United States Coast Guard

Report of the Investigation into the Passenger Vessel SANDY GROUND (O.N. 1299657) Engine Room Fire in Upper New York Bay on December 22, 2022

MISLE Activity Number: 7613155. MISLE Case Number: 1332469.

U.S. Department of Homeland Security
United States Coast Guard

Commandant
United States Coast Guard

US Coast Guard Stop 7501
2703 Martin Luther King Jr. Ave. SE
Washington, DC 20593-7501
Staff Symbol: CG-INV
Phone: (202) 372-1032
E-mail: CG-INV1@uscg.mil

16732/IIA #7613155
21 Feb 2025

ENGINE ROOM FIRE ONBOARD THE PASSENGER FERRY SANDY GROUND (O.N. 1299657) IN THE BAY RIDGE CHANNEL NEAR MANHATTAN, NEW YORK ON DECEMBER 22, 2022

ACTION BY THE COMMANDANT

The record and the report of the investigation completed for the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendation are approved subject to the following comments. This marine casualty investigation is closed.

ACTION ON RECOMMENDATION

Recommendation 1: Revision to the United States Coast Guard Marine Safety Center (MSC) Plan Review Guidelines (PRG), Procedure E1-10 Fuel Oil Systems, and Procedure E1-35 Miscellaneous Piping Systems, is proposed for the incorporation of Title 46 Code of Federal Regulations (CFR) § 56.07-10 as a reference for vessels subject to 46 CFR Subchapter F. The objective of this proposal is to highlight and include the design conditions and criteria for piping systems in regard to its maximum allowable working pressure and relief valves in accordance with 46 CFR § 56.07-10, as part of the Plan Review Guidelines for Procedure E1-10 Fuel Oil Systems and Procedure E1-35 Miscellaneous Piping Systems. Additionally, it is proposed that Coast Guard approved machinery system letters should include a statement detailing the maximum allowable working pressure that the approval is based on.

Action: I partially concur with this recommendation. As the First Coast Guard District stated in their endorsement, MSC PRGs serve as guidance in the plan review process and are not a substitute for applicable legal requirements, nor are they themselves a rule. They represent the Coast Guard's current thinking on the applicable topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. Based on this recommendation and to help better address this design hazard, the Marine Safety Center updated PRG E1-10, Fuel Oil Systems to reference 46 CFR 56.01-1(b).

[redacted]

A. M. BEACH
Captain, U.S. Coast Guard
Director of Inspections and Compliance (CG-5PC)

U.S. Department of Homeland Security
United States Coast Guard

Commander
First Coast Guard District

408 Atlantic Ave.
Boston, MA 02110-3354
Staff Symbol: (dp)
Phone: (617) 406-9045

16732
05 Sep 2024

PASSENGER VESSEL SANDY GROUND (O.N. 1299657) ENGINE ROOM FIRE IN UPPER BAY, NEW YORK ON DECEMBER 22, 2022

ENDORSEMENT BY THE COMMANDER, FIRST COAST GUARD DISTRICT

The record and the report of the investigation convened for the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations are approved subject to the following comments. It is recommended that this marine casualty investigation be closed.

ENDORSEMENT/ACTION ON SAFETY RECOMMENDATIONS

Recommendation #1 – Revision to the USCG Marine Safety Center Plan Review Guidelines, Procedure E1-10 (Fuel Oil Systems), and Procedure E1-35 (Miscellaneous Piping Systems), is proposed for the incorporation of 46 CFR § 56.07-10 as a reference for vessels subject to 46 CFR Subchapter F. The objective of this proposal is to highlight and include the design conditions and criteria for piping systems in regard to its maximum allowable working pressure and relief valves in accordance with 46 CFR § 56.07-10, as part of the Plan Review Guidelines for Procedure E1-10 (Fuel Oil Systems) and, Procedure E1-35 (Miscellaneous Piping Systems). Additionally, it is proposed that Coast Guard approved machinery system letters should include a statement detailing the MAWP that the approval is based on.

Endorsement: Concur With Intent – My office agrees, at least in part, that the unsafe conditions, actions, or other unwanted outcomes identified need to be addressed. However, it is recommended the OCMI conduct outreach with their vessel operators, specifically NYC DOT Staten Island Ferry Division to ensure Coast Guard Marine Safety Center (MSC) Plan Review Guidance (PRG) is being adhered to and that all repairs or alterations are made in accordance with 46 CFR 71.55-1.

MSC PRGs serve as guidance in the plan review process and are not a substitute for applicable legal requirements, nor are they themselves a rule. They represent the Coast Guard's current thinking on the applicable topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. Therefore, it is not recommended that PRG E1-10 and E1-35 be incorporated by reference for vessels subject to 46 CFR Subchapter F.

It is also not recommended that MSC Approval letters include maximum allowable working pressure (MAWP) for fuel oil piping systems. Being that the fuel oil piping system is a pressurized system, the MAWP and burst pressure should be included in the original builder plan and associated calculations submitted to MSC for approval. In this

case the plan containing those calculations was returned approved. The crux of the issue in this case is that an alteration of the fuel oil piping system occurred where check valves had been replaced with ball valves on the return lines. It is likely that if this alteration had been submitted for approval, the local OCMI would have identified the non-conforming fuel valve arrangement, thus making the safety recommendation unwarranted.

[redacted]

D. E. O'CONNELL
Captain, U.S. Coast Guard
Chief of Prevention, First Coast Guard District
By direction

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Sector New York

212 Coast Guard Drive
Staten Island, NY 10305-5005
Staff Symbol: (s)
Phone: (718) 354-4003
Email: Zeita.Merchant@uscg.mil

16732
14 Mar 2024

MEMORANDUM

[redacted]

From: Z. Merchant, CAPT
CG Sector New York (s)

To: COMDT (CG-INV)
Thru: CGD One (dp)

Subj: PASSENGER VESSEL SANDY GROUND (O.N. 1299657) ENGINE ROOM FIRE IN UPPER NEW YORK BAY ON DECEMBER 22, 2022

Ref: (a) Title 46 United States Code, Chapter 63
(b) Title 46 Code of Federal Regulations, Part 4
(c) Marine Safety Manual, Volume V, COMDTINST M16000.10 (series)
(d) Marine Investigations Management and Documentation Requirements, CG-INV Policy Letter 3-18 (CH-1)

1. In accordance with the above references, the Sector New York Investigations Division conducted a Marine Casualty Investigation into the engine room fire on the Staten Island Ferry SANDY GROUND on December 22, 2022, with approximately $12.7 million in damages.

2. I have reviewed and concur with the Report of Investigation's findings of fact, analysis, conclusions, and recommendations. Please find the enclosed Report of Investigation, formatted in accordance with reference (d), for your review and approval.

#

Enclosure: (1) Report of the Investigation into the Passenger Vessel SANDY GROUND (O.N. 1299657) Engine Room Fire in Upper New York Bay on December 22, 2022

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Sector New York

212 Coast Guard Drive
Staten Island, NY 10305
Staff Symbol: (spv)
Phone: (718) 354-4319
Email: Joseph.I.Quitugua@uscg.mil

16732
January 29, 2024

PASSENGER VESSEL SANDY GROUND (O.N. 1299657) ENGINE ROOM FIRE IN UPPER NEW YORK BAY ON DECEMBER 22, 2022

EXECUTIVE SUMMARY

On December 22, 2022, at approximately 1640, the Passenger Vessel SANDY GROUND (O.N. 1299657) departed from the Whitehall Terminal in Manhattan, New York, with 866 passengers, 16 New York City Department of Transportation (NYC DOT) Staten Island Ferry Division crewmembers, and two New York City Police Department (NYPD) Officers on board. The vessel was on its scheduled southbound transit to the St. George Terminal in Staten Island, New York. During normal operations, the engineering crew noticed uneven fuel oil levels in the port and starboard day tanks and attempted to level them by manipulating the fuel valves. At approximately 1647, an over-pressurization event occurred in the fuel oil return system, triggering numerous alarms at the Engine Operation Station (EOS).

The fuel piping over-pressurization resulted in the material failure of the fuel filters on the #1, #2, #3, and #4 main diesel engines, leading to fuel oil spraying throughout the engine room. Crewmembers tried to contain the fuel by using oil absorbent pads and rags on the spraying filters. The Chief Engineer promptly informed the Master about the fuel oil spray and the impending loss of propulsion and steering. The Master instructed the Pilothouse crew members to stop the vessel and deploy the New York end anchor.

A crewmember observed that the spraying fuel was landing on the #2 main diesel engine exhaust manifold and at approximately 1654, a fire erupted on the #2 main diesel engine. The fire broke out when the vessel was approximately 1.5 nautical miles Northeast of the St. George Terminal. The Chief Engineer informed the Master about the fire and his intention to shut down all four main diesel engines but didn't activate the emergency stops, believing they were already activated due to various alarms sounding at the EOS.

The Master ordered the crew to deploy the Staten Island end anchor to assist in keeping the vessel in the channel and the Chief Engineer ordered the evacuation of the engine room. Before leaving the engine room, the Chief Engineer closed the emergency fuel shutoff valves, shutting down all the machinery in the engine room.

The emergency diesel generator automatically started, providing temporary power. Crew members prepared boundary cooling with a fire hose and secured ventilation to the engine room. At approximately 1700, the Emergency Diesel Generator unexpectedly shut down and couldn't be restarted, leaving the vessel without electrical power. With no emergency power for the fire

pump, the Master instructed the Chief Engineer to activate and release the NOVEC 1230 fixed fire suppression system in the engine room, which doesn't rely on the ship's power.

Nearby vessels, including NYC Ferries RIVER SPRINTER and GREAT EAGLE, NY Waterway Ferry FRANKLIN D ROOSEVELT, and towing vessels MISTER JIM and CHARLES JAMES, assisted in evacuating 816 passengers. The passenger evacuation was halted due to increasing winds that caused the SANDY GROUND to drag anchor. The vessel was then towed back to the St. George Terminal, where the remaining 50 passengers, and crew disembarked without further incident.

The SANDY GROUND sustained an estimated $12.7 million in fire damage. Drug and alcohol testing was conducted in accordance with the Serious Marine Incident (SMI) requirements of 46 CFR 4.03-2 and the company's drug and alcohol policy; all tests yielded negative results.

As a result of the investigation, the Coast Guard determined the initiating event to be the over-pressurization of the fuel oil return lines between the main diesel engines and the fuel oil day tanks. The subsequent events were determined to be the engine room fire, the loss of propulsion, and the loss of emergency power. Causal factors contributing to this casualty were: 1) Absence of an established written procedure for leveling the fuel oil day tanks, 2) Absence of suitable pressure relief devices and improper fuel piping modifications, 3) Material failure of the main diesel engine secondary spin-on fuel oil filters, 4) Delayed emergency fuel pull shutoff valve activation, 5) Lack of alternative means for propulsion during an engine room fire, and 6) Emergency Diesel Generator failure.

U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Sector New York

212 Coast Guard Drive
Staten Island, NY 10305
Staff Symbol: (spv)
Phone: (718) 354-4319
Email: Joseph.I.Quitugua@uscg.mi

16732
January 29, 2024

PASSENGER VESSEL SANDY GROUND (O.N. 1299657) ENGINE ROOM FIRE IN UPPER BAY NEW YORK ON DECEMBER 22, 2022

INVESTIGATING OFFICER'S REPORT

1. Preliminary Statement

1.1. This marine casualty investigation was conducted, and this report was submitted in accordance with Title 46, Code of Federal Regulations (CFR), Subpart 4.07, and under the authority of Title 46, United States Code (USC) Chapter 63.

1.2. The Investigating Officer designated the New York City Department of Transportation (NYC DOT) Staten Island Ferry Division, the NYC Department of Investigation (DOI), and the Eastern Shipbuilding Group, Inc., as parties-in-interest for this investigation. No other individuals, organizations, or parties were designated a party-in-interest in accordance with 46 CFR Subsection 4.03-10.

1.3. The Coast Guard was the lead agency for all evidence collection activities involving this investigation. The National Transportation Safety Board (NTSB) assisted in this investigation.

1.4. All times listed in this report are in Eastern Standard Time using a 24-hour format and are approximate.

2. Vessel Involved in the Incident

Figure 1. Photograph of the SANDY GROUND. Provided by the NTSB.

Official Name:	SANDY GROUND
Identification Number:	1299657 – Official Number (US)
Flag:	United States
Vessel Class/Type/Sub-Type	Passenger Ship / Ferry / Non-Ro-Ro
Build Year:	2017
Gross Tonnage:	4,669 GT
Length:	304.2 feet
Beam/Width:	70 feet
Draft/Depth:	21.5 feet
Main/Primary Propulsion: (Configuration/System Type, Ahead Horsepower)	4 - EMD 12V-710, 10,000 HP Voith Schneider Propeller
Owner:	NYC DOT Staten Island Ferry Staten Island, NY, USA
Operator:	NYC DOT Staten Island Ferry Staten Island, NY, USA

3. Deceased, Missing, and/or Injured Persons

Relationship to Vessel	Sex	Age	Status
None	N/A	N/A	N/A

4. Findings of Fact

4.1. The Incident:

4.1.1. On December 22, 2022, at 1430, the engineering crewmembers on the afternoon shift relieved the morning shift onboard the Passenger Vessel SANDY GROUND. The afternoon shift consisted of the Chief Marine Engineer (CME), Marine Engineer (ME), Marine Oiler 1 (MO1), and Marine Oiler 2 (MO2). The SANDY GROUND provided service from St. George Terminal on Staten Island to the Whitehall Terminal in lower Manhattan. The vessel was double-ended with identical pilothouses and propulsion systems on each end that allowed the vessel to approach and depart both terminals without turning around. The vessel's operating manual stated that the Staten Island end (SIE) was considered the stern and the New York end (NYE) was considered the bow. The port fuel oil storage tank and the port fuel oil day tank were located in the SIE of the Engine Room, while the starboard fuel oil storage tank and the starboard fuel oil day tank were located in the NYE of the Engine Room. The vessel's tank gauging system sent the Tank Level Indicator (TLI) data for the fuel oil day tanks to the Machinery Control Station (MCS), which was located in the Engine Operating Station (EOS). At approximately 1434, the MCS logged 1,762 gallons in the port fuel oil day tank and 1,721 gallons in the starboard fuel oil day tank.

4.1.2. At 1537, the port and starboard fuel oil day tanks showed approximately 1,470 gallons and 1,930 gallons of fuel oil, respectively. This disparity caused the two oilers to take actions to level the day tanks.

4.1.3. At 1602, the MO2 made clockwise turns on the port day tank supply globe valve, located at the Staten Island end (port) fuel oil station, while the ME and the CME observed the TLI readings in the EOS.

4.1.4. At 1605 and 1610 the port day tank low fuel level alarm sounded. At 1612, the starboard day tank low fuel level alarm sounded. The CME acknowledged and disabled the alarms as the engineering crewmembers continued to address the uneven day tank levels, believing that these were nuisance alarms.

4.1.5. From 1609 to 1646, the MO1 and MO2 continued to manipulate the port day tank supply valves with clockwise and counter-clockwise turns as seen on the Closed-Circuit Television (CCTV) camera above the port fuel oil station. There were several valve adjustments over this period, followed by the crewmembers observing the day tank levels on the EOS display and local tank gauges. There is also a ball valve on the fuel oil return line that is located near each supply valve, but the CCTV recording does not show whether these valves were adjusted, and the crewmembers do not recall manipulating the return valves. There was no camera overlooking the New York end (starboard) fuel oil station. At 1640, the SANDY GROUND had departed the Whitehall Terminal, with 866 passengers, 16 Staten Island Ferry crewmembers, and two NYPD Officers onboard for its scheduled southbound transit to the St. George Terminal.

Figure 2. Photograph of the Machinery Control Station (MCS) in the Engine Operating Station (EOS) with the tank level indication display onboard the SANDY GROUND's sister vessel, the SSG MICHAEL H OLLIS, taken on December 23, 2022. Provided by the U.S. Coast Guard.

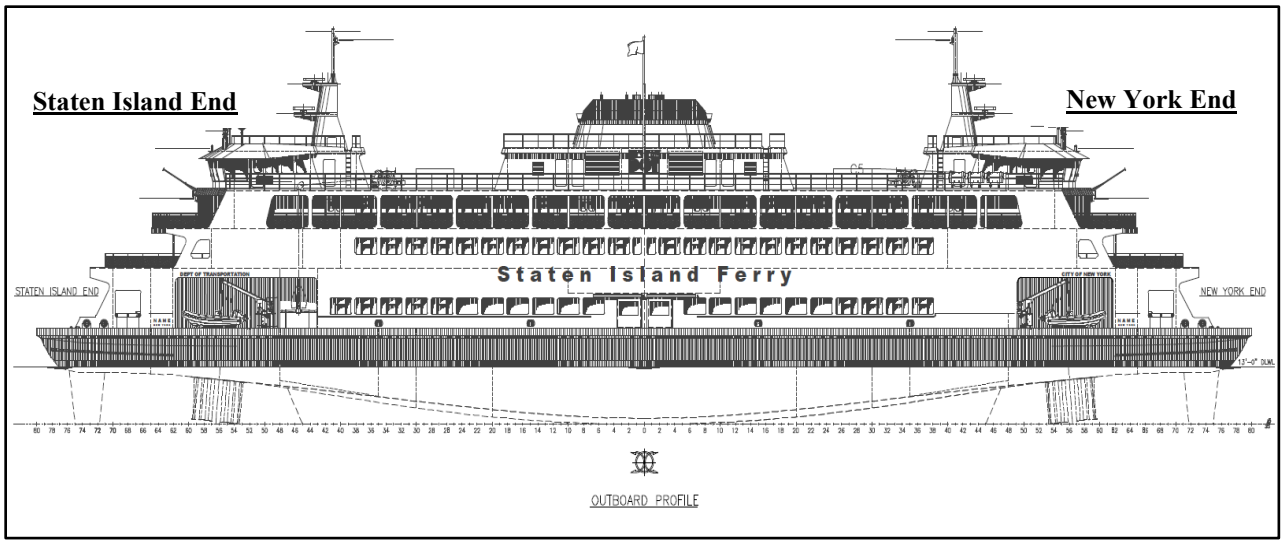

Figure 3. SANDY GROUND outboard profile. Provided by the NYC DOT Staten Island Ferry Division.

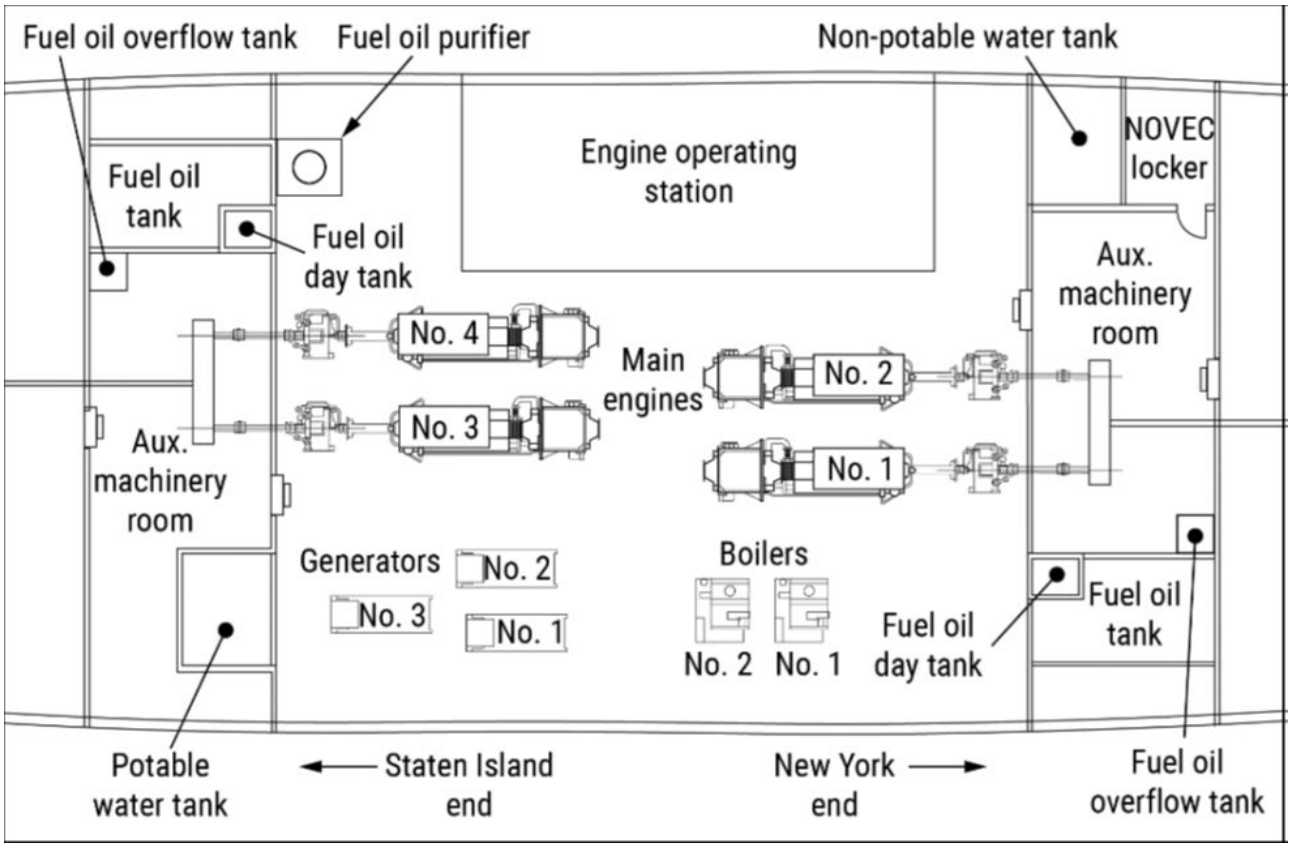

Figure 4. SANDY GROUND Engine Room Layout. Provided by the NYC DOT Staten Island Ferry Division and annotated by the NTSB.

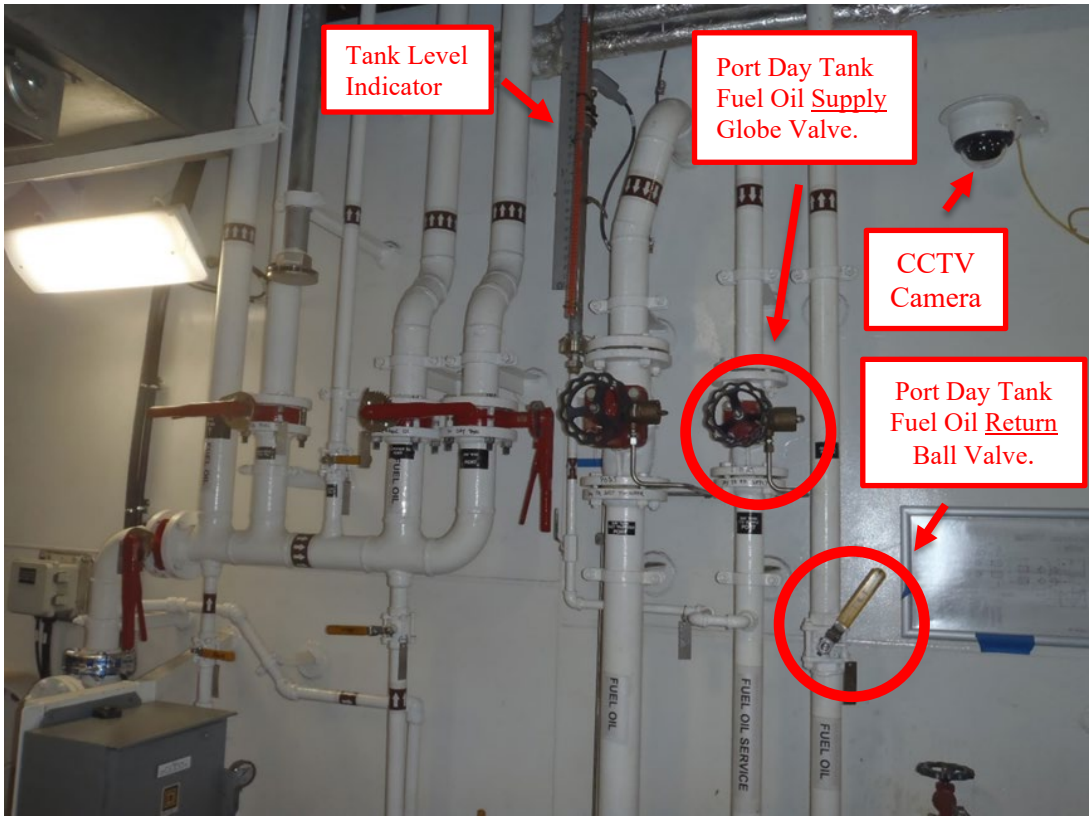

Figure 5. Photograph of the Staten Island end (port) fuel oil station onboard the SANDY GROUND's sister vessel, the SSG MICHAEL H OLLIS, showing the port fuel oil day tank supply and return valves, taken on January 10, 2023. Photograph provided by the U.S. Coast Guard.

4.1.6. At 1647, MO1 proceeded to the port fuel oil station and MO2 proceeded to the starboard fuel oil station. After observing the port day tank level, MO1 joined MO2 at the starboard fuel oil station. While at the starboard fuel oil station, the fuel oil return system over pressurized, which resulted in the material failure of the spin-on fuel oil filters that are mounted on all four main diesel engines. The EOS alarmed with high fuel oil filter pressure differentials and low engine fuel oil pressure. Immediately following the failure of the spin-on filters, pressurized fuel oil began to spray from the fuel oil filter assemblies on the #1, #2, #3, and #4 main diesel engines, and low fuel oil pressure alarms affecting all four main diesel engines were activated.

4.1.7. At 1649, MO1 and MO2 observed fuel oil spraying from the fuel oil filters on the #3 and #4 main diesel engines. The CME observed fuel oil spraying from the spin-on fuel filter assembly on the #2 main diesel engine, then alerted the Master that the fuel oil was leaking and that a loss of propulsion and steering was imminent.

4.1.8. At 1650, the Master ordered the Pilothouse crew to stop the vessel and deploy the New York end anchor. MO1 proceeded to the port fuel oil station and manipulated the fuel oil supply valve while MO2 returned to the EOS.

4.1.9. At 1651, MO1 gathered shop rags in order to absorb the fuel oil while the CME directed MO2 to the port fuel oil station to check the fuel oil system valve alignment.

4.1.10. At 1652, MO2 observed the port fuel oil system valve alignment and proceeded to the EOS.

4.1.11. At 1653, the ME entered the engine room from the Main Deck passenger space access door and observed a shower of fuel oil in the vicinity of the #2 main diesel engine. The ME returned to the EOS and informed the CME that fuel oil was hitting the #2 main diesel engine exhaust manifold and presented a fire risk. MO1 used absorbent pads in an attempt to block the fuel oil that was spraying from the fuel filter assembly towards the #2 main diesel engine exhaust manifold.

Figure 6. Photograph of the ruptured #1 main diesel engine online spin-on fuel oil filter with protruding gasket taken on December 23, 2022. Provided by the U.S. Coast Guard.

4.1.12. At 1654, MO2 proceeded to the port fuel oil station to retrieve additional absorbent pads. During this time a fire erupted near the exhaust manifold on the #2 main diesel engine. After observing the fire, MO1 and MO2 ran back to the EOS to inform the CME of the fire. MO1's clothes had been soaked in fuel oil from attempting to hinder the fuel oil spraying from the fuel oil filter assembly. The CME informed the Master of the fire and that he intended to secure all four main diesel engines from the MCS. The CME then observed multiple alarms, including low fuel pressure alarms, on the MCS displays for all

four main engines, which made the CME believe that all four main engines were already shutdown. As a result, the main diesel engines continued to run while the fuel oil sprayed.

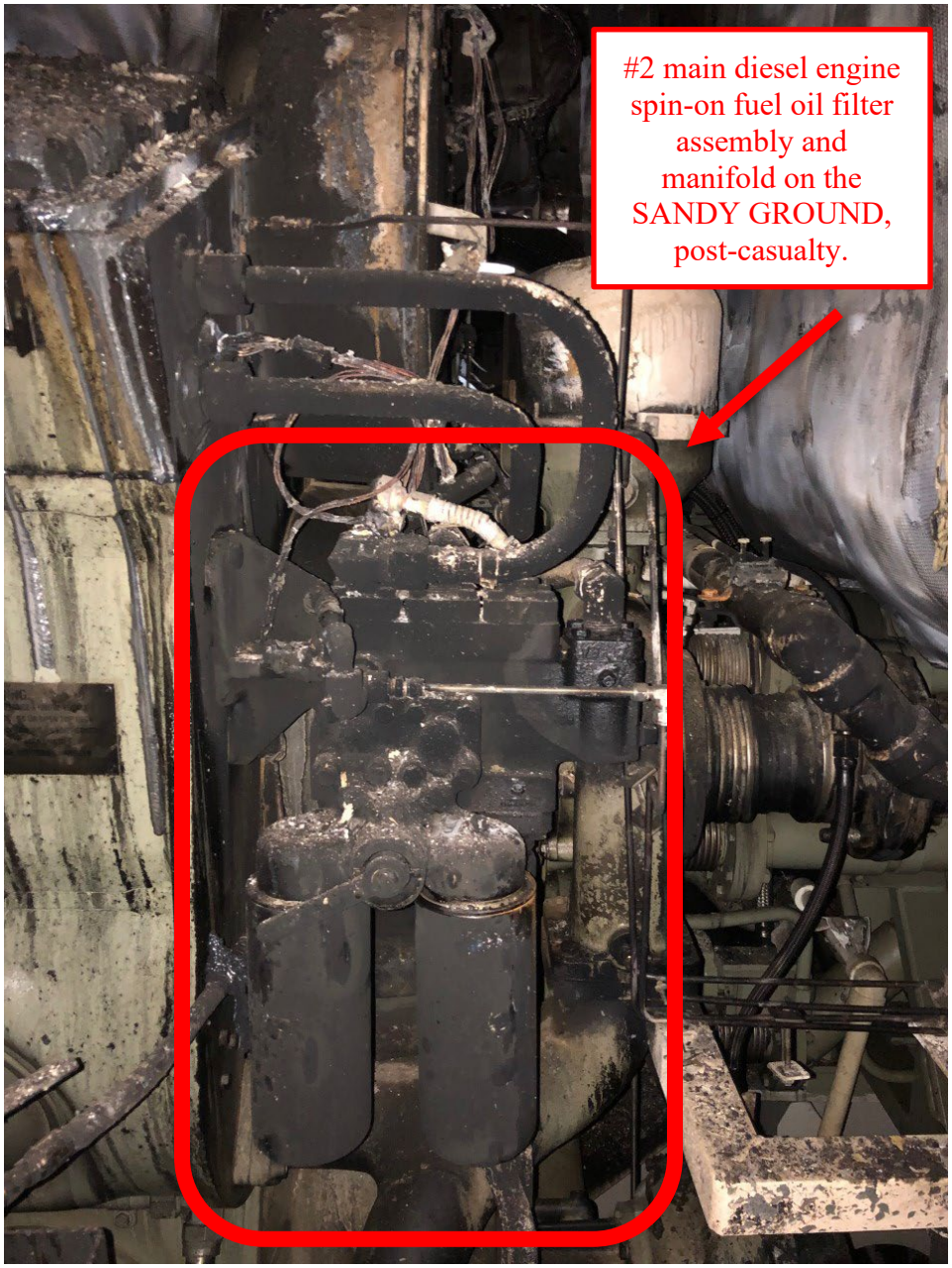

Figure 7. Photograph of the #2 main diesel engine spin-on fuel oil filter assembly and manifold (block) post-casualty taken on December 23, 2022. Provided by the U.S. Coast Guard.

Figure 8. Photograph of the #2 main diesel engine (inboard) post-casualty, facing the New York End of the SANDY GROUND taken on December 23, 2022. Provided by the U.S. Coast Guard.

4.1.13. At 1655, MO1 and MO2 exited the EOS to look at the fire then returned to the EOS and signaled the CME towards the escape hatch. The CME then ordered the evacuation of the engine room. MO2 and ME were the first two to exit the engine room through the emergency escape hatch. There were no attempts to fight the fire with portable extinguishers.

4.1.14. At 1656, the CME requested that the Master activate the NOVEC 1230 fixed fire suppression system from the Pilothouse. At this time, the Master also ordered the Pilothouse crew to deploy the Staten Island End anchor.

4.1.15. At 1658, MO1 exited the EOS through the emergency escape hatch and the CME activated the emergency fuel shutoff valves located in the EOS then, also exited through the EOS escape hatch. With the fuel supply secured to all main diesel engines, boilers, and the ship's service diesel generators the vessel lost power. The Emergency Diesel Generator (EDG) detected a loss of power and started automatically. Shortly after, the ship’s

emergency power was restored.

Figure 9. Photograph of the emergency fuel shutoff valves located in the EOS taken on December 27, 2022. Provided by the U.S. Coast Guard.

4.1.16. At 1659, the CME directed engineering crewmembers to position a fire hose by the engine room door for boundary cooling and asked the Master to energize the emergency fire pump. The Pilothouse crew energized the pump and secured ventilation to the engine room with the emergency stop buttons located in the Pilothouse.

4.1.17. At 1700, a shutdown of the EDG occurred when the generator control system detected an abnormal condition and the SANDY GROUND was without emergency power.

4.1.18. At 1701, the Master granted permission for the CME to activate the NOVEC 1230 fire suppression system.

4.1.19. At 1703, the CME manually activated the NOVEC 1230 fire suppression system and bypassed the 61-second time delay for the immediate release of the fire protection agent into the engine room.

4.1.20. At 1705, the CME proceeded to the hurricane deck in an attempt to reestablish emergency power but was unable to re-start the emergency diesel generator. The CME observed that the generator had a lock-out which prevented its operation and informed the Captain that emergency power could not be restored.

4.1.21. At 1719, the crew of the SANDY GROUND commenced the evacuation of passengers. The NYC Ferries RIVER SPRINTER and GREAT EAGLE, the NY Waterways Ferry FRANKLIN D ROOSEVELT, and the towing vessels MISTER JIM and CHARLES JAMES provided assistance for the vessel-to-vessel transfer of 816 passengers. The RIVER SPRINTER was the first vessel and took 138 passengers onboard, the FRANKLIN D ROOSEVELT was the second vessel and took 558 passengers onboard, and the GREAT EAGLE was the third vessel and took 120 passengers onboard.

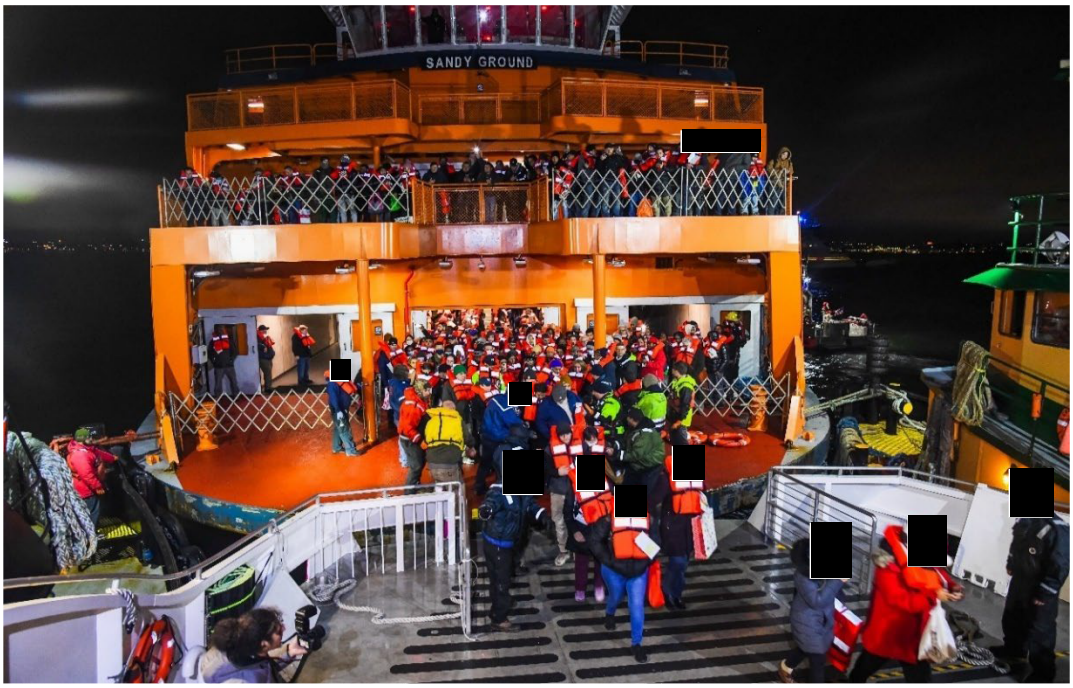

Figure 10. Photograph of the vessel-to-vessel passenger evacuation taken on December 22, 2022. Provided by the NYC DOT Staten Island Ferry Division.

4.1.22. At 1808, the crew of the SANDY GROUND concluded the vessel-to-vessel transfer of passengers as winds from the north increased, and the SANDY GROUND began to drag anchor. The vessel was placed under tow back to the St. George Terminal.

4.1.23. At 1825, the SANDY GROUND moored at the St. George Terminal and the remaining 50 passengers, crewmembers, and NYPD Officers disembarked without further incident.

4.1.24. At 1955, crewmembers underwent mandatory chemical testing for evidence of drug and alcohol use in accordance with 46 CFR Subpart 4.06. Two of the crewmembers were unable to be tested for alcohol within the required time frame as they were receiving

medical evaluation and were unavailable to provide a sample. All test results were negative.

4.1.25. At 1742, on December 23, 2022, FDNY personnel deemed the engine room cleared to enter. Subsequently, a Marine Chemist certified the engine room atmosphere safe for entry.

5. Analysis

5.1. Absence of an Established Written Procedure for Leveling the Fuel Oil Day Tanks.

5.1.1. The SANDY GROUND has two 15,000-gallon fuel tanks and two 2,500-gallon day tanks, which supply fuel to all of the ship's engines. The fuel oil is pumped from the day tanks to the engine through the filters and excess fuel that is not used, leaves the injectors through the fuel return lines and back to the day tanks. The fuel oil return lines are essential because not all of the fuel that is pumped to the engine is used for combustion, and the excess fuel that leaves the engine is returned to the day tanks via the fuel return lines. Fundamentally, there are two ways to level the day tanks in a system using multiple tanks. Option one is to manipulate supply to an engine, which either limits or exaggerates the amount of unused fuel being returned to the tank. Option two is to close or limit the return valves to one tank, which will divert some or all of the unused fuel to the other tank. Although not explicitly required, the SANDY GROUND did not have an established written procedure for leveling the port and starboard fuel oil day tanks. Many crewmembers work on different classes of vessels within the Staten Island Ferry fleet which have dissimilar engine room layouts and configurations. The various arrangements along with the ability of double ended symmetrical vessels to travel in both directions, may make it easy to become disoriented and confuse port and starboard piping systems.

5.1.2. During the interviews of the Staten Island Ferry engineering crewmembers, various Chief Marine Engineers (CMEs) and Marine Oilers (MOs) who had served on the SANDY GROUND provided conflicting accounts of the methods and procedures employed to manage fuel oil levels in the port and starboard day tanks. These procedures lacked standardization, differed across shifts, and were largely at the discretion of the on-duty engine room crew. Several CMEs and MOs associated with the SANDY GROUND mentioned the use of fuel oil system return valves as a means to control the levels in these tanks. Notably, the CME working during the incident expressed uncertainty regarding the status of these valves—whether they were open or closed—as part of the leveling process for the port and starboard fuel oil day tanks. Additionally, MO2 stated that the training they received on day tank leveling did not include the use of the fuel oil system return valves, while MO1 explained that the return valves, situated at the Staten Island End and the New York End fuel stations, were indeed adjusted and employed for level regulation. Both MO1 and MO2 had no recollection if the fuel oil return valves for the port and starboard day tanks were closed at the time of the incident. During an inspection of the sister vessel SSG MICHAEL H OLLIS, investigators observed the partially closed return valve for the port day tank, which indicated that this valve was occasionally used. Once the engine room on the SANDY GROUND was deemed safe for entry by a certified Marine Chemist, investigators proceeded to the port and starboard fuel manifolds to document the positions of the return valves. However, Staten Island Ferry personnel had already entered the engine room prior to their arrival. Investigators

observed that the fuel return valves for the port and starboard day tanks were in the open position during the initial on-scene investigation. Although no one had admitted to tampering with the scene, the vessel's representatives could not provide an alternate explanation for the over-pressurization event other than a blockage in the fuel return line. Compressed air was applied to the fuel return piping system to verify that the piping was free of any obstructions which could have restricted return fuel oil flow. The pipes were found to be in good working order. Both fuel oil day tanks were emptied and opened for inspection and were found to be free of any debris or blockages. Based on this information, it is believed that the return valves were closed, which prevented the excess fuel from returning to the day tanks as intended and led to the over-pressurization event.

5.1.3. The Staten Island Ferry vessels have a voluntary Safety Management System (SMS), which has the goal of establishing and implementing safeguards against all identified risks. This incident made it clear that the SANDY GROUND's engine room arrangement presents a risk. On other vessels operated by the Staten Island Ferry Division, both return valves were on the same end of the vessel, so the same oiler would have had control over the balancing of the fuel. However, the SANDY GROUND's fuel manifolds are on opposite sides of the vessel. Subsequent to the incident, the USCG Sector New York Inspections Division issued a deficiency on January 17, 2023, using the Vessel Inspection Requirements, Form CG-835V, to the SSG MICAHEL H OLLIS, the sister vessel of the SANDY GROUND. This deficiency pointed out the absence of a documented procedure for equalizing the fuel oil day tanks and for utilizing specific valves in this process. The deficiency required that the NYC DOT Staten Island Ferry Division collaborate with the American Bureau of Shipping to develop formal fuel oil day tank leveling procedures, integrate these procedures into the vessel's SMS, provide training, and document this training for all personnel involved.

5.2. **Absence of Suitable Pressure Relief Devices and Improper Fuel Piping Modifications.**

5.2.1. During the construction of the SANDY GROUND, the Coast Guard approved the vessel's fuel oil diagram, which included check valves on the fuel oil return lines. The primary function of a check valve is to prevent the reverse flow of a liquid within a piping system. However, upon delivery of the vessel, the check valves were replaced with ball valves on the return lines without Coast Guard approval. Consequently, the ball valve installation made it possible to halt fuel oil return flow with a simple 90-degree turn. According to the fuel system design considerations from the manufacturer of the Electro-Motive Diesel (EMD) main engines installed onboard the SANDY GROUND, a typical day tank capacity should range from 500 to 1000 gallons, be located in or near the engine room, and return fuel leaving the engine should be routed to the top of the main fuel tank without shutoff valves. Although there are no explicit prohibitions against using ball valves in a fuel system, compliance with 46 CFR 56.07-10 (incorporated by 46 CFR 70.20-1) addresses this issue. This regulation mandates that any system potentially exposed to pressures exceeding its maximum allowable working pressure must be safeguarded with appropriate relief devices. The approved fuel oil piping diagram indicated a maximum expected fuel oil service pressure of 30 psi, with a maximum allowable working pressure (MAWP) of 100 psi, which the engine-driven positive displacement fuel pump could exceed. According to the NYC DOT Ferry Division, pressure relief valves were installed on the return lines of other ferries in their fleet, although it remains unclear why this safeguard was omitted on the SANDY GROUND.

Crewmembers further clarified that these relief valves on other vessels were integrated into the fuel return system as an additional safety measure, designed to prevent potential fuel valve misalignment that might lead to over-pressurization of the fuel oil system.

5.2.2. The main diesel engine fuel filter assembly was designed with a built-in bypass pressure relief valve. This 120-psi relief valve opens when there is either a major blockage in the fuel filters, piping, or the relief valve has ruptured and the fuel is returned back to the day tanks. Under these circumstances, the engine will lose power and eventually shutdown due to fuel starvation. However, there was a critical issue with the setup on the SANDY GROUND. When the fuel pressure reached the bypass threshold, the fuel was redirected towards the day tank via the return lines. In this specific incident, it is believed that the over-pressurization event occurred because the closed return valves prevented the excess pressure from venting into the tanks as it should have.

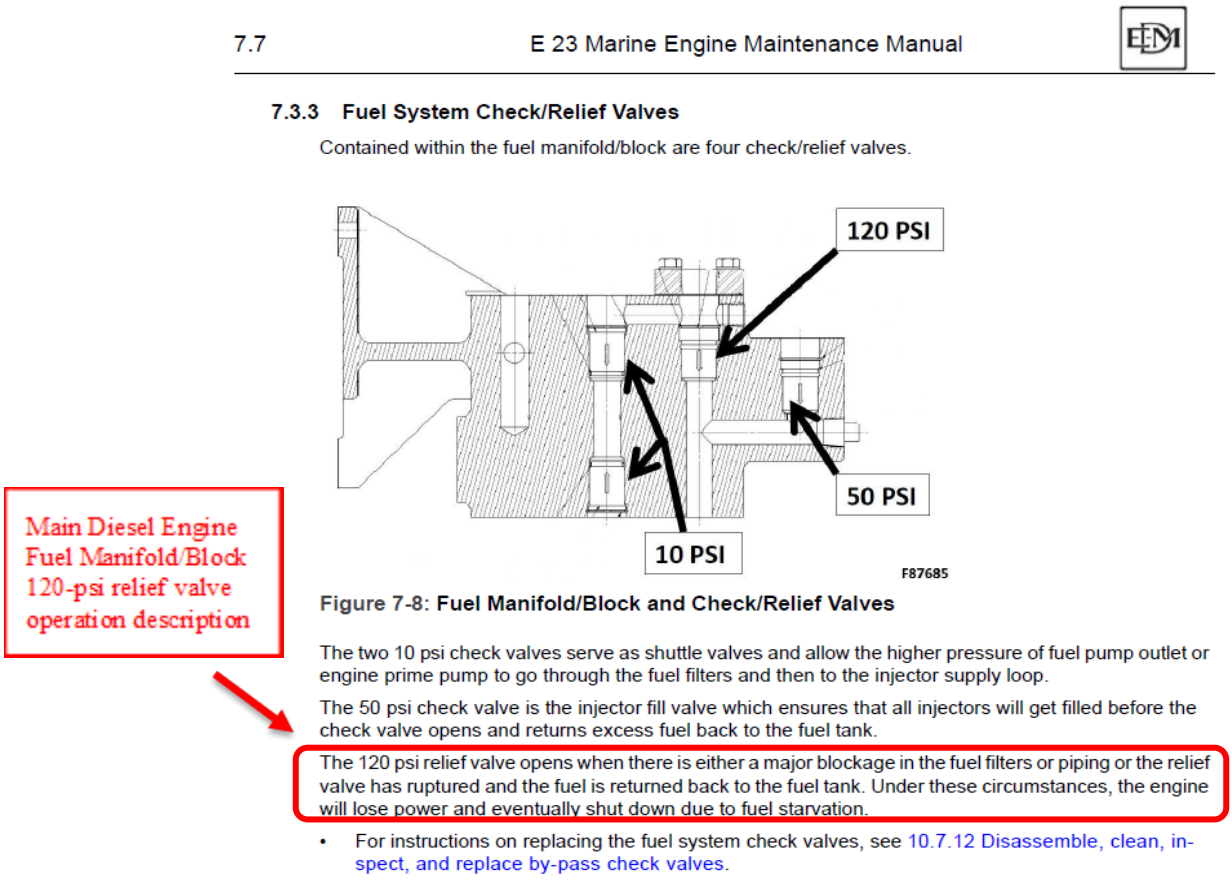

Figure 11. Fuel Filter Manifold Diagram, provided by the NYC DOT Staten Island Ferry Division.

5.2.3. As per 46 CFR 71.55-1, no repairs or alterations that impact the vessel's safety in terms of its hull, machinery, or equipment shall be made without the knowledge of the Officer in Charge, Marine Inspection. Moreover, any changes should have their drawings approved before commencing work, unless the Officer in Charge, Marine Inspection deems it unnecessary. In this case, the local Officer in Charge, Marine Inspection did not approve of the installation of the ball valves on the fuel oil return lines that occurred after the vessel was delivered. Furthermore, it is likely that if this alteration had been submitted

for approval, the local Officer in Charge, Marine Inspection would have identified the non-conforming fuel valve arrangement.

5.3. **Material Failure of the Main Diesel Engine Secondary Spin-on Fuel Oil Filters.**

5.3.1. The over-pressurization of the fuel oil return system led to the failure of the spin-on fuel filters on all four main diesel engines, resulting in fuel oil spraying from these engines. Post-casualty images of the SANDY GROUND's engine room depict signs of material failure due to over-pressurization, including gasket failures, deformation, and depressurization. According to the EMS-Marcon Alarm and Monitoring System Log dated December 22, 2022, the maximum recorded fuel system pressures on all four main diesel engines during the over-pressurization event were as follows: 148 psi on the #1 main diesel engine, 124 psi on the #2 main diesel engine, and 148 psi on both the #3 and #4 main diesel engines. The computer also showed that over the previous several hours, the normal operating pressure was between 87 and 92 psi. If the bypass relief valves had functioned as intended or if there was an additional relief valve further downstream in the fuel system, the high-pressure fuel would not have reached the fuel filters, preventing their subsequent failure.

Figure 12. Photograph of the ruptured fuel oil filter on the #3 main diesel engine taken on December 23, 2022. Provided by the U.S. Coast Guard.

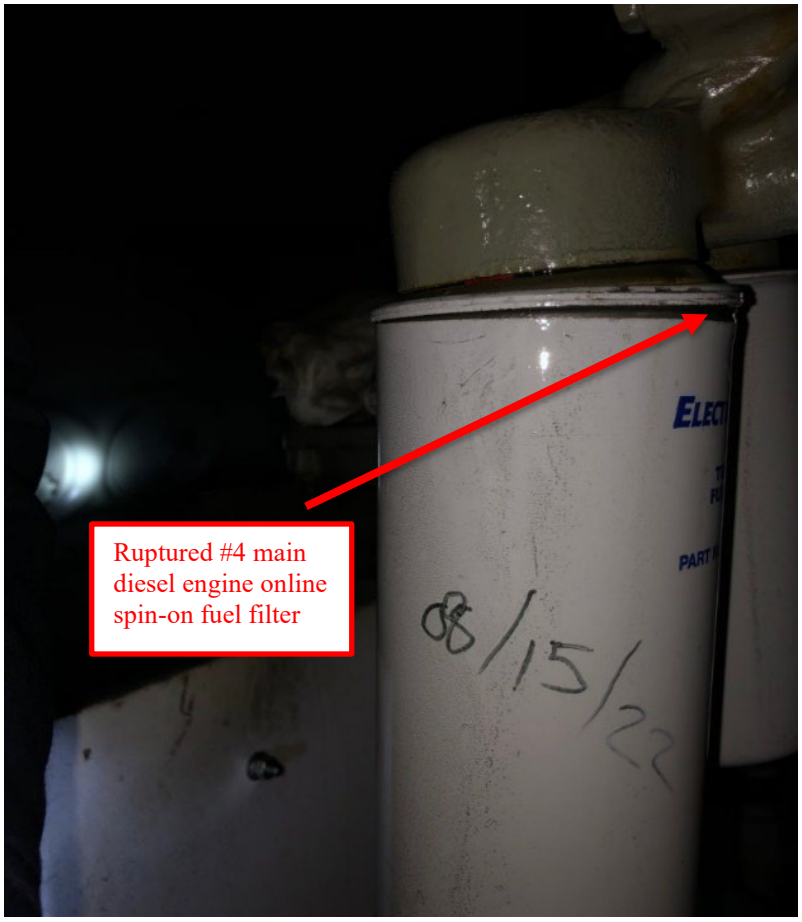

Figure 13. Photograph of the ruptured fuel oil filter on the #4 main diesel engine taken on December 23, 2022. Provided by the U.S. Coast Guard.

5.4. Delayed Emergency Fuel Pull Shutoff Valve Activation.

5.4.1. The vessel's Operating Manual defined an emergency condition as severe damage to one of the main propulsion diesel engines, warranting an immediate shutdown, and includes instances such as an engine room fire. The emergency condition checklist stipulated that the crew must cut off power and/or fuel to the affected machinery. On the SANDY GROUND, this could be achieved by pressing the emergency stop buttons on the EOS panel, at the local engine control panels, or in either pilothouse. However, the hydraulic emergency fuel shutoff switch was considered a last resort because using it would also result in the loss of all ship boilers and ship service generators. The fuel oil sprayed onto the engine room lagging and components for approximately seven minutes before the engine fire ignited. If the fuel had been shut off to the affected machinery and the emergency fuel pull shutoff valves had been activated earlier, it might have prevented the ignition of the fuel oil spray, potentially averting the engine room fire altogether.

5.5. Lack of Alternative Means for Propulsion During an Engine Room Fire.

5.5.1. According to the vessel's Operating Manual, if the NOVEC 1230 system in the machinery space is activated, it will automatically shut down the main propulsion diesel engines and the ship service diesel generators. The vessel's Emergency Procedures Manual also stated that once the NOVEC 1230 system is activated, the Master and CME are responsible for securing the space and waiting for shoreside support to ensure it's safe

for personnel to enter. After the CME activated the NOVEC 1230 fixed fire suppression system, the emergency diesel generator was the only power generating source available, which is only designed to energize vital systems such as bilge pumps, fire pumps, and emergency communication. Based on this engine room design, there is no alternative means to provide propulsion power in the event that the NOVEC 1230 system in the machinery space is activated.

5.6. **Emergency Diesel Generator Failure.**

5.6.1. Emergency power was automatically activated after the ships service diesel generators located in the engine room had shutdown. However, unexpectedly, it went offline about a minute later due to a system failure. Despite efforts, the crew couldn't restore emergency power, leaving the vessel in darkness, except for battery-powered emergency lighting. Upon closer examination, it became clear that the fire had caused extensive damage to the overhead cables in the engine room and the adjacent main deck machinery casing. Among the damaged cables was the Emergency Diesel Generator (EDG) run status indicator cable, which extended from the emergency switchboard to the main switchboard located in the EOS. The cable sheathing had melted, resulting in a short circuit that triggered a critical system failure and led to an immediate and irreversible shutdown of the EDG. If the NOVEC 1230 fire suppression system had been activated earlier, the engine room fire might have been extinguished more rapidly, potentially preventing damage to the vital cables.

5.6.2. Upon further investigation into the EDG shutdown and the short circuit in the run status cable, it was revealed that the cable had caused an over-current fuse failure in the emergency generator panel. This, in turn, was interpreted as a phase loss by the Woodward Easygen Controller located at the emergency switchboard. The vessel’s Operating Manual specified that the EDG supplies 395 KW, 480 VAC, 3-phase, 60 Hz power to the emergency switchboard. It provides power to essential systems needed for safe vessel navigation. The Woodward Easygen Controller monitors and manages bus voltage, 3-phase generator voltage, current, engine start/stop, parallel generator operation on the bus, and load sharing between generators. When the engine controller detects what it believes to be a loss of phase, it automatically and irreversibly shuts down the engine to prevent potential damage to the system. Furthermore, Staten Island Ferry maintenance personnel discovered missing terminal connections for the emergency generator run status cable from the emergency switchboard compared to the "as-built" electrical diagram drawings. As a response to this incident, the Staten Island Ferry Division developed an engineering modification to provide overcurrent protection and isolate cables routed outside of the emergency switchboard in order to prevent them from affecting the generator Controller. If there had been a means to prevent the phase loss caused by the damaged cable, the generator shutdown and lockout might not have occurred, potentially allowing the vessel to maintain its emergency power generation capability including the emergency fire pump.

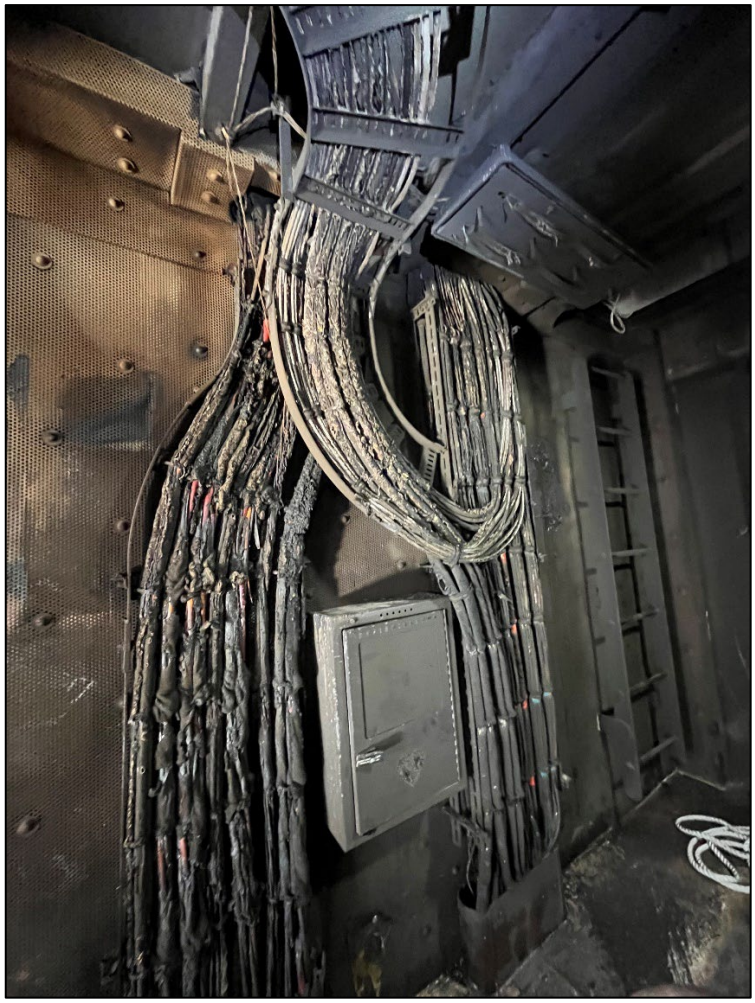

Figure 14. Photograph of damaged cables located in the main deck machinery casing above the engine room. Provided by the NTSB.

6. Conclusions

6.1. Determination of Cause:

6.1.1. The initiating event for this casualty is the over-pressurization of the fuel oil return lines between the main diesel engines and the fuel oil day tanks. Causal factors leading to this event were:

6.1.1.1. Absence of an established written procedure for leveling the fuel oil day tanks.

6.1.1.2. Absence of suitable pressure relief devices and improper fuel piping modifications.

6.1.1.3. Material failure of the main diesel engine secondary spin-on fuel oil filters.

6.1.2. The subsequent event was fuel oil igniting causing an engine room fire. Causal factor that led to this event was:

6.1.2.1. Delayed emergency fuel pull shutoff valve activation.

6.1.3. Following the fire, the fuel shutoff valve activation and use of the NOVEC 1230 fixed fire suppression system left the ship without propulsion. Causal factor that led to this event was:

6.1.3.1 Lack of alternative means for propulsion during an engine room fire.

6.1.4. Following the loss of power and propulsion, the emergency diesel generator unexpectedly shutdown, leaving the ship without emergency power. Causal factor leading to this event was:

6.1.4.1. Emergency Diesel Generator Failure.

6.2. Evidence of Act(s) or Violation(s) of Law by Any Coast Guard Credentialed Mariner Subject to Action under 46 USC Chapter 77: There were no acts of misconduct, incompetence, negligence, unskillfulness, or violations of law by a credentialed mariner identified as part of this investigation.

6.3. Evidence of Act(s) or Violation(s) of Law by U.S. Coast Guard Personnel, or any other person: There were no acts of misconduct, incompetence, negligence, unskillfulness, or violations of law by Coast Guard employees or any other person that contributed to this casualty.

6.4. Evidence of Act(s) Subject to Civil Penalty: No civil penalty for this offense is recommended. No other evidence of acts that would warrant civil penalty were identified.

6.5. Evidence of Criminal Act(s): This investigation did not identify violations of criminal law.

6.6. Need for New or Amended U.S. Law or Regulation: This investigation identified no matters needing new or amended U.S. law or regulation.

6.7. Unsafe Actions or Conditions that Were Not Causal Factors: This Investigation identified no unsafe actions or conditions that were not causal factors.

7. Actions Taken Since the Incident:

7.1. The NYC DOT Staten Island Ferry Division has employed the following actions.

7.1.2. Reviewed proper fuel valve operations with engineering crews upon reassignment to the SSG MICHAEL H OLLIS and other sisterships.

7.1.3. Issued fleet-wide SMS Safety Alert to its Captains and Chief Marine Engineers that communicated corrective action and identified best practices for vessel fuel systems.

7.1.4. Reviewed SMS procedures and revised the Marine Oiler Practical section of the Personnel Familiarization Form to better define what should be covered with respect to comprehension of the fuel and lube oil systems on all Staten Island Ferry Classes of vessels.

7.1.5. Conducted SMS training for the continued sharing of best practices identified from the marine casualty event.

7.1.6. Submitted the design for the installation of fuel oil return system pressure relief valves to be retrofitted on the Ollis Class vessels to the USCG Marine Safety Center for plan review. Also received the necessary components for the permanent installation of fuse blocks for the emergency diesel generator running light indicator circuit to be installed on the Ollis Class vessels.

8. Recommendations

8.1. Safety Recommendations: Revision to the USCG Marine Safety Center Plan Review Guidelines, Procedure E1-10 Fuel Oil Systems, and Procedure E1-35 Miscellaneous Piping Systems, is proposed for the incorporation of 46 CFR § 56.07-10 as a reference for vessels subject to 46 CFR Subchapter F. The objective of this proposal is to highlight and include the design conditions and criteria for piping systems in regard to its maximum allowable working pressure and relief valves in accordance with 46 CFR § 56.07-10, as part of the Plan Review Guidelines for Procedure E1-10 Fuel Oil Systems and Procedure E1-35 Miscellaneous Piping Systems. Additionally, it is proposed that Coast Guard approved machinery system letters should include a statement detailing the maximum allowable working pressure that the approval is based on.

8.2. Administrative Recommendations:

8.2.1. Recommend this investigation be closed.

Chief Warrant Officer, U.S. Coast Guard
Investigating Officer