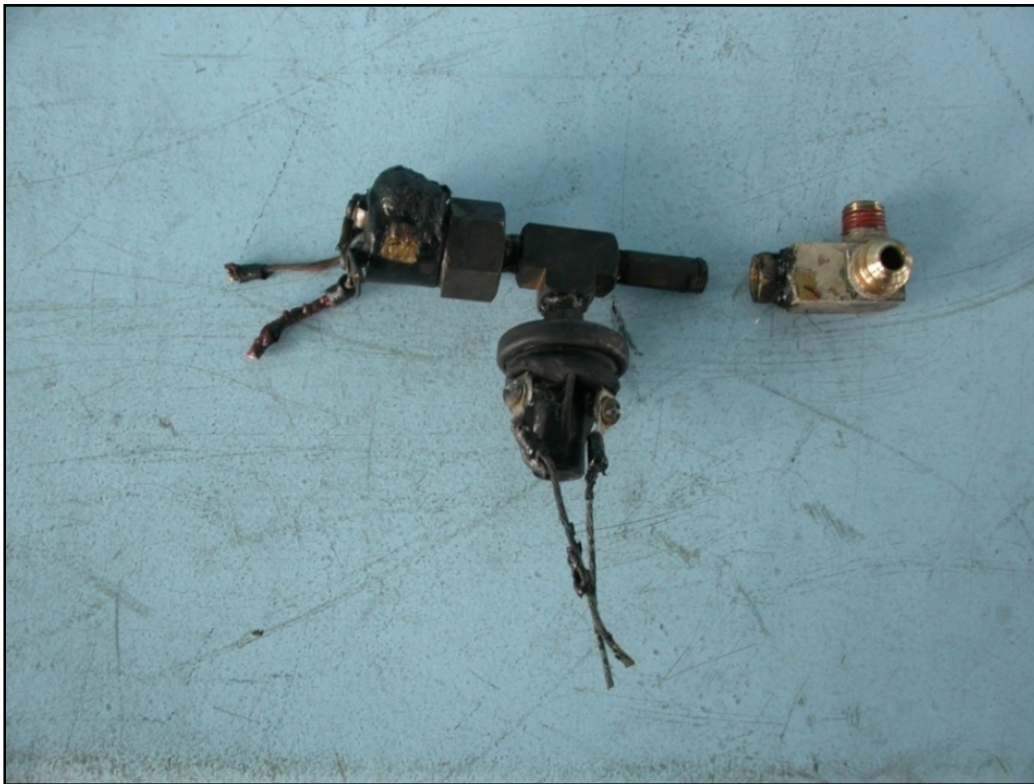


Figure 13. Pipe nipple and T-fitting from center engine.

Origin and Cause of Fire

Fire damage, including damage from smoke, was limited to the engineroom and adjacent structures such as the ventilation ducts for the engineroom and aft access hatches. Damage was more severe between the center and port engines, particularly overhead, where wiring bundles were melted and charred. Based on the location of the damage, investigators determined that the fire had originated in the aft portions of the port and center engines.

Shortly before the fire broke out, the crew had smelled fuel and the master had found fuel leaking from the nipple connection to the secondary fuel filter on the center engine (which was idling at the time). The postaccident laboratory examination found a fractured connection (pipe nipple) on the fuel filter. All three engines had experienced leaking at that connection. It is

reasonable to conclude that during the voyage across the bay from Long Island to Ocean Beach, with all three engines running, pressurized fuel had sprayed from the crack in the pipe nipple up onto the exhaust duct for the port engine (refer to figure 3). Based on the fracture analysis, the master's discovery before the fire, and the history of issues with the nipple connection, investigators determined that diesel fuel coming from the fractured fitting on the center engine was the source of fuel for the fire.

The exhaust ducts from the vessel's engines, as the only exposed hot components in the engineroom, were covered with insulation (lagging). After the fire, the lagging on the port exhaust duct was removed. The lagging was charred both inside and outside, and molten plastic was observed on the surface of the duct, suggesting the presence of a gap in the stitching that held the lagging together. Therefore, the fuel from the center engine that had sprayed onto the port engine's exhaust duct could have leaked through the gap onto the hot surface of the duct, even after the center engine was shut down at Ocean Beach.

The engines were at idle while at the Ocean Beach dock, but the temperature of the exhaust from the port engine would have increased once the vessel got under way toward Fair Harbor. The autoignition temperature of the ultralow sulfur No. 2 diesel fuel used in the engines is 489° F. That temperature is below the temperature of the exhaust gas at full engine power (671° F). The apparent gap in the lagging demonstrates that despite the presence of insulation, the port exhaust duct was exposed, and fuel could therefore have contacted the hot duct. The gap in the lagging and the damage to the lagging itself suggest that the hot surface of the port engine's exhaust duct was the ignition source for the fire.

Postaccident Actions by Owner

Fire Island Ferries made several changes to the *Fire Island Belle* after the fire:

- Altered the lubricating oil filtration system to activate by the ignition system rather than by the secondary fuel filter.
- Eliminated the pipe nipple and T-connector from the secondary fuel filter configuration.
- Added two-part insulation/lagging wrap to the exhaust ducting and duct hangers.
- Installed aluminum frames on the engineroom vent covers and aluminum mesh backing on the vents to keep the PVC part of the covers from falling inside the vents.
- Added another nozzle to the fire suppression system, making three nozzles in the engineroom—two over the engines and one forward.
- Updated the vessel's fire control plan.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the engineroom fire on the *Fire Island Belle* was the ignition of fuel that had leaked from a fatigue-fractured fitting on the center engine's secondary fuel filter, sprayed onto the lagging around the port engine exhaust duct, and seeped through a gap in the lagging onto the hot duct, where it caught fire.

Adopted: July 2, 2010