National Transportation Safety Board

Office of Marine Safety

Washington, D.C. 20594

Group Chairman's Factual Report

Engineering Group

Caribbean Fantasy

DCA16FM052

January 25, 2018

1 Accident Information

Vessel: *Caribbean Fantasy*
Accident Number: DCA16FM052
Date: August 17, 2016
Time: 0725 Atlantic standard time (coordinated universal time – 4)
Location: Atlantic Ocean, 3 miles north of San Juan, Puerto Rico
18° 30.1' N, 66° 8.0' W
Accident type: Fire

2 Engineering Group

Chairman: Luke Wisniewski, Marine Engineer Investigator
Office of Marine Safety
National Transportation Safety Board
Member: [redacted], Investigator
Sector San Juan
US Coast Guard
Member: Gustavo Abaroa, Designated Person Ashore
Baja Ferries S.A. de C.V. (owner/operator)
Joseph J. Hinson [1]
Baja Ferries USA (US affiliate of owner/operator)
Member: Zdenko von Heyden-Linden, Section Manager
MAN Diesel & Turbo SE
Member: Tommy Stendel, Superintendent Engineer
Technical Service
MAN PrimeServ
MAN Diesel & Turbo SE

3 Accident Summary

The *Caribbean Fantasy* was a roll-on/roll-off (Ro/Ro) passenger vessel operating on a scheduled service between the ports of San Juan, Puerto Rico, and Santo Domingo, Dominican Republic. On August 17, 2016, the vessel was approaching the pilot station outside the entrance of the Port of San Juan, Puerto Rico, when a fuel leak started on the port side main engine fuel supply pipe end flange. Seconds later, the fuel ignited upon contact with a hot surface, and a fire followed. The master altered the course of the ship away from the entrance to the port and ordered a fire alarm announcement to be made. The safety officer began mobilizing fire teams to fight the fire. At 0737,

[1] Mr. Hinson representative for Baja Ferries SA de CV. And participated with the engineer group while on scene in September 14-16, 2016. Mr. Hinson assisted with the removal of the port engine fuel supply pipe end flange and blanking plate. He was also part of the engineering group discussion and decision to remove the bolt and nut that prevented the closure of the lube oil storage tank QCV.

after determining all engine crew were accounted for, the master ordered the activation of the carbon dioxide (CO_2) fixed firefighting system. CO_2 was released in the main engine room soon thereafter.

The master contacted US Coast Guard Sector San Juan, located about 4 miles away, reported the fire, and informed watchstanders that he was preparing the vessel for evacuation.[2] Search and rescue craft, law enforcement boats, and good Samaritan vessels began arriving on scene about 20 minutes later. The master, concerned about reported explosions and spreading fire and smoke, ordered an announcement to be made on the public address (PA) system at 0745 notifying all passengers that there was a "fire on board." The English-language announcement directed the passengers to go to evacuation stations. A Spanish-language announcement that immediately followed told passengers that they were abandoning ship. There was no roll call conducted of the passengers. Instead, the crew searched accommodation spaces and cabins to ensure that no passengers or crew were left behind.

The ship's three lifeboats and two marine evacuation system (MES) slides were prepared by the crew. Upon word from the master, crew members began loading the lifeboats with passengers and lowering them to the water about 0800. Each lifeboat reported problems with either their releasing mechanism, engine, or bowsing gear.[3] After troubleshooting efforts, two lifeboats were able to launch, and one was hoisted to a position above the water where the passengers and crew were evacuated to a nearby Coast Guard vessel.

All remaining passengers and crew evacuated the vessel via the starboard side MES, sliding down to a landing platform where they were then loaded into liferafts or directly onto nearby vessels. Most passengers and crew were taken ashore to Pier 6 in San Juan harbor, where they were triaged, checked by immigration, and released. A total of 387 passengers and 124 crew were on board the *Caribbean Fantasy* at the time of the accident. At least 5 people were reported to have had serious injuries, while about 50 people were reported to have had minor injuries. The Caribbean Fantasy had seven dogs on board. The dogs had been kept in kennels in an air-conditioned room in between the ship's stacks on deck 7 aft. However, in preparation for the intended arrival in port, two of the dogs in small kennels were moved down to deck 3 (garage B). When interviewed, the ships hotel director told

[2] All references to miles in this report are nautical miles (1.15 statute miles) unless otherwise specified.
[3] *Bowsing gear* are lines, straps, or other tackle that pull a lifeboat alongside the vessel when the boat is lowered from the stowed position to the embarkation deck, facilitating ease of boarding for passengers.

investigators the dogs were moved there upon request of the owners. Five were rescued by helicopter and two died from apparent smoke inhalation.

The *Caribbean Fantasy* remained aground outside the Port of San Juan for 3 days, with the fire continuing to burn. On August 20, the vessel was towed into the port, where the fire was extinguished by marine salvage and firefighting crews.

4 Investigation

Six investigators from the National Transportation Safety Board (NTSB), with expertise in operations, human factors, survival factors, safety management, fire investigation, and recorders, arrived in San Juan on August 18, 2016. After meeting Coast Guard investigators at Sector San Juan headquarters, the team began conducting interviews with crewmembers and Coast Guard personnel. On August 19, a team member boarded the vessel, which was still grounded outside the harbor, to retrieve the voyage data recorder (VDR) capsule and conduct an initial examination of the bridge.[4] Once the vessel was towed into port, the fire was extinguished, and the atmospheric conditions on the vessel were determined to be safe, the investigation team boarded the vessel on August 23 to examine spaces and equipment and collect documentation. Investigators were unable to enter the engine room until the following day, as the environment was deemed too hazardous. Following this initial phase of the investigation, NTSB staff returned to headquarters on August 26, 2016.

The Engineering group was not convened on scene but was formed about a month after the accident. The purpose of the group was to: revisited the vessel and examine the engineering machinery spaces and equipment, document the shipboard engineering department's action taken inside the engine room during the fire, removal of the Mitsubishi MAN B&W 8L58/64 port main engine fuel oil supply pipe end flange and blanking plate (the suspected origination source of the fuel leak) and review of policies, governing rules, and history of Caribbean Fantasy maintenance. Investigators returned to San Juan September 14–16 to participate in the post casualty examination and surveys of lifesaving systems and the ship's machinery and accommodation spaces.

The engineering group developed the port main engine (PME), fuel oil supply line end flange and pipe test plan and conducted examination on January 12th, 2017 and recorded the material

[4] *VDR*s maintain continuous, sequential records of data relating to a ship's equipment and its command and control, and capture bridge audio from certain areas in the pilothouse and on the bridge wings. Regulation 20 of the International Convention for the Safety of Life at Sea (SOLAS) Chapter V requires Ro/Ro passenger ships, such as the *Caribbean Fantasy*, to carry VDRs.

condition, fasteners, and gaskets material. The group convened by telephone conference and emails throughout the course of the investigation and participated in the Coast Guard Lead Marine Board of Investigation (MBI) on March 20, 2017. During the hearing, held in San Juan, Coast Guard and NTSB investigators questioned crewmembers, company management, classification society representatives, and Coast Guard personnel, under oath, to gain further insight into accident events, vessel maintenance and inspection practices, policies and procedures governing the vessel's operations, and the search and rescue response.

From October 24 to 28 and from December 5 to 9, investigators travelled to the Coast Guard Cruise Ship National Center of Expertise (CSNCOE) in Fort Lauderdale, Florida, to conduct interviews with passengers, Coast Guard personnel, first responders, classification society representatives, and other witnesses.

On March 20, 2017, the Coast Guard conducted a 9-day district formal hearing into the accident. During the hearing, held in San Juan, Coast Guard and NTSB investigators questioned crewmembers, company management, classification society representatives, and Coast Guard personnel to gain further insight into accident events, vessel maintenance and inspection practices, policies and procedures governing the vessel's operations, and the search and rescue response. A representative from the flag state of Panama was present at the hearing.

The investigation was led by the Coast Guard. Parties to the investigation were the Coast Guard, Baja Ferries, MAN Diesel & Turbo SE.

5 Vessel Information

5.1 General

The *Caribbean Fantasy* was built by Mitsubishi Heavy Industries in Kobe, Japan, and completed in 1989 as hull number 1174. Originally named the *Victory*, the vessel sailed with the Higashi Nippon Ferry services in Japan from 1989 to 1998 and with the Grandi Navi Veloci services in Italy from 1998 to 2008. The vessel was purchased in early 2008 by Baja Ferries S.A. de C.V., renamed the *Chihuahua Star*, and put into service under the flag of Mexico on February 8, 2008, in the Gulf of California.

In the spring of 2011, the company began the process of shifting the operations of the vessel from Mexico to scheduled runs between the ports of San Juan and Mayaguez, Puerto Rico, and Santo

Domingo, Dominican Republic, under a time charter agreement with America Cruise Ferries, Inc. On October 21, 2011, the company officially changed the name of the vessel to *Caribbean Fantasy* and changed the flag to Panama. Although marketed as a cruise ferry, the company had no affiliation or membership with any cruise industry trade groups.

Figure 1. Panamanian-flagged Ro/Ro passenger vessel *Caribbean Fantasy*. (Photo by Baja Ferries)

From August 8, 2011, to April 11, 2014, the *Caribbean Fantasy* was managed by V-Ships Leisure, a maritime service provider that specialized in technical ship management and outsourcing services for cruise ships, passenger ferries, and high value yachts. From April 12, 2014, through the time of the accident, technical management was performed by Baja Ferries S.A. de C.V. The *Caribbean Fantasy* was classified by RINA SERVICES S.p.A (RINA) as a steel single-hull Ro/Ro passenger ship equipped for the carriage of containers with no navigational restrictions.[5] It was capable of carrying 130 forty-foot equivalent unit (FEU) containers and 60 cars on three vehicle decks, two of which were continuous.

The *Caribbean Fantasy*'s machinery consisted of two 14,400 hp (10,738 kW) MAN B&W 8L58/64 main propulsion diesel engines produced under license by Mitsubishi Heavy Industries. Each of the engines directly drove one of the ship's twin controllable pitch propellers. The vessel had three electric generators, in a compartment aft of the main engine room, that powered the ship's various electrical systems.

[5] Classification societies such as RINA SERVICES S.p.A. are nongovernmental organizations that establish and maintain standards for shipbuilding and operation, and they are authorized to perform vessel inspection and certification functions delegated by the Coast Guard.

The *Caribbean Fantasy* was subdivided into five main vertical zones (MVZs) that provided both watertight integrity and thermal containment. The thermal containment divisions were rated at "A-60" class, which are designed to limit the thermal transmission of heat to an adjacent or overhead area for a period of 60 minutes.[6] The ship also had two main horizontal zones (MHZs) subdividing the vehicle decks, with A-60 insulation in between. The ship had six watertight doors.

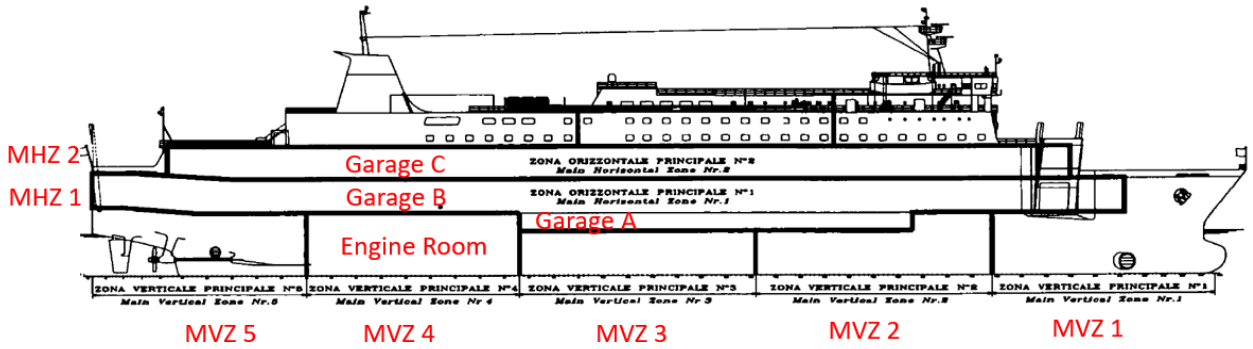


Figure 2. Profile of the *Caribbean Fantasy* showing MFZs and MHZs. Garages A and B are in HFZ1 and Garage C is in HFZ2. The engine room is directly below garage B.

[6] a) Per SOLAS II-2 Regulation 9.2.2.1.1.1, in ships carrying more than 36 passengers, the hull, superstructure, and deckhouses shall be subdivided into main vertical zones by "A-60" class divisions. b) Per SOLAS II-2 Regulation 3.2., A-60 divisions are to be constructed of steel or equivalent material suitably stiffened. They are to be insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140°C above the normal temperature, nor will the temperature, at any one point, including any joint, rise more than 180°C above the original temperature within 60 minutes. The construction must be capable to prevent the passage of smoke and flame.

5.2 Vessel Particulars

Vessel Name	***Caribbean Fantasy***
Owner/Operator	Baja Ferries, S.A. de C.V.
Port of Registry	Panama City
Flag	Panama
Type	Ro/Ro passenger
Built	1989
IMO number	8814263
Classification society	RINA SERVICES S.p.A.
Construction	Welded steel
Draft (at time of accident)	20 ft (6.1 m) forward, 22 ft (6.7 m) aft
Length	613.9 ft (187.1 m)
Beam	88.7 ft (27 m)
Gross tonnage	28,112
Engine power; manufacturer	Two 14,400 hp (10,738 kW) Mitsubishi MAN B&W 8L58/64 diesel engines
Persons on Board	511 (387 passengers, 124 crew)

6 Accident Events - Engineering

On August 17 about 0530, the third engineer started to complete the engine room arrival checklist in accordance with the vessel's safety management system (SMS) procedures.[7] Checks included synchronizing clocks and verifying the various means of communication with the bridge, checking the start air and clutch air compressors, securing the water generator and oily water separator, and ensuring power was available to the deck machinery, shell doors, and bow thrusters. At 0645, the third engineer started no. 3 diesel generator and paralleled it with the main electrical bus. No.1 and no. 2 diesel generators were already online and had been providing electrical power to the vessel during the entire voyage from Santo Domingo. The main propulsion engines remained in bridge control throughout the voyage. The engines had been utilizing low sulfur marine gas oil (MGO) for more than

[7] Baja Ferries S.A. de C.V., *Fleet Operations Manual, Vol. 2,* "Engine Room Arrival Checklist," Form SAF 27, version 1, issued January 2014.

seven hours.[8] The change over from heavy fuel oil (HFO) to MGO started at 2320 on August 16 and was finalized prior to entering the US Caribbean Emissions Control Area (ECA) at 2400.[9]

At about 0700 on August 17, the chief engineer entered the main engine room, conducted a routine round of the space, and recorded the fuel oil levels of the main engines service tank prior to the ships 0730 arrival at the San Juan pilot station. About 0720, the wiper concluded a round of tank soundings and was bringing the sounding tape back to the work bench when he and the motorman discovered the smell of diesel oil in the main engine room. Upon investigation, the motorman saw fuel oil spraying from the aft end (coupling end) of the port main engine (PME), a Mitsubishi MAN B&W 8L58/64 diesel engine. He immediately notified the chief engineer, who was at the forward end of the main engine room. The third engineer, who was on his way back to the engine control room (ECR) after checking the cooling water temperatures of the three online generators in the auxiliary engine room was flagged down by the motorman and informed of the leak. The chief engineer, motorman, and wiper attempted to locate the source of fuel oil leak and found fuel oil discharging on the outboard side (control side) of the PME. The chief engineer later described the leak, which was at the PME fuel oil supply pipe end flange, as a "big leak" with most of the fuel being directed downward due to the presence of anti-splashing tape on the flange. The chief engineer returned to the ECR, called the bridge, and notified the master of the fuel oil leak. He informed the master that repairing the leak required securing the fuel oil system and isolating the PME fuel oil supply line, which would shut down the PME propulsion. The master at that time informed the chief engineer that they were getting ready to board the pilot.

The chief engineer, with approval from the master, took control of the main propulsion in the ECR. He reduced the load on the PME and starboard main engine (SME) by decreasing the pitch angle of the controllable pitch propellers (CPP) in preparation for stopping one or both engines. The chief engineer and motorman returned to the outboard side of the PME to further investigate the source of the fuel leak with flashlights, due to low light level in the PME coupling end area and discovered an increased amount of fuel was spraying from the fuel oil supply pipe end flange and blanking plate in the direction of the main exhaust manifold casing and turbocharger. As he walked the centerline of

[8] *Caribbean Fantasy Engine Room Log Book* 2000-2400 watch remarks, August 16, 2016, pg 16.
[9] The US Caribbean ECA entered into force in January of 2014 under the International Maritime Organization (IMO) *International Convention from the Prevention of Pollution from Ships* (MARPOL), which designated specific portions of the coastal waters around Puerto Rico and the US Virgin Islands as an emission control area (ECA). The ECA imposes limits on the emission of nitrogen oxides, sulfur oxides, and particulate matter.

the main engine room between the PME and SME, the wiper also noticed the increased fuel oil spray towards the last cylinder cover and exhaust manifold.

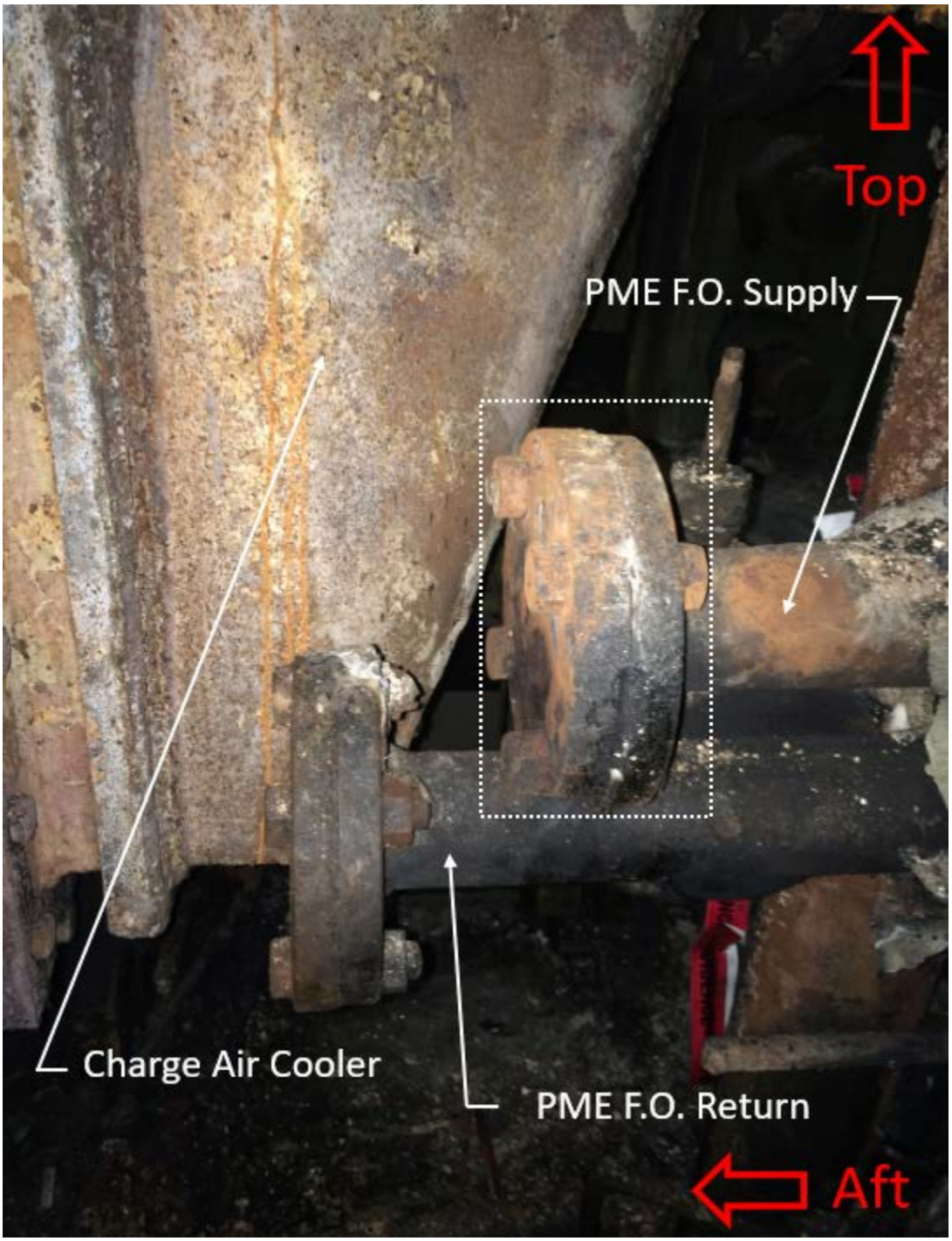


Figure 1. *Caribbean Fantasy*'s port main engine fuel oil supply and return pipe end flanges and blanking plates. The white dotted box indicates the location of the fuel leak. View from the coupling end of the engine looking outboard to the fuel pump control linkage and charge air cooler.

The chief engineer told investigators that he was about a meter away from the PME supply end flange when the fuel oil spray ignited. A large plume of fire, heat, and smoke forced the chief engineer,

the motorman, and the wiper to exit the area. The chief engineer and motorman returned to the ECR. The wiper attempted to go forward towards the ECR, but the smoke and heat prevented him from doing so. Instead, he exited the space aft through watertight door no. 4, which lead to the auxiliary engine room containing the diesel generators. He then proceeded farther aft and exited the auxiliary engine room through watertight door no. 6. He proceeded up the starboard ladder well to deck no. 3, garage B.

Meanwhile in the ECR, the third engineer heard the ignition, looked out the ECR window into the main engine room and saw the fire. He called the bridge to notify them of the fire and depressed the fuel oil supply and boost pump stop buttons on the control console. The third engineer then pulled both propulsion levers to zero pitch from the console in the ECR. Soon thereafter, the chief engineer entered the ECR and depressed the fuel oil supply and boost pump stop buttons again. He believed the pumps were already stopped by the third engineer but pressed the buttons as a precautionary measure to ensure the fuel source was secure. Functional alarm history and or event data loggers was not available in the ECR to verify and document securing of machinery. During initial interviews with investigators, the engine crew did not discuss whether the lube oil system was secured. Follow-up informal questions with the crew while examining the fire damage in the main engine room in September 2016 did not reveal if the lube oil system was secured.

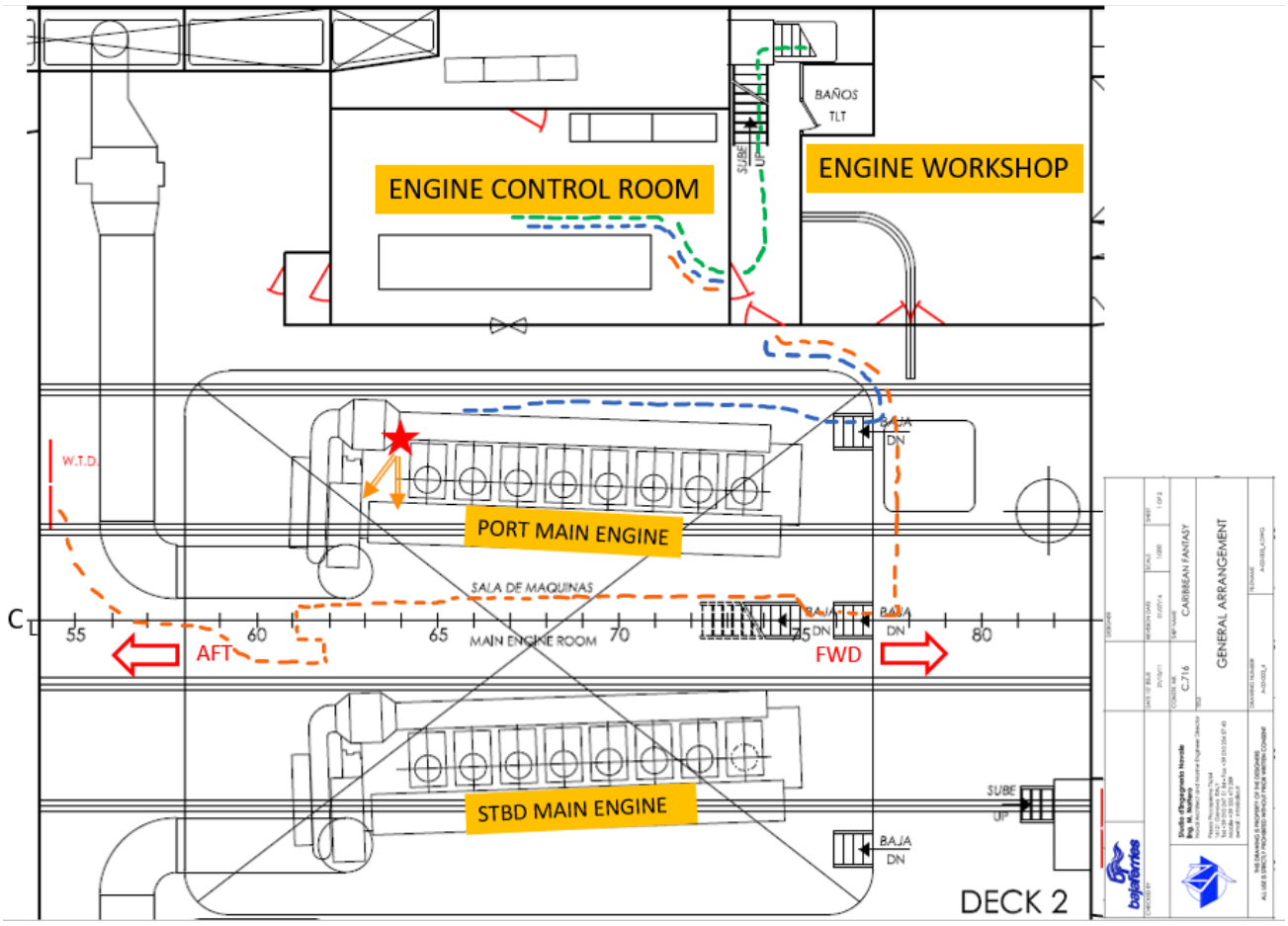


Figure 3. Excerpt from the general arrangement drawing of the *Caribbean Fantasy*'s main engine room and adjacent spaces. The red star represents the location of the fuel spray from the port main engine fuel oil supply end flange in the direction of the exhaust manifold and turbochargers. The port and starboard main engines, engine control room, and engine workshop are depicted. The blue dotted line indicates the path taken by the chief engineer and motorman to investigate the fuel oil spray. The green dotted line indicated how the chief engineer, third engineer, and motorman exited the space. The orange dotted line shows the wipers investigation path and evacuation route.

The chief engineer then manually activated the HPN Nebula high pressure water-mist fixed firefighting system from the engine control room localized panel over the PME and SME by depressing the red push buttons for zones no. 1 (starboard machinery) and no. 2 (portside machinery) as labeled on the control panel.[10]

[10] The HPN Nebula system is an open nozzle, dry pipe fire protection system that when activated provides a high-pressure water mist that extinguishes a fire through cooling. It is designed to use less water than a traditional sprinkler system.

Figure 4. The HPN Nebula firefighting system localized protection system panel located in the ECR. White dotted box indicates the zones the chief engineer said he activated and arrow shows the green indicator light for the service pump (MP.01.01)

The chief engineer stated to investigators that he knew the system was on because the green indicator light for the service pump was illuminated on the control panel in the ECR. This signified the high-pressure pump motor controller was energized, but there was no means to verify the system pressure or that pump was running. Further he did not state he saw any section valve light indication on the panel. The pump was in the machinery and equipment of air condition space forward of the main engine room on deck no. 1. There was no indicator for water mist pressure on the local control panel located in the ECR, and the heavy black smoke inhibited the chief engineer from visually verifying the system was operating as designed.

The staff captain, upon order from the master, arrived in the engine room and witnessed the fire and stated by the time he got there was a lot of heat and the flames were “very violent”. He was only in the engine room for a few seconds before going to the ECR. From the ECR the staff captain stated he could see through the window looking into the engine room that he saw the flames getting bigger and bigger and were touching the celling of the engine room. A muster was taken in the ECR and the wiper was not accounted for. Consequently, the third engineer attempted to re-enter the engine room without an emergency escape breathing device (EEBD). He called out to the wiper, but the smoke was too thick to see or hear anything. He returned to the ECR. The chief engineer also attempted to re-enter the space with an EEBD but without success. The smoke had continued to build, and he could not see a meter in front of him. He returned to the ECR.

The chief engineer ordered the third engineer and motorman to evacuate the area and proceeded to exit the space with them using the forward (no. 9) ladder well to deck 3, garage B. The staff captain informed the master by radio of the fire on the port main engine and that it was big and violent, recommending a release of CO_2 and then evacuated. When exiting the stairwell, the chief engineer manually activated the closing valve for the eight ventilation dampers (four on each side of the main engine machinery space) and the eight fuel and lube oil quick closing valves (QCVs). The ventilation dampers, when closed, were designed to prevent the spread of smoke, reduce the supply of oxygen to the fire, and prevent the CO_2 firefighting agent (when released) from escaping the space. The QCVs, when closed, sealed the main engine space and cut off fuel supply from the fuel and lube oil day, settling, and storage tanks.

7 Shipyard and Other Repairs

7.1 CMR Tunisia Ship Repairs Shipyard

CMR Tunisia Ship Repairs facility is situated in Menzel Bourguiba, in the governate of Bizerte, on the north-eastern coast of Tunisia. Per the company’s website, it is the largest shipyard in the south Mediterranean area. The *Caribbean Fantasy* entered Tunisia Ship Repairs drydock No. 4 on March 26, 2016, at 0701 Greenwich mean time (GMT). The vessel stayed 100 days at the shipyard, during which extensive repairs were performed on the Mitsubishi MAN B&W 8L58/64 main engines: the exhaust gas turbochargers were overhauled, the gear coolers were inspected, engine alignments were performed, inspection of Vulkan couplings, thrust bearing inspections, disassembly of marine gears, deflection of the crankshafts, laser alignments of the reduction gears, injector refurbishments,

cylinder head overhauls including removal of the exhaust and intake valves .[11] The *Caribbean Fantasy* departed the Tunisia Ship Repairs facility on July 3 at 1010 GMT.

7.2 Diesel Generator Failures and Subsequent Repairs in Gibraltar, British Overseas Territory

The *Caribbean Fantasy* arrived at the Gibraltar East Anchorage the evening of July 5. The following morning, while maneuvering inside the Bay of Gibraltar toward the Gibraltar Cruise Terminal, the vessel experienced a full blackout—including a loss of propulsion a loss of primary electrical power. About 0725 local time, a fire alarm activated on the bridge for the auxiliary engine room that contained the electric power distribution system and diesel generators due to the presents of smoke. According to the chief engineer's statement after the blackout, he had stopped all three online diesel generators in response to the alarms and smoke, which caused the loss of electrical power and propulsion to the vessel.[12]

The emergency generator started as designed and the supply and exhaust fans were restarted to clear the smoke in the space. No.1 diesel generator was identified as the source of smoke and taken out of service. Upon investigation, the engineers discovered that the generator's cooling water was leaking into the crankcase. Diesel generators no. 2 and no. 3 were restarted and placed back online to provide electrical power while the crew started to extract the cylinder liners on generator no. 1. Once the lines were extracted, they discovered that cylinder liners no. 5 and no. 6 cooling water o-rings were completely destroyed due to excessive heat. The failure of the o-rings allowed cooling water to enter the crankcase.

Due to the reported blackout, a port state control inspection ensued on the evening of July 6, conducted by the Gibraltar Maritime Administration.

At 1340 local time the next day, July 7, a second blackout occurred due to smoke in the diesel generator space again. The smoke was caused by the same issue of damaged o-rings that allowed cooling water to leak into the crankcase, this time on cylinders no. 3 and no 4 of no. 2 diesel generator. The crew secured no. 2 diesel generator and started No.3 generator to provide power. Excessive dark smoke and a small explosion were seen and heard emanating from the port side exhaust funnel. The

[11] *Vulkan* is the name brand of marine drivetrain couplings manufactured by VULKAN Kupplungs- und Getriebebau Bernhard Hackforth GmbH & Co. KG.
[12] Chief engineer email to master and DPA, "Statement regarding the blackouts on July 11th, 2016 at 11:54 local time."

port authorities ordered the vessel to stop activities, and it remained on emergency power for the remainder of the day.

The Gibraltar Maritime Administration port state control officer issued three deficiencies on August 8, 2016, and the vessel was detained under SOLAS 81 Amendment Chapter II-I, Regulation 26. The specific deficiencies were:

- auxiliary engine nos. 1, 2, and 3 not operational;
- seawater feed pump to the auxiliary engines not operational; and
- general engine room cleanliness insufficient.

Paris MoU on Port State Control — REPORT OF INSPECTION IN ACCORDANCE WITH THE PARIS MEMORANDUM OF UNDERSTANDING ON PORT STATE CONTROL — FORM B/1 Rev 02/14

1. Name of ship: Caribbean Fantasy 2. IMO number: 8814263 3. Date of report: 8/7/16 4. Place of inspection: GIBRALTAR

DEFICIENCIES FOUND AND FOLLOW UP ACTIONS**)

Nr.	Code/Def	Nature of Defect *)	Convention ref. *)	Ground for detention	Action taken	Additional Comments	ISM related	RO resp.	Accidental damage *)
1	13102	Not as required	Solas 81 Amend Ch II-I / Reg 26.		17/10	Auxiliary engines Nº 1, 2 & 3 not operational. Flag/class to be consulted. Vessel currently using emergency generator.			
2	13199	other (Machinery)	other		17/10	1 x Sea water feed pump to auxiliary engines not operational			
3	18420	Not as required	MLC 2006 Title 4/ St A4.3 Reg 4.3		17/15	General engine room cleanliness insufficient			

A shore based team of technicians boarded the vessel and overhauled diesel generators no. 2 & no. 3. No. 2 diesel generator was operational on July 10 at 1920 local time. Diesel generator no. 3 was placed out of service due to damage o-rings. The vessel's bow thrusters were also taken out of service temporarily.

In the opinion of the chief engineer, the cause of the failures could be traced back to the Tunisia shipyard, where cooling water supplied by the shipyard to the diesel generators was unexpectedly stopped two or three times causing diesel generators no. 1 and no. 2 to overheat and shutdown. The chief engineer also questioned the quality of the o-rings installed.

At the owner's request, a RINA surveyor boarded the vessel on July 11 and carried out an "occasional" survey following the port state control inspection.[13] The attending RINA surveyor verified compliance with SOLAS II Regulation 41, electrical balance on board of diesel generators no. 1 and no. 2. Diesel generators No. 1 and no. 2 were subjected to a dedicated berth trial test that included alarms and safety devices, with satisfactory results. .[14]

7.3 Navantia Cadiz Shipyard

The *Caribbean Fantasy* made a required stop at Navantia Cadiz Shipyard, in Cadiz, Spain, on July 21 to replace the PME bearing shells (upper and lower) on no. 9 bearing.

Alliance Diesel Refit assisted and provided direct support to the crew and shipyard personnel of the repairs performed in Tunisia and Cadiz with the no. 9 bearing shell replacement. See Alliance Diesel Report ADRO16.

According the Alliance Diesel Refit reports, both main engines experienced high vibrations. Section h of the report states, "High vibration level of the starboard engine is reported at idle speed, seems to be much more than before and sensible everywhere on board the ship." The port engine Vulkan coupling had been replaced, however investigators could not determine when the replacement occurred, and the starboard Vulkan coupling was original (28 years since installation). The report stress the importance of conducting a vibration analysis on both engines immediately to confirm the source of the vibration and there locations to minimize them and to avoid critical speeds by lowering speed or increasing it above the critical steps. No additional reports were provided to investigators to indicate a vibration analysis was performed on the main engines.

8 Fuel and Lube Oil Quick-Closing Valves

8.1 Background

Fuel and lube oil QCVs are positive shutoff valves on fuel and lube oil systems designed to isolate the tanks in the event of an emergency. For the safety of the crew and the vessel, these valves are designed to be remotely operated in situations where local operation is impossible or impracticable due to a hazardous situation. In the event of a fire, they also prevent "fueling" of a fire in circumstances

[13] Unlike a periodic survey that may be conducted to meet statutory timing requirements, an *occasional* or non-periodic survey may be conducted by the classification society when required due to damage, alterations or major repairs, or a change of ownership.
[14] Rina Port State Control Follow-Up Report, File 16-XA-695-01. 11-14 July 2016.

where system piping and components are compromised. In some circumstances, QCVs may be the only means of securing the fuel to a flammable liquid fire.

Proper routine maintenance and, in some cases, approved modifications and/or replacement of components may be necessary to ensure reliability of the remote operation and closure of the valve. Fittings for testing remote closure without physically securing the valve should only be used as intended.

The US Coast Guard issued a Marine Safety Alert on January 31, 2011, after port state control officers discovered many quick closing valves that were intentionally blocked, modified, and poorly maintained, which prevented the valves from operating as designed during an emergency.[15]

8.2 Port State Control Assessments and Inspections

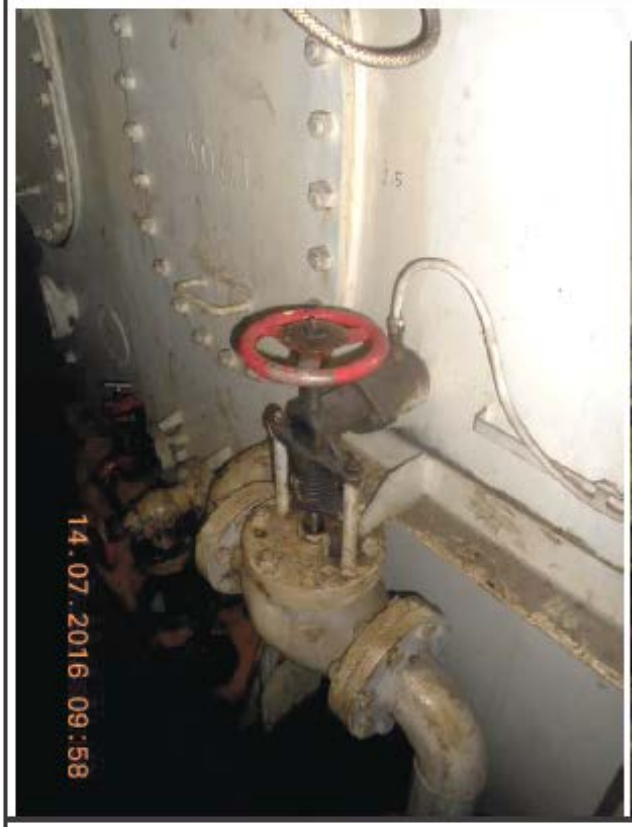
A RINA surveyor conducted a "Port State Control Preventive Assessment" on July 14, 2016, to verify the deficiencies recorded by the Gibraltar Maritime Administration port state control deficiency cards. The RINA surveyor duly reviewed and checked on board and the record deficiencies were found on board.

The two photographs in figure 5 were taken by the RINA surveyor one month prior to the accident. They were listed in section 5 of the photographs and found on page 3 of the report produced by the surveyor. The photograph on the left is the lube oil storage tank QCV. A bolt and nut have been lodged in the valve mechanism which rendered the valves unable to isolate fuel and lube oil from the main engine room during the fire, per their designed purpose. There is no description or deficiencies recorded in the narrative section for QCVs as required by the RINA report form.[16]

[15] US Coast Guard, *Inspection of Fuel Oil Quick-Closing Valves*, Marine Safety Alert 01-11, January 31, 2011.
[16] RINA, *Port State Control Preventive Assessment*, RINA no. 7647, File no. 16/XA/695/01.

Pictures (attach at least 2 significant shots for each subject)

5	Quick closing devices



Pictures (attach at least 2 significant shots for each subject)

Figure 5. RINA Port State Control Preventive Assessment photographs of QCVs.

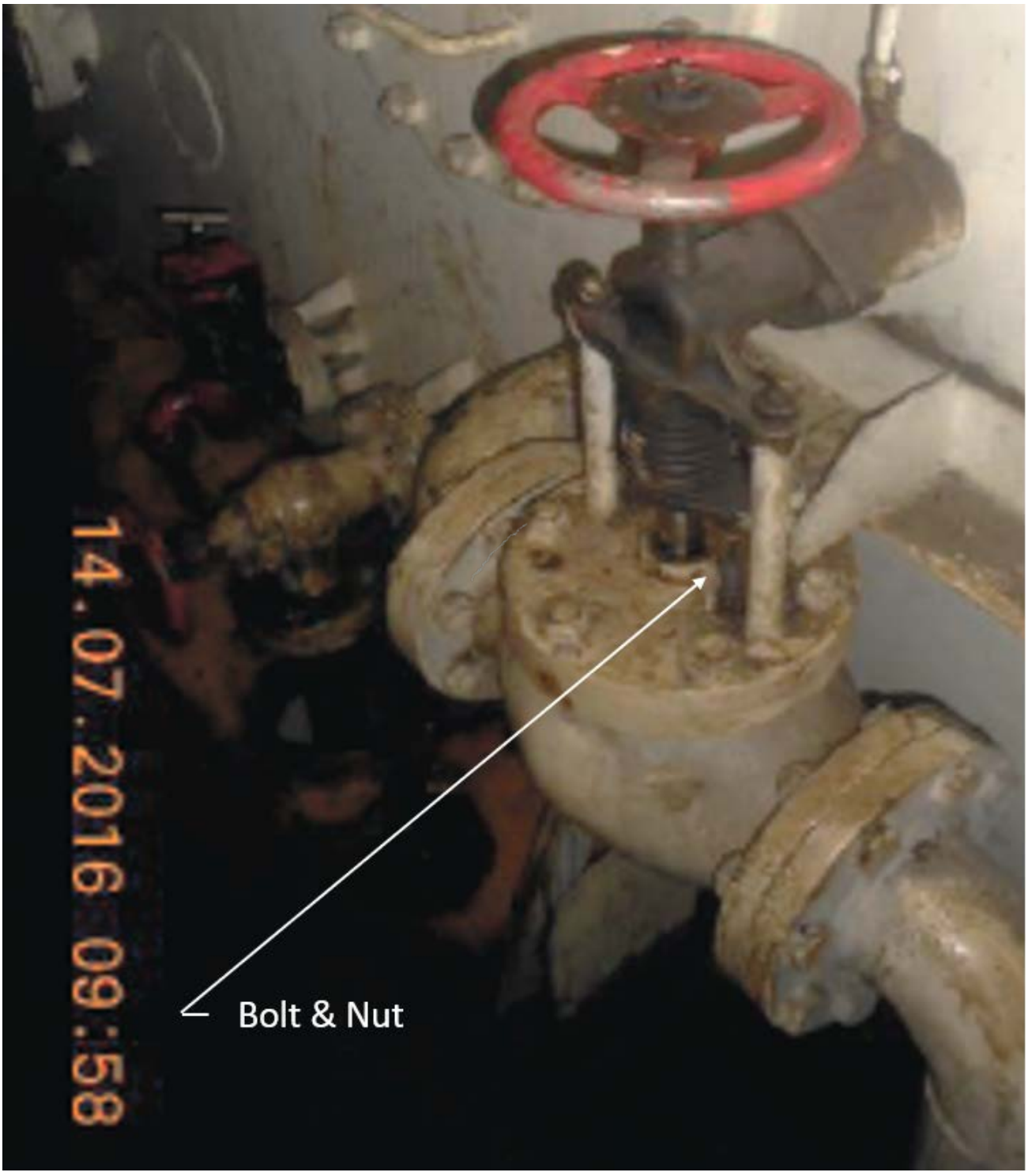
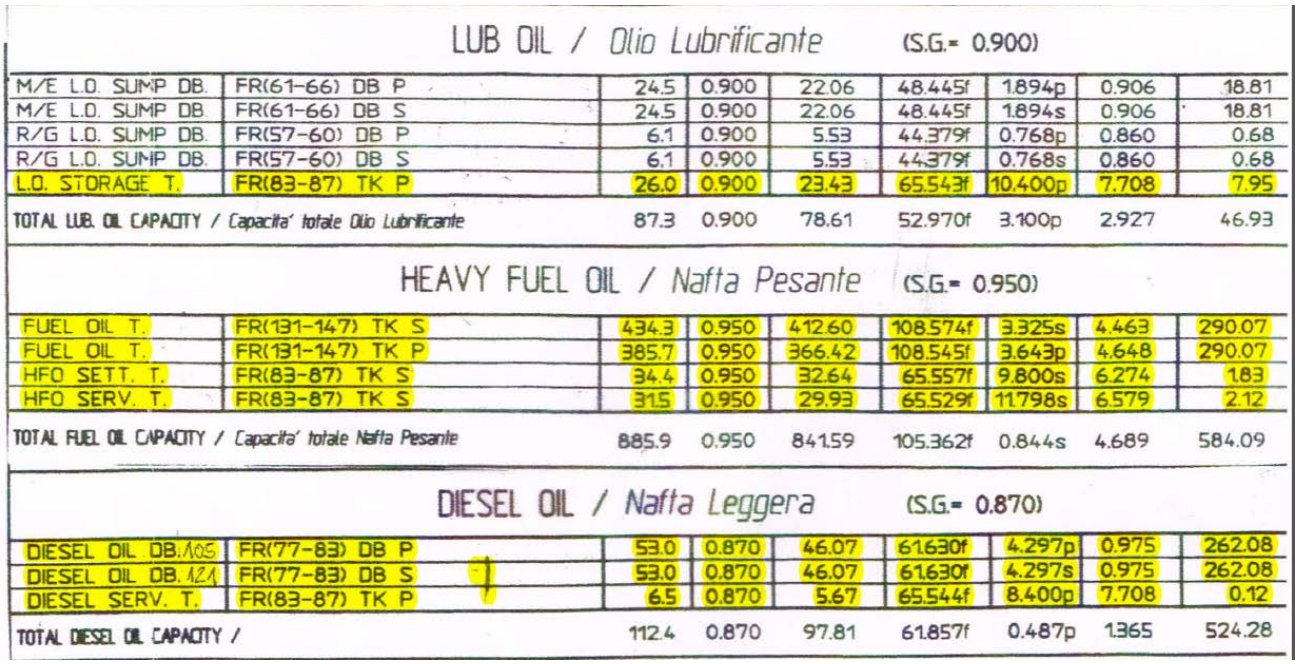


Figure 6. Enlarged photograph of lube oil storage tank QCV from RINA Port State Control Preventive Assessment.

QCV operations were spot checked during a US Coast Guard port state control inspection on August 9, 2016, in San Juan, Puerto Rico. No QCV deficiencies were noted. The port state control officers allowed the ship's crew to demonstrate the QCVs operation using shipboard developed

procedures. The port state control officer and the ship's crew indicated that a bolt and nut was placed in between the valve stems to keep the vital systems online to avoid a blackout during the inspection.

After the accident, investigators discovered that all eight fuel and lube oil QCVs were intentionally blocked open, which made it impossible to isolate fuel and lube oil supply from the main engine room during the fire. Figure 7 lists the tank capacities listed for heavy fuel oil (HFO), marine gas oil (MGO), and lube oil (LO) tanks in the trim and stability booklet. The tanks associated with the QCVs that were intentionally blocked open are highlighted in yellow. The second column lists the locations of the tanks by frame numbers.



LUB OIL / *Olio Lubrificante* (S.G.= 0.900)								
M/E L.O. SUMP DB.	FR(61-66) DB P	24.5	0.900	22.06	48.445f	1.894p	0.906	18.81
M/E L.O. SUMP DB.	FR(61-66) DB S	24.5	0.900	22.06	48.445f	1.894s	0.906	18.81
R/G L.O. SUMP DB.	FR(57-60) DB P	6.1	0.900	5.53	44.379f	0.768p	0.860	0.68
R/G L.O. SUMP DB.	FR(57-60) DB S	6.1	0.900	5.53	44.379f	0.768s	0.860	0.68
L.O. STORAGE T.	FR(83-87) TK P	26.0	0.900	23.43	65.543f	10.400p	7.708	7.95
TOTAL LUB. OIL CAPACITY / *Capacita' totale Olio Lubrificante*		87.3	0.900	78.61	52.970f	3.100p	2.927	46.93
HEAVY FUEL OIL / *Nafta Pesante* (S.G.= 0.950)								
FUEL OIL T.	FR(131-147) TK S	434.3	0.950	412.60	108.574f	3.325s	4.463	290.07
FUEL OIL T.	FR(131-147) TK P	385.7	0.950	366.42	108.545f	3.643p	4.648	290.07
HFO SETT. T.	FR(83-87) TK S	34.4	0.950	32.64	65.557f	9.800s	6.274	1.83
HFO SERV. T.	FR(83-87) TK S	31.5	0.950	29.93	65.529f	11.798s	6.579	2.12
TOTAL FUEL OIL CAPACITY / *Capacita' totale Nafta Pesante*		885.9	0.950	841.59	105.362f	0.844s	4.689	584.09
DIESEL OIL / *Nafta Leggera* (S.G.= 0.870)								
DIESEL OIL DB. MGO	FR(77-83) DB P	53.0	0.870	46.07	61.630f	4.297p	0.975	262.08
DIESEL OIL DB. MGO	FR(77-83) DB S	53.0	0.870	46.07	61.630f	4.297s	0.975	262.08
DIESEL SERV. T.	FR(83-87) TK P	6.5	0.870	5.67	65.544f	8.400p	7.708	0.12
TOTAL DIESEL OIL CAPACITY /		112.4	0.870	97.81	61.857f	0.487p	1.365	524.28

Figure 7. *Caribbean Fantasy*'s HFO, MGO, and LO tank capacities as listed in the trim and stability booklet. Tanks associated with the eight QCVs that was intentionally blocked open are highlighted.

There were four oil tanks located in the forward part of the engine room, upper level, where the fire was mostly concentrated: the lube oil storage tank, port, (Frame 83-87), the diesel oil service tank, starboard (Frame 83-87), the fuel oil service tank, starboard (Frame 83-87), and the fuel oil settling tank, starboard (Frame 83-87).

The port lube oil storage tank QCV that was intentionally blocked open was evaluated post accident by parties to the investigation and the chief engineer. In agreement with all parties, the bolt and nut were removed by the chief engineer to verify the valve stem closure. The valve stem moved in the downward direction about 2 inches, closing the valve. Figure 8 is a photograph of the valve after removal of the bolt and nut.

Investigators were unable to determine the periodicity the company required shipboard personnel to test the QCVs. There was no test procedure or interval required for QCVs listed in their preventative maintenance schedule or quarterly safety checklist.[17]

There is no objective evidence the company had an established critical equipment procedure that identifying QCVs as critical equipment to meet the requirements of section 10.3 and 10.4 of the ISM Code.

Section 10.3 of the Code states the following:

> *The Company should establish procedures in its safety management system to identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The safety management system should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.*

Section 10.4 of the Code states:

> *The inspections mentioned in 10.2 as well as the measures referred to 10.3 should be integrated in the ship's operational maintenance routine.*

There were no records onboard indicating *Caribbean Fantasy* personnel submitted requisitions for spare parts to repair the QCVs or arrange for any kind of service for repair. Further, there was no evidence in any of the shipyard documentation indicating any service or repair was done to any of the QCV's. Engine personnel interviewed were not aware of how or why the QCV's were blocked open or if the system was in an operational readiness status or not.

Investigators requested maintenance records from the owner and operator to determine the last maintenance or functional tests performed on the eight QCVs. There were no corrective or preventative maintenance records on board the vessel documenting testing or maintenance and the QCVs were not specifically listed as part of the monthly, quarterly, semiannual, or annual maintenance checks. Under the provisions of International Conventions - SOLAS - International Convention for the Safety of Life at Sea - Chapter II-2 - Construction - Fire protection, fire detection and fire extinction (SOLAS II-2 regulation 14 2.2.3.6), a there is a requirement to have a maintenance plan in place for

[17] Baja Ferries S.A. de C.V., "Quarterly Safety Devices Report," Form OP 48, revision date August 2015.

emergency shutdown of fuel supply. Regulation 14.2.1 also states, such a system should be kept in good order to ensure their required performance if a fire occurs.

Section 14.2.2 of SOLAS Chapter II-2/) Maintenance Plan

To be kept on board and be available for inspection. It includes installed fire protection systems and fire-fighting systems and appliances :Fire main, fire pumps, hydrants, hoses nozzle, international shore connections, fixed fire detection and alarm systems, fixed fire-extinguishing systems, other fire extinguishing appliances, automatic sprinkler, fire detection and fire alarm systems, ventilation systems, emergency shut down of fuel oil supply, fire doors, general emergency alarm system, EEBDs, portable fire extinguishers, fire-fighter's outfits, low-location lighting and public address systems, inert gas system, deck foam systems, fire safety arrangements in cargo pump room and flammable gas detectors.

In addition, SOLAS Chapter II-2 - Construction - Fire protection, fire detection and fire extinction - Part B - Prevention of fire and explosion - Regulation 5 describes the means of control for quick closing valves in a machinery spaces in section (5.2.2.3 – 5.2.2.5)

Regulation 5 - Fire growth potential
2.2 Means of control in machinery spaces
2.2.3 Means of control shall be provided for stopping forced and induced draught fans, oil fuel transfer pumps, oil fuel unit pumps, lubricating oil service pumps, thermal oil circulating pumps and oil separators (purifiers). However, paragraphs 2.2.4 and 2.2.5 need not apply to oily water separators.
2.2.4 The controls required in paragraphs 2.2.1 to 2.2.3 and in regulation 4.2.2.3.4 shall be located outside the space concerned so they will not be cut off in the event of fire in the space they serve.
2.2.5 In passenger ships, the controls required in paragraphs 2.2.1 to 2.2.4 and in regulations 8.3.3 and 9.5.2.3 and the controls for any required fire-extinguishing system shall be situated at one control position or grouped in as few positions as possible to the satisfaction of the Administration. Such positions shall have a safe access from the open deck.

Several flag states, class societies, recognized organization (RO), and marine insurances companies (hull & machinery) have developed safety alerts, marine safety advisories, and critical items checklists for their owner, operators, masters, marine surveyors and inspectors to raise awareness and underscore the importance for accurately testing and verifying satisfactory operation of quick closing. [18] See NTSB docket for safety alerts, marine safety advisories, and critical items checklists.

[18] Classification societies are non-government organizations that establish technical standards for vessels, depending on their type and service, and ensure vessels are designed, constructed, operated and maintained to these standards

Figure 8. *Caribbean Fantasy*'s port lube oil storage tank QCV that was intentionally blocked open. The bolt and nut were removed to verify the valve stem closed.

Figure 9. *Caribbean Fantasy*'s port HFO storage tank QCV that was intentionally blocked open with a bolt, nut, and washer.

Figure 10. *Caribbean Fantasy*'s HFO purifier settling tank starboard QCV that was intentionally blocked open with a bolt and nut.

Figure 11. *Caribbean Fantasy*'s port MGO service tank QCV that was intentionally blocked open with a bolt and nut.

Figure 12. *Caribbean Fantasy*'s starboard HFO storage tank QCV that was intentionally blocked open with a bolt and nut. Lower left image of close up view of the bolt and nut with paint and dust.

Figure 12 above shows the starboard HFO storage tank QCV that was purposely blocked open with a bolt and nut to prevent the valve stem from seating when activated. The bolt is under compression in the photograph. Paint is present on the nut and bolt threads, which, along with the presence of dust, dirt, and rust, indicate the nut and bolt have been in place for an extended amount of time. The presence of soot in this area was minimal. Posted next to the valve near the manhole for the tank, were three documents. One was a gas free certificate issued on June 14, 2016, from the Tunisia Shipyard, a hot work permit issued by Grand Bahama shipyard on May 10, 2014 and a confined space permit also issued by Grand Bahama shipyard on May 10, 2014. Both had expiry dates of May 11, 2014.

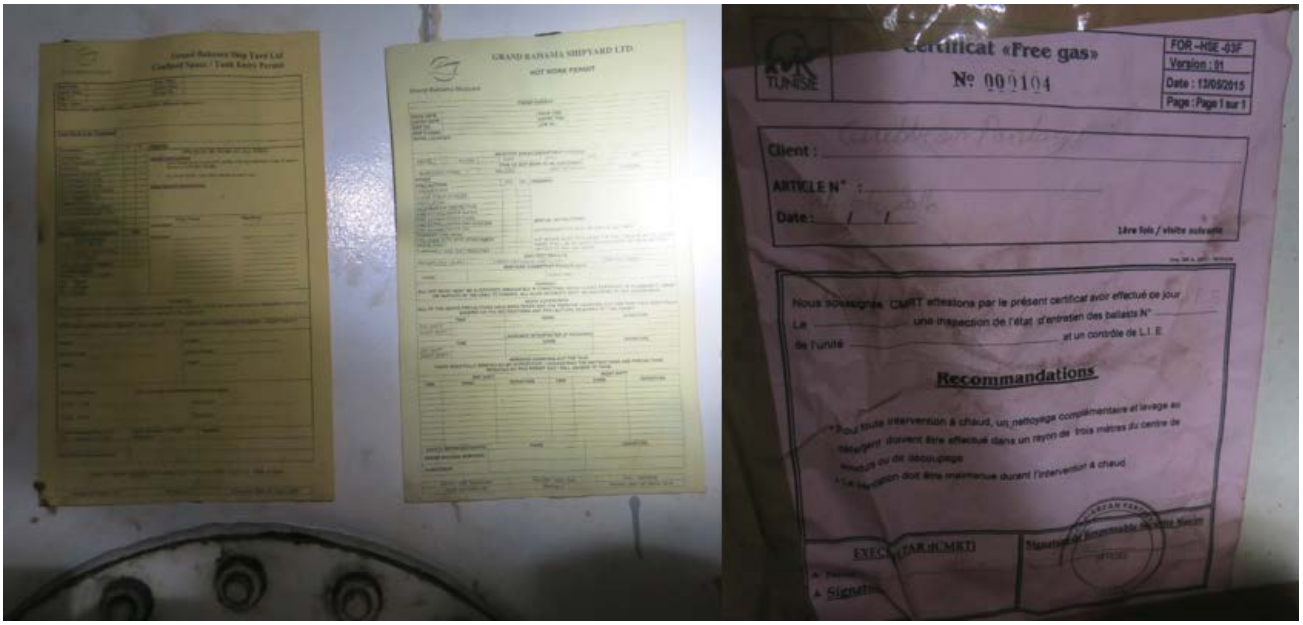


Figure 13. Outdated hotwork, and tank entry permits found posted near manhole on the starboard side HFO storage tank.

Figure 14. Port side view of the main engine room forward of engine workshop, deck 2, at frame 83. An inch and a half of lube oil is on the deck. The white arrow points to the lube oil storage tank QCV.

Figure 15. Port side view of the main engine room looking forward into the engine workshop, deck 2, at frame 75. An inch and a half of lube oil is on the deck.

9 Engineering Plant Description

9.1 Main Propulsion

The *Caribbean Fantasy's* main propulsion system was comprised of two medium speed Mitsubishi MAN B&W diesel engines with the identifier 8L58/64. The engines were constructed and installed at Mitsubishi Heavy Industries in Kobe, Japan, under a license agreement with MAN B&W. Each 4-stroke, in-line (single-bank), non-reversing engine had 8 cylinders, with 580 mm cylinder bore and 640 mm piston stroke and was capable of producing 14,400 metric horsepower (PS) (14,203 mechanical horsepower [10,591kW]) at 428 RPM with a specific fuel consumption rate of 177g/kWh.

The engine style and configuration were the favored method of propulsion on passenger vessels built during this time frame, where minimal head room (space) was desirable. The righthand, port main engine, crankshaft rotated in the clockwise direction with a name plate serial number of D164024. The starboard main engine was also a righthand engine, but the crankshaft rotated in the counter-clockwise rotation. The starboard main engine serial number was D164023. The engine name plate photographs are found in figure 16 below.

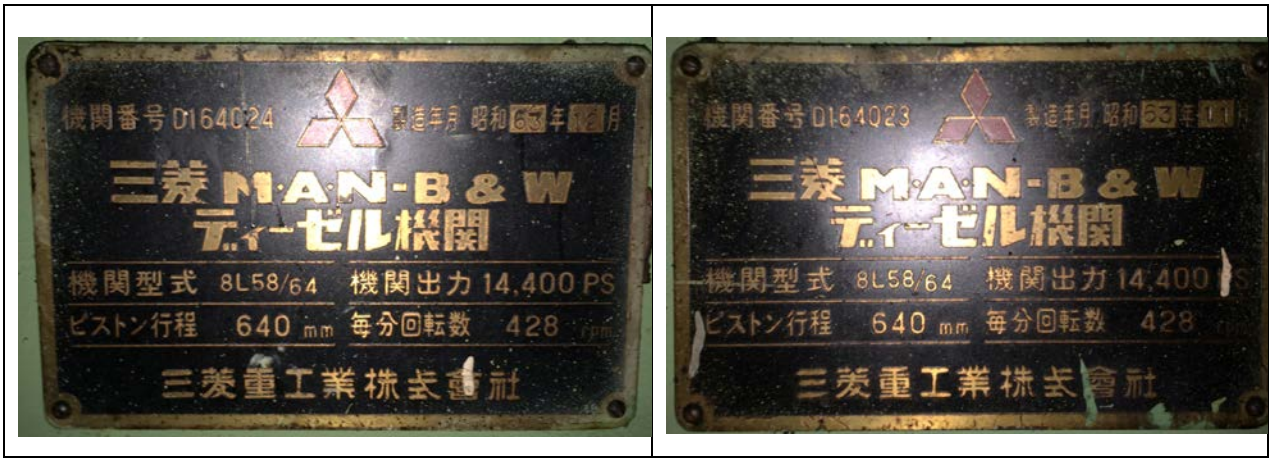


Figure 16. *Caribbean Fantasy*'s Mitsubishi MAN B&W engines nameplates. Left is port main engine; right is starboard main engine.

Each engine was connected via a Vulkan coupling to a Niigata Converter Co., Ltd. single helical reduction gear, model MG32042H18, ratio 2.703 to 1, and then via a shaft to a Nakashima Model XL-135EP controllable pitch propeller, a 4-bladed, 20.8 foot (6.37 meter) diameter propeller. The vessel's service speed was 22 knots, with a maximum speed of 24.5 knots at 413 rpm and a controllable pitch angle of 35 degrees ahead.

The vessel has remote telegraph controls on the Bridge and in the Engine Control Room (ECR). This enables bridge personnel to transfer the commands of engine speed and direction of thrust from the bridge and the engine control room. When in "bridge control" the telegraph directly controls the engine. Maneuvering lever commands and associated rpm and speed tables were found on metal placards near the engine control stations in both the bridge and ECR. All engine throttle placards corresponded to information found on the pilot card.

9.2 Electrical Power Distribution System

The electric power distribution system, located in the auxiliary engine room, a space aft of the main engine room, consisted of three Daihatsu diesel generators, type 6DL-28, each capable of producing 1,550 kva, 3-phase, 440 volts, 60Hz electrical power at 720 rpm. At the time of the accident,

0730 on August 17, all three generators were online and paralleled to the electrical bus in anticipation of arrival in San Juan. No. 3 generator was started and paralleled at 0645 in accordance with the company's arrival policy.[19]

9.3 Fuel Oil Supply Pressure to the Main Engines

The two fuel oil supply pumps and two fuel oil booster pumps maintained a constant pressure of 4–6 bar (58 psi–87 psi) at the fuel oil inlet supply pipe upstream of the engine fuel injector pumps.

The recommended fuel viscosity at the inlet of the injection pump was 10 - 14 mm^2/s.

9.4 Port Main Engine Fuel Oil Flange Blanking Plate Installation

There is no objective evidence that the PME fuel oil supply end flange/blanking plate fasteners (threaded bolts and nuts) and gasket material were properly installed and torqued in accordance with the engine manufacturer's specifications for a four-bolt end flange. Investigators reviewed corrective and preventative maintenance records and engine log book entries but were unable to determine when the blanking plate, gasket material, and fasteners were last repaired or replaced. The repair was not performed in the Tunisia shipyard. The flange blanking plate was not provided by the original equipment manufacturer nor was it fabricated to a design or quality standard (for example, Japanese Industrial Standards [JIS], German Institute for Standardization [DIN] standards, ASTM International standards, or American National Standards Institute [ANSI] standards). The blanking plate was not dimensionally accurate to match the flange. The blanking plate did not have a raised face or meet the engine manufacturer's specifications. See NTSB Materials Laboratory Factual Report, No. 17-008.

The SME fuel oil supply end flange blanking plate gasket was replaced on August 11 as a result of a discovered leakage while the *Caribbean Fantasy* was at the Don Diego Ferry Terminal in Santo Domingo, Dominican Republic, as stated by the first engineer and motorman during their interviews and recorded in the motorman's daily work log.[20] The replacement gasket was hand cut by the motorman. The motorman, with the permission of the watch engineer, secured the SME fuel oil supply system and conducted the repair. The system was checked for leaks by the watch engineer and the first engineer. The gasket and flange were then wrapped in anti-spray tape as shown in figure 17.

[19] Baja Ferries S.A. de C.V., *Fleet Operations Manual, Vol. 2*, "Engine Room Arrival Checklist," Form SAF 27, version 1, issued January 2014.
[20] *Caribbean Fantasy* First Engineer's "Daily Work Log," 12/08/2016, pg. 26.

According to the chief engineer's standing orders, the first engineer was responsible for the main propulsion engines.[21] The first engineer made daily checks of the engines and stated in his interview that the watch standards made the daily inspections of the engines that included monitoring the PME fuel oil supply end flange because a leak had developed on the SME, but there was no follow up activity to inspect, tighten, or replace the supply and return gaskets on the PME.

Figure 17. *Caribbean Fantasy* SME fuel oil supply and return line flanges and blanking plates as found by investigators. Photo illustrates the wrapping of spray tape around each flange and blanking plate and the classification approval stamps on the tape.

The MAN Diesel & Turbo SE party representative, in consultation with his license department and Mitsubishi Heavy Industries, provided party members with electronic copies of the original documentation and approved drawings from 1984 for the 58/64 type engines, serial numbers D164023 and D164024. All original documentation and approved drawings were written in Japanese because

[21] *Chief Engineer's Standing Orders & Engine Department*, "Responsibilities for the First Engineer," signed July 26, 2016

the vessel was built for Higashi Nippon Ferry services in Japan. The current owner/operator, Baja Ferries, did not provide operation manuals in the working language to the crew when the vessel entered service with the company.[22] (Drawings received from MAN were annotated by NTSB investigators with blue text representing a Japanese to English translation, utilizing the Google application Google Translate, Version 5.14.59044.) The drawings provided the following specifications for the flange blanking plate, fasteners, and gasket material:

• The bolt material was JIS8.8, equivalent JIS SCM435Q. The drawing was JIS B1180/M16/50 (refer to page 3, Annex Table 2.2, Medium and Small Hexagon Bolt Display, arrow mark). It required a high-tensile metric fine threaded head bolt with a nominal 16mm diameter, commonly referred to as an M16X1.5X50, with a grade 8.8 property class.

• The nut material was JIS6, equivalent JIS SCM435. The drawing was JIS B1181/M16 (refer to page 4, Attachment 3 - Shape and Dimension of Style (Part grade A) Shape, size arrow mark and circle). It required a high-tensile metric fine thread M16X1.5 hexagon nut. See NTSB Materials Laboratory Factual Report, No. 17-008, Table 2, fastener data.

• The blank flange material was JIS SS440. The drawing was JIS B2220/10k-50/BL (refer to page 1, Appendix Table 2-3, Nominal Pressure 10K Closed Flange (BL) Horizontal, arrow mark). See NTSB Materials Laboratory Factual Report, No. 17-008, page 3, paragraph 3.

• That spring washer material was SWRH62. The drawing was JIS B1251/16/2 (refer to page 5, arrow mark). See NTSB Materials Laboratory Factual Report, No. 17-008, Table 2, fastener data. No spring washers were present in the assembly of the fuel oil pipe flange and blanking plate on the *Caribbean Fantasy*.

• The packing (gasket) material was VALQUA V#6500 (non-asbestos joint sheet). The drawing was D456500-50-t2 (refer to page 2, arrow mark). See NTSB Materials Laboratory Factual Report No. 17-053.

There was no inspection or lifecycle management of the gasket material for any of the main engine fuel supply and return lines, Gaskets were only being replaced after failure.

[22] International Safety Management (**ISM**) Code, Section A-10, The Company should establish procedures by which the ship's personnel receive relevant information on the SMS in a working language or languages understood by them.

The motorman and first engineer did not use a torque wrench to tighten the SME fuel oil supply flange after replacing the gasket.

9.5 Oil Fuel Lines and Splash Guards

IMO SOLAS Chapter II-2, PART B (Prevention of fire and explosion) Regulation 4, titled Probability of ignition, paragraph 2.2.5.3 states that oil fuel lines shall be designed to assure that they are sufficiently separated from hot surfaces, electrical installations, or other sources of ignition and shall be screened or otherwise suitably protected to avoid oil spray or oil leakage onto possible ignition sources. The purpose of Regulation 4 is to prevent the ignition of combustible materials or flammable liquids. Per Regulation II-2/4.2.2.5.3 (SOLAS Consolidated Edition 2001), ships are required to apply proper protection systems to prevent leakage and splashing of flammable oils from FO, LO and other piping. Vessels constructed before July 1998 shall comply with the requirement no later than July 1, 2003.

MAN Diesel & Turbo SE developed and distributed a Customer Information letter, CUS 321, in February 2013, titled: *Splash Guard, Instruction for correcting guarding*. The letter informed owners of the above mentioned SOLAS requirement and offered solution packages from MAN approved providers. The customer information letter was sent on March 11, 2013, via mail to Baja Ferries in Mexico.[23] Baja Ferries Designated Person Ashore (DPA) stated that the company did not receive the customer information bulletins in January of 2017. The DPA provide MAN party representative the email addresses of the individuals within Baja Ferries, S.A. de C.V. who should received these bulletins.

Several engineering crew members told investigators that the fuel oil supply end flange was wrapped with SOLAS approved spray tape. The multilayer tape composed of aluminum, glasscloth, and a polyethylene terephthalate (PET) Liner with special adhesive was designed to to mitigate the risk of fuel spray on surface temperatures greater than 220°C. During the post-casualty inspection of the engine room, investigators discovered several areas of inadequate installation of anti-splash/anti spray tape on the PME and SME fuel oil piping flanges and connections. Only one layer of tape was fitted around the fuel oil flanges and connections. List below in figure 17, is the fuel oil supply and

[23] Caribbean Fantasy MAN Turbo Documentation of Customer Information Letters Distribution Email, February 1st 2017.

return lines to cylinder no. 8 fuel pump. The supply line flange on the left has one layer of spray tape. The return line on the right does not have spray tape installed on flange.

The DPA during an internal inspection which started in Tunisia shipyard developed an internal punch list in July of 2016 of discrepancies and areas to focus on prior to the vessel's port state control inspection. An updated punch list, table 1 listed below was distributed to senior crew members and the DPA on August 7, 2016. Among the items listed as pending or in progress included:

3.10	Restore missing insulation in exhaust pipes both engines.	In progress
3.11	Restore anti splash tape to flanges of FO and LO pipes	In progress
3.13	Fuel Oil pipes fwd of Port Main Engine. Insulation soaked with FO	Pending
3.25	Valves of FO, ULSO, LO. Test remotely from all operable locations, including ventilation emergency stops outside of Chief Engineers cabin.	Pending

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Pos.	Found	Actions	Responsibile
2.3	Sounding pipes. Remove hold backs, close valves, install caps. Always keep closed.	Pending	
2.4	Clean and secure floor plates with bolts	In progress	
2.5	Intermediate shafts bearings. Some thermometers in wrong position, can't be read. Install properly	Pending	
2.6	Equipment to be cleaned	Pending	
2.7	CPP Room, emergency escape. There is water in floor. Source?	Pending	
3.0	**Main Engines space**		
3.1	Separator Oil DB Tk. Install man hole cover	Requested to do immediately. Done. Risk of fire	
3.2	Bilges. Remove garbage, remove oil, clean. This can lead to a detention from USCG	In progress. There is Fuel-Oil-Water in bilges starboard side in way of boiler and hot well	
3.3	Sounding pipes. Remove hold backs, close valves, install caps. Always keep closed.	Pending	
3.4	Clean and secure floor plates with bolts	In progress	
3.5	Camshaft vibration damper of Stbd Main Engine is removed and laying aside of ME. Suggest to remove from Engine Room.	Pending	
3.6	A/C sea water cooling pump with heavy SW leak	Done	
3.7	Main Engines FW cooling Temperature controller without glass cover.	Done	
3.8	Installation at Starboard side from LO purifiers with mud, rust. To be cleaned and improve image.	Pending	
3.9	Ballast system. Butterfly valve Discharge overboard. Original with actuator, replaced with butterfly valve hand operated. Same as per 1.3	Pending	
3.10	Restore missing insulation in exhaust pipes both engines.	In progress	
3.11	Restore anti splash tape to flanges of FO and LO pipes	In progress	
3.12	Fuel injection pumps. Clean HFO. Eliminate leaks	Done. To be tested	

Table 1. *Caribbean Fantasy*'s internal discrepancy list, update 7 August 2016.

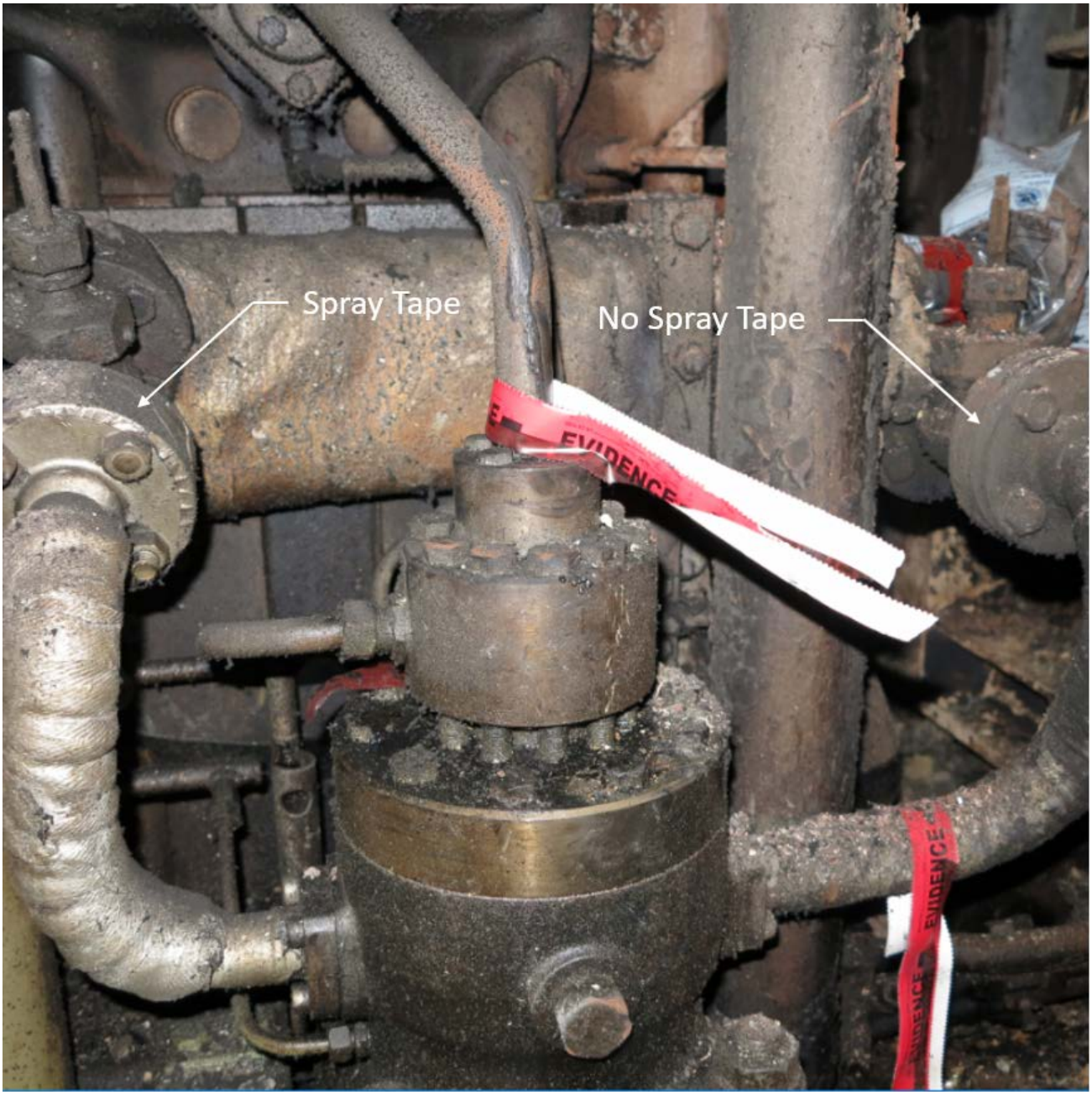


Figure 17. *Caribbean Fantasy* PME fuel oil supply and return line flanges on cylinder no. 8 near the drive (coupling) end, lower left control side where the fuel injection pumps and the camshaft are mounted (opposite to the exhaust manifold) after the fire. Photo illustrates the limited application of spray tape.

The photograph in figure 18 below is *Caribbean Fantasy*'s PME fuel oil supply and return line flanges with blanking plates, located near the lower left (control side) of the Mitsubishi MAN B&W engine (viewed looking forward while standing at the drive [coupling] end where the injection pumps and the camshaft are mounted, opposite to the exhaust manifold). The photo shows one layer of spray tape on the fuel oil supply line flange and blanking plate, the source of the fuel leak. Red arrows

depicting the direction of fuel oil spray in the direction of the exhaust manifold and turbocharger, as reported by the chief engineer during his interview with investigators.

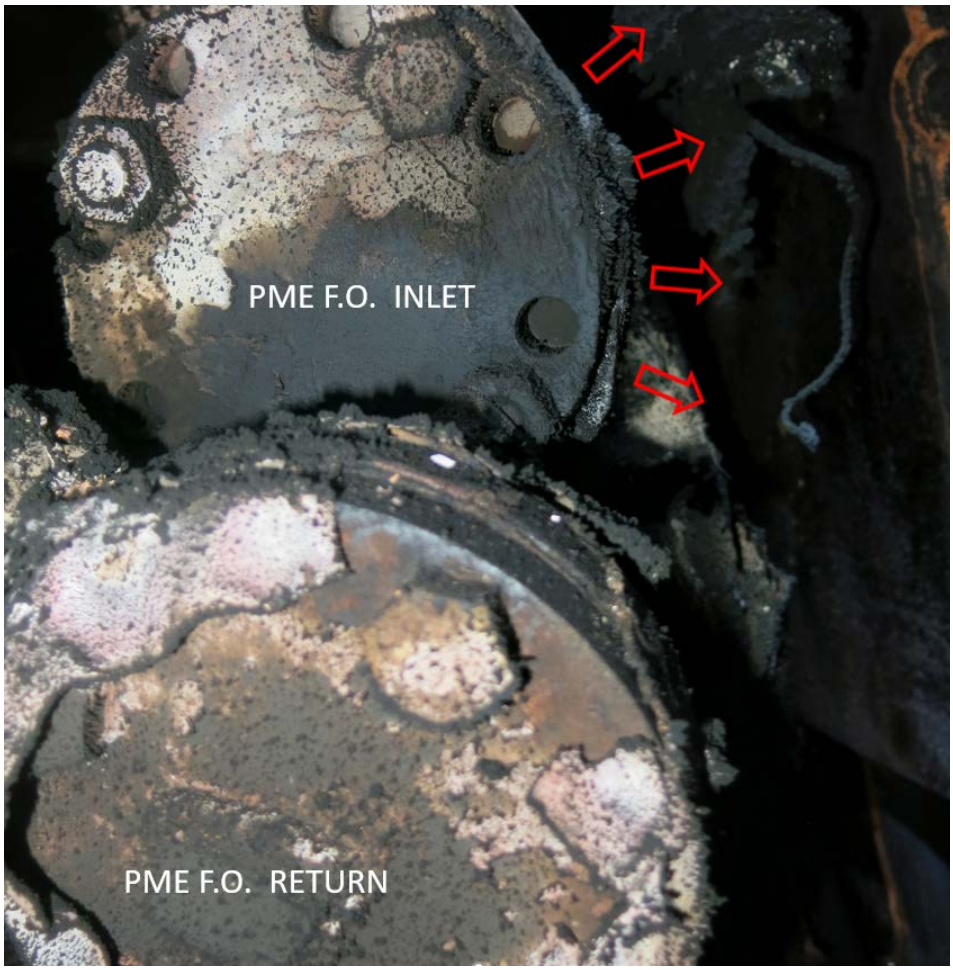
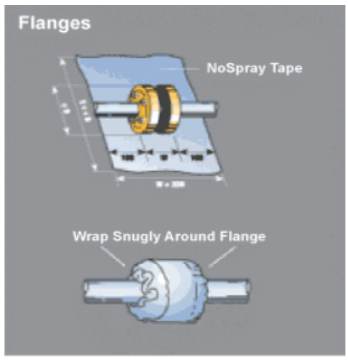


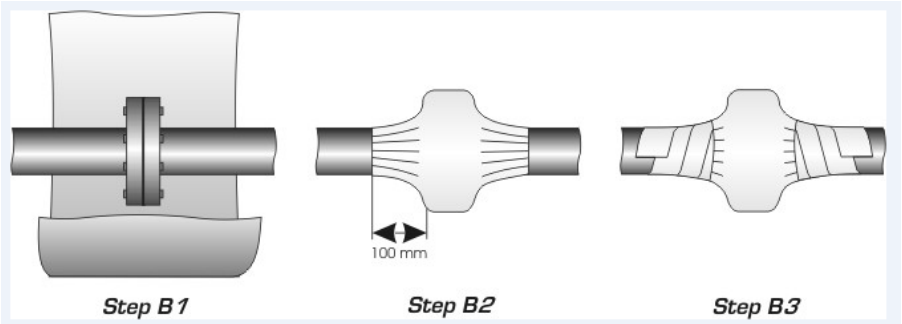
Figure 18. *Caribbean Fantasy* PME fuel oil supply and return line flanges and blanking plates near the drive (coupling) end, lower left control side where the injection pumps and the camshaft are mounted (opposite to the exhaust manifold) after the fire. Photo illustrates the degraded spray tape at the source of the fuel leak. Red arrows depict the direction of fuel oil spray. Photo was taken prior to as found on August 24, 2016 once the engine room atmosphere was cleared as safe for investigators to enter.

Several anti-spray tape manufacturers' installation instructions were reviewed by investigators. These instructions are provided in figures 19-21.



NoSpray® Protective Tape

NoSpray®
Protective Tape



Application Instructions

1.) Be sure that all surfaces to be protected are cleaned and free of oil.

2.) Select the NoSpray Tape format applicable to your installation, and, with adhesive film in place, cut with scissors as follows:

For Pipes and Joints

Use NoSpray Tape and allow overlap of 50% each turn.

For Valves, Flanges, and other irregular shaped equipment

Use NoSpray Sheet and cut one piece:

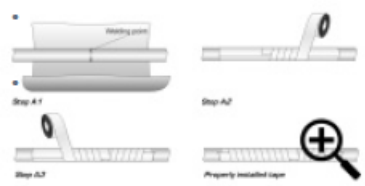
- Length to wrap 2 layers thick around surface to be protected.
- Width to be enough to completely cover bolts and overlap onto connecting pipe at least 100 mm (4").
- Special care must be taken where a device such as a valve is connected to the pipe being wrapped. In this case, the NoSpray Tape must be wrapped around the attached device as well as the pipe.
- When using NoSpray Sheet, apply NoSpray Tape on top of the sheet overlapping 50% to secure the NoSpray Sheet.

3.) **Important Tip:** When applying NoSpray Tape, be sure to wrap loosely to allow free flow of oil leak. DO NOT WRAP TIGHTLY.

Figure 19. Insulmastic NoSpray protective tape installation instructions. (Source: www.insulmastic.com/index.php/products/marine-division/15-nospray%C2%AE-protective-tape.html)

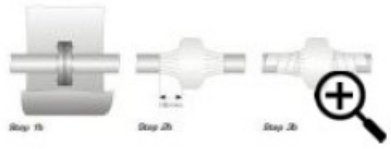
ANTISPRAY TAPE - INSTALLATION INSTRUCTIONS

When installing on welded pipes



The risk-point should be covered with a double layer of wide sheet of the MF 01 tape (Step A1).
Next - the separate pieces of the 35 mm or wider tape should be installed from the central point to the both sides in a spiral motion which will enable to direct the leakage beyond the installed tape. Each separate layer should overlap the preceding one at least by 50% (Step A2 and A3).

When installing on Flanges, Valves and other specially shaped equipment



- It is advisable to use the MF01 material available in wide rolls with its width corresponding to the dimension of the protected element (Step B1).
- When installing the tape on flanges its width should cover the entire surface of the flange and a minimum of 100 mm on both sides of the pipe joint. This is required to ensure enough adhesive surface strength in case when high pressure expands installed material. (Step B2).
- The length of the material should be selected in such a way as to ensure that the areas where the tape is applied are covered by at least two layers of the tape.
- Next - the separate pieces of the 35 mm or wider tape should be installed from the central point to the both sides in a spiral motion which will enable to direct the leakage beyond the installed tape. Each separate layer should overlap the preceding one at least by 50% (Step B3).
- In cases where the protected pipe is directly connected to a valve, the valve should also be entirely wrapped in the Antispray MF01 material keeping in mind that two layers of tape should be applied.

Additional instructions

- Prior to installation it is advised to create an oil path on the surface. This procedure is supposed to make it easier for the leakage to find its way out along the pipe. The installed tape will create a very strong tunnel around the protected area, while the oil path would easily lead the leakage to the intended place.
- The installed MF01 cannot have any mechanical damages visible on the surface. If there are any damages noticed on the surface the MF01material should be replaced with a good one.
- The MF01 material can be cut with the use of scissors or a sharp blade. During the installation the liner should be released gradually while making sure that the adhesive layer does not get soiled which could result in it losing some of its adhesive qualities.
- The MF01 tape should be installed in accordance to the direction in which a potential leak can occur. The protected area should be long enough for the tape to end in a place where there is no danger of leakage of substances onto a hot surface.
- To remove the tape it is the best to use pliers or a sharp blade.
- The tape which has been removed cannot be used again.
- Do not wrap too tightly. Tape should be loose enough to allow for free oil flow.

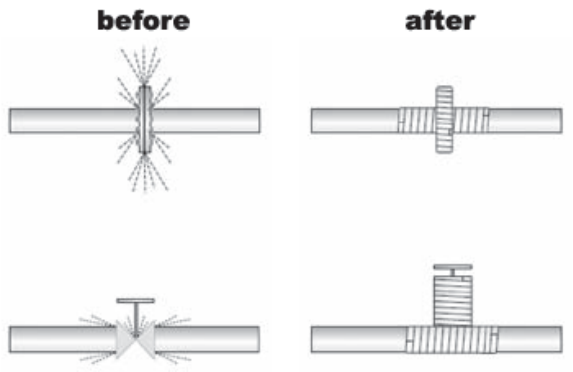
Figure 20. Mareflex anti-spray tape installation instructions. (Source: http://www.mareflex.com/anti-spray-instruction.php)

W&O SprayStop

SprayStop — SPRAY PROTECTION TAPE

Spray-Stop is a superb anti-splash and -spray tape for a wide range of applications. Designed by experienced safety specialists, this high-tech laminated, multi-layer aluminum tape prevents spray-outs of hot or hazardous liquids from piping systems. Spray-Stop can help prevent fires, explosions or other potentially catastrophic mishaps. According to the SOLAS amendment chapter 2-2 regulation, ships are required to apply proper protection systems to prevent leakage and splashing of flammable oils from FO, LO and other piping. Spray-Stop is an excellent choice for this and complies with IMO A653 (6) regulations.

APPLICATION



SPECIFICATION

Multilayer Aluminum/Glasscloth/PET Liner with special adhesive
1 Color printed with logo "Spray-Stop" and T-iss

Temperature: -70° ~ 200°C above
Adhesion: 1000g above; 25mm g/f
Shelf Life: Minimum 3 years when properly stored
Approved: ABS, Bureau Veritas, DNV, GL, Class NK
KR, LR under construction

DIMENSION

Width	Length	Rolls/box	Impa No.
1.000 mm	10 meter	4/box	87 18 06
500 mm	10 meter	9/box	87 18 05
250 mm	10 meter	20/box	87 18 07
140 mm	10 meter	30/box	87 18 03
100 mm	10 meter	30/box	87 18 04
50 mm	10 meter	50/box	87 18 02
35 mm	10 meter	50/box	87 18 01

USAGE

Maximum Temperature 150° C & 300 PSI

- Fuel oil injection pipes, fuel oil service pipes, fuel oil valve cooling oil pipe attached to diesel engines
- Lube oil service pipes and hydraulic oil pipes attached to diesel engines
- Flammable oil pipes
- Flammable oil pump and strainer
- Fuel oil heater
- Lube oil heater and cooler
- Fuel oil purifier – Lube oil purifier
- Fuel oil burning unit for boiler, thermal oil heater, inert gas generator and incinerator
- Level gauge, fittings and oil tray of flammable oil tanks
- Sounding pipe head of double bottom fuel oil tank
- Special pipe joint (threaded pipe joint, compression fitting joint, etc.) and expansion joint in the oil piping

The preceding areas of fire risk should be protected from the following sources of ignition:

- Exhaust gas pipe
- Steam pipe
- Turbo charger
- Electrical equipment
- Boiler, thermal oil heater, incinerator
- Welding spatter, cigarettes, etc.

INSTALLATION GUIDE

1. Cut tape to the right length before placing. The length should be a little longer than needed. Leave the back layer of the tape on. Clean the site where the tape will be installed.
2. During the installation to the site, gradually peel back the backside of the tape. Do not remove the backside layer completely before the installation because oil, spills, dust can cause adhesion problems.
3. If you have to install the tape at a place where there is no smooth surface, wrap tape two (2) or more times around the pipe or equipment in order to protect against splashes.
4. During the installation, continue to wind the tape making sure to cover a minimum of 1/3 of the former area of the installed tape. You do not need extra force for the application of the tape; however, a little pressure by hand will not harm the installation.
5. Use a knife or scissors to remove SprayStop tape. Removed tape cannot be reused!
6. Punch a drain hole in the tape after installing. Note: Tape is not a seal for leakage.

Amended SOLAS regulations of IMO, International Marine Organization, has been executed since July 1998 and the provision of II-2/15.2.11, for new ships with more than 375 KW output power, has been obliged to treat to prevent outbreak of splashing of flammable fluid from piping which contacts on high temperature surface of exhaust pipe or other mechanical portion when a pipe joint, a valve, a pressure gauge or a joint for auxiliary components becomes loose due to vibration, fatigue, deterioration of materials, excess tension or when a pin hole or a crack is formed in the pipe itself or when a welder portion is broken or when the attachment of a device to the piping become incomplete.

Running vessels constructed before July 1998 shall comply with the requirement of it not later than July 1, 2003.

1-800-962-9696
wosupply.com

Figure 21. W&O SprayStop anti-spray tape installation instructions.

9.6 SOLAS Requirements for Machinery Surface Temperatures Greater than 220 °C

In accordance with the 2001 consolidated edition of SOLAS provisions, it was required that all ships' engines be retrofitted no later than July 1, 2003, with insulation and thermal protection for:

- Surface temperature greater than 220 °C
- Splash protection at the flanges of pipes for combustion fluids in low-pressure areas.

As a result, MAN B&W Diesel developed and distributed a Customer Information letter, CUS 195 in May 2003 for 58/64 engine series owners. The bulletin, titled *SOLAS Requirements for 58/64 Engine Series,* informed owners of the Regulation II-2/4.2.2.5.3 (SOLAS Consolidated Edition 2001), requirements and offered solution packages for MAN B&W diesel engines to meet the requirement specified in the SOLAS provision.

The manufacturer indicated that engine surface temperatures greater than 220 °C (428 °F)—commonly referred to as "hot spots"—could occur in the regions of the indicator valves, turbocharger, exhaust insulations, bypass flaps, and wastegate devices on the 58/64 series engines. Many classification societies recommended that a thermographic analysis be conducted on board vessels in order to locate the relevant hot spot areas.

The Customer Service letter recommended the following,

Regarding hot spots; examine all heat sources particularly with respect to engine exhausts. Owners and operators should look closely at these areas where exhaust piping lagging and casing covers meet. Numerous fires onboard vessels have occurred in these areas. Ensure all insulation, blankets, and lagging are maintained and kept clean and properly secured. Look for areas where released fluids (flammable sprays) may make contact with hot surfaces. Check that spray shielding and anti-spray tape is kept in place. Follow the manufacturer's application instructions for the proper installation of anti-spray tape around fuel pipe connections, gasketed flanges, and valves. Periodic inspections must be carried out in areas applied with anti-spray tape. Unravelling, curling, loosening or cracking indicates tape on the applied area must be replaced.

MAN B&W Diesel, as well as several other marine engine manufacturers, provided on-board thermographic analysis services in order to assist the owners and operators. However, there is no indication that a thermographic analysis was conducted on board the *Caribbean Fantasy*. Of note, no thermographic analysis was conducted after the major overhaul of the main engines at the shipyard in Tunisia. It is not uncommon for lagging and insulation be removed to access specific components of the engine and for existing lagging to be reused on the main engine as was with this overhaul.

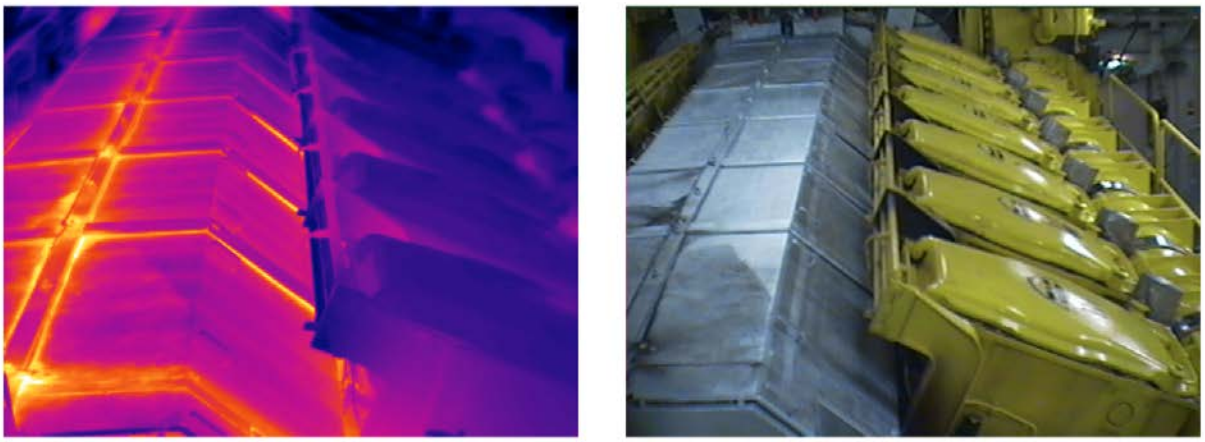


Figure 22 MAN B&W customer service bulletin thermal imagery of the first version of a V-type 48/60 engine. The cylinder covers and exhaust insulation is similar to the main engines on the *Caribbean Fantasy*.

According to the VDR, the ship lost main electrical power at about 0817 indicating there was fuel and the auxiliary generators up until that point. Once power was lost, the crew members and shore-based fire fighters recalled hearing the EDG running and providing emergency lighting and power as designed. This was also evident when lifeboat no. 3 was hoisted back from the water before it tripped because of the weight of the boat full of people. According to the salvage and marine firefighting (SMFF) team that arrived on board the *Caribbean Fantasy* the next day, the EDG was not running when they arrived on board. They did however start it and use it as a source of power and noted that it ran fine with no problems.

9.7 Exhaust Insulation

Investigators discovered several areas where exhaust pipe insulation was severely degraded, exposing the hot exhaust pipe manifold where the average temperature range is between 400 and 450 °C (752 and 842 °F). The vessel was operating on MGO when the fire occurred and for over 7 hours prior. The auto ignition temperature for MGO is 257 °C (495 °F). When MGO makes contact with a heated surface that is above 495° F, ignition can be instantaneous.

Figure 23. *Caribbean Fantasy*'s main engine exhaust trunk with degraded insulation and exposed exhaust manifold pipe. Post accident photograph of the inboard inlet side of the exhaust pipe before the turbo taken from the PME drive (coupling) end.

Figure 144. *Caribbean Fantasy*'s port turbocharger casing and exhaust manifold. Dark residual oil coats the forward inboard side of the turbocharger casing and exhaust manifold lagging. Postaccident photograph taken from the inboard side of the PME.

Figure 15. *Caribbean Fantasy*'s PME exhaust trunk manifold and turbocharger casing. Dark residual oil coats the forward inboard side of the turbocharger casing and exhaust manifold lagging. Post-accident photograph taken from the centerline of the main engine room (inboard side of the PME).

Figure 26. *Caribbean Fantasy*'s PME cylinder no. 8. Post-accident photograph taken from the centerline of the main engine room (inboard, exhaust manifold side of the PME).

Figure 27. *Caribbean Fantasy*'s PME photograph taken prior to the shipyard from the forward end of the engine's centerline in the aft direction (inboard, exhaust manifold side of the PME).

10 Documentation and electronic evidence

NTSB and Coast Guard investigators requested and reviewed *Caribbean Fantasy*'s last 6 months of preventative maintenance and repair reports for the main engines, propulsion, generators, and steering systems. The Coast Guard also took custody of the work computers from the chief engineer, engine storekeeper, safety officer and engine control room for analysis.

At the time of this factual reports release, VDR parametric data was not completed nor release to the engineering group or group chairman.

The last record of reported maintenance was completed in March 2016, prior to entering the shipyard. The technical manager stated that during the requested time period the corrective and preventive maintenance was performed and completed during the vessel's intermediate survey in Tunisia and most of the jobs had been performed. The technical manager provided several shipboard

reports to the investigators to review. All shipboard reports provided to investigators appeared to meet maintenance and record keeping requirements for the main engine.[24]

The first engineer kept a daily log (notebook) of corrective maintenance, work items and tasks performed by his department. The notebook was the only record of corrective maintenance tasks perform onboard under the direction of the first engineer. Corrective maintenance records were not entered into the automated preventative maintenance system. Safety management system (SMS) procedures were not established onboard to document and record corrective and preventative maintenance work performed by the crew.

Investigators recovered a closed-circuit TV (CCTV) digital video recorder (DVR) from the engine control room. The recorder was capable of recording multiple video channels on board. When accessed, only two channels were found to have worked which was the external view of the ships stacks. The video ended at 07:38:40. The DPA stated the intention of the system was to only give the engine room crew a view of the engine exhaust stacks."

Figure 28. ECR CCTV view of the port and starboard stacks. The left frame shows the initial signs of black smoke from the port funnel at 0728 local time. Note in the foreground, a crew member is in process of moving one of the dogs from the kennel on this deck (deck 7) forward in preparation for debarkation. On the right, about one minute later, smoke can be seen emitting from starboard stack. The video at that point also showed the ship in a turn to port.

Investigators recovered what appeared to be a recently installed alarm system for the generators and main engine room alarms. One SIMATIC human machine interface (HMI) comfort panels and indication displays were located in ECR. According to the technical manager, this was installed in the shipyard in Tunisia with the intention of replacing obsolete hardware but at the time of the fire, the

[24] Technical Manager email, "Re: Caribbean Fantasy Technical Drawings / Manuals / Records Request," Wednesday, November 30, 2016, 9:35:42 AM

system was not fully functional and as such no alarm history or event logger data was recovered from the ECR.

11 Engineering Department Organization and Crew Information

The *Caribbean Fantasy*'s engine department consisted of 27 crew members representing 7 different nationalities: Guyana 3, Guatemala 3, Honduras 12, Philippines 2, Poland 5, Slovakia 1, and Ukraine 1. The senior engineering licensed officers, the chief engineer, the first engineer, and second assistant engineer, were all from Poland.

One second engineer and two third engineers stood watches in the main engine room and worked the traditional watchkeeping periods on a 4-hour rotation. One second engineer stood watch from 0000 to 0400 and 1600 to 2000, and one third engineer stood the 0800 to 1200 and 2000 to 0000 watches with the other third engineer standing the from 0400 to 0800 and 1600 to 2000 watch.. Normally, two motormen were also assigned to each watch and carried out routine inspections, maintenance, and rounds in engine spaces. However, just prior to the accident, one of the Caribbean Fantasy's six motormen signed off the ship, and his position on the 0400 to 0800 watch was filled by a wiper. The watchkeeping engineers and motormen also had 1 hours of non-watchkeeping duties for a total of 9 hours of daily work while at sea and in port. The remainder of the engineering staff performed day work (non-watchkeeping duties) from 0700 to 1200 and from 1300 to 2130 for a total of 13 hours of daily work while at sea or in port.[25]

The engineering department day workers included the chief engineer; the first engineer; the A/C manager and an A/C engineer; the chief electrician and an electrician; the plumber and two assistant plumbers; a storekeeper; a fitter; a senior motorman; five wipers; and a donkey man.

Investigators were not provided official time cards or records from the owner/operator to verify the work/rest history for the 96 hours prior to the accident to evaluate fitness for duty and fatigue management in accordance with the IMO Seafarer's Training, Certification, and Watchkeeping (STCW) code and International Labor Organization (ILO) Maritime Labor Convention (MLC).[26]

[25] Baja Ferries, S.A. de C.V., "Record of Seafarer's Scheduled Working Arrangements, August 2016," Form C630 A, version 1, issued January 2014.

[26] The STCW code Section A-VIII/1, "Fitness for duty," states, that each officer in charge of a watch or rating forming part of a watch shall be provided with a rest period of not less than a minimum of 10 hours of rest in any 24-hour period and 77 hours in any 7-day period. The ILO MLC states that (a) maximum hours of work shall not exceed: (i) 14 hours in

During the Tunisia shipyard period, a new crewing management company, Midocean replaced Ship Supply of Florida Inc. Midocean is a subsidiary of Peter Dohle and proved the new engineering crew who possessed roll-on and roll off (ro-ro) and ro-pax vessel technical knowledge. The master was the only crewmember directly employed by the owner. Because the owner had changed the crewing agency, several of the senior engineering officers were new to the *Caribbean Fantasy* and had been rotated in during the time the vessel was in the shipyard. Table 2 below is a crew list by position, with the sign on date and number of months on board for the crewmember filling the position. The chief engineer, first engineer, and third engineer had only worked on the vessel for 1 month. The remaining officers had less than 1 week onboard. The previous regular chief engineer spent also from July 17, 2016 up to Aug 11, 2016 as part of the familiarization process of the new chief engineer.

any 24-hour period; and (ii) 72 hours in any seven-day period; or (b) minimum hours of rest shall not be less than: (i) 10 hours in any 24-hour period; and (ii) 77 hours in any seven-day period.

Position	Sign on Date	Approximate Months Onboard
Master	5-Aug-16	Less than 2 weeks
Staff Captain	1-Jun-16	2
Safety Officer	31-Oct-15	9
Second Officer 04-08	8-May-16	3
Second Officer 00-04	13-Aug-16	Less than 1 week
Third Officer 08-12	21-Jun-16	2
Deck Cadet	1-Jul-16	1
Assistant. Bosun	3-Jun-16	2
Chief Engineer	17-Jul-16	1
1st Engineer	26-Jul-16	1
2nd. Engineer	6-Aug-16	Less than 1 week
3rd Engineer	17-Jul-16	1
3rd Engineer	13-Aug-16	Less than 1 week
Storekeeper	11-Jun-16	2
A/C Engineer	28-May-16	3
A/C Mechanic	13-Aug-16	Less than 1 week
Electrician	11-Jun-16	2
Asst. Electrician	1-Jun-16	2
Plumber	14-Nov-15	21
Asst. Plumber	10-Jun-16	2
Asst. Plumber	31-May-16	3
Donkey Man	17-Oct-15	22
Senior Motorman	19-Dec-15	20
Motorman	29-Jun -16	1
Motorman	26-Jun -16	1
Motorman	16-Jan -16	7
Motorman	8-May-16	3
Motorman	7-Nov-15	21
Motorman	16-Aug-16	Less than 1 week
Engine Fitter	16-Jan-16	7
Wiper	14-Jan-16	7
Wiper	14-Jan-16	7
Wiper	11-Aug-16	Less than 1 week
Wiper	11-Aug-16	Less than 1 week
Wiper	11-Aug-16	Less than 1 week
Hotel Director	16-Jun-16	2
Chief Purser	19-May-16	3

Table 2. *Caribbean Fantasy*'s engine department and key deck and hotel position sign on dates and months on board. (Source *Caribbean Fantasy* IMO crew list dated August 16, 2016)

When they joined the vessel, the chief engineer and first assistant engineer did not receive proper handover notes as required by the company's SMS.[27] The previous chief engineer and first assistant engineer were released prior to their contract service dates. The owner did not disclose to investigators the reasons for terminating the contracts early.

Investigators reviewed the officers' mariner certificates of competency, endorsements and training. All personnel responsible for the operational control of the main propulsion and auxiliaries systems were in possession of qualifications and certificates issued under the provisions of the STCW code. The number of required engineering personnel specified by the national requirements and international agreements were also met.

Baja Ferries, S.A. de C.V. FLEET OPERATIONS MANUAL VOLUME 2 - TECHNICAL OPERATIONS		
	Section:	205 Caribbean Fantasy
	Version:	1
	Issued (mm/yy):	01/14
	Revision:	0
	Issued (mm/yy):	

5.0 ASSIGNEMENT OF TECHNICAL DEPARTMENT DUTIES AND RESPONSABILITIES

5.1 TECHNICAL DEPARTMENT ORGANISATION

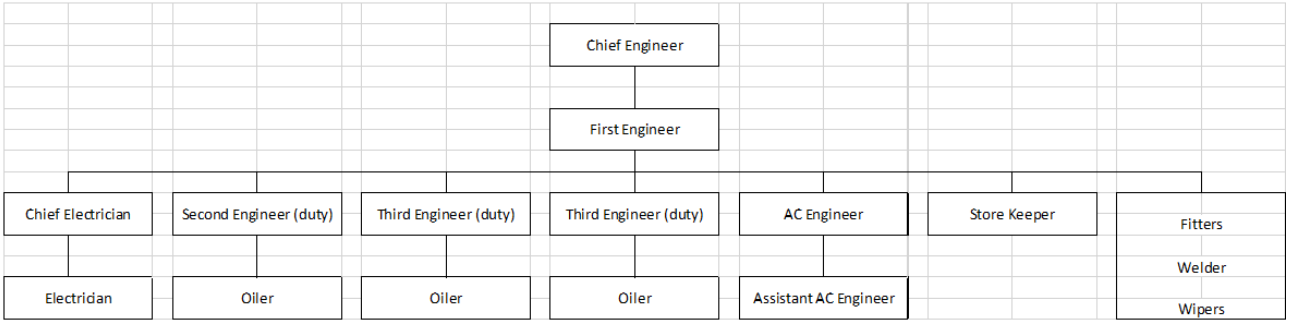


Figure 29. *Caribbean Fantasy*'s engine department organization chart.

The chief engineer reported directly to the master "with functional responsibility to the Managing Director of the Company." He advised the master on all engineering matters and was responsible for the engineering spaces and machinery.[28] However, according to the DPA the chief

[27] Baja Ferries, S.A. de C.V., "Chief Engineer's Handing Over Form," Form OP42, version 1, issued January 2014.
[28] Baja Ferries, S.A. de C.V., *Fleet Operations Manual, Volume 2*, "Technical Operations," Section 202, version 1, issued April 2014.

engineer point of contact with the company was directly with the Technical Superintendent and not the Managing Director.[29]

The first assistant engineer was the chief engineer's deputy. According to the company's SMS, the first assistant engineer was responsible to the chief engineer for the discipline and control of all "Engine Room Staff assigned to the maintenance and operation of the Engine Room."[30]

Specific responsibilities of the first engineer, as laid out in the chief engineer's standing orders, included: emergency diesel generator (EDG) and systems belonging to the EDG, emergency equipment tests and maintenance according to the preventative maintenance schedule (PMS), main engine general adjustments and maintenance, and CO_2 installation maintenance. [31]

12 *Caribbean Fantasy* Arrival Conditions

According to the engine room log book, the last fuel oil accounting was performed on August 11, 2016, at noon. The log book recorded 137,990 long tons (LT) of MGO remained on board while 282,280 LT of HFO remained.[32] The shipboard stability computer, a laptop, was removed from the ship prior to investigators being allowed on board. The DPA stated the salvage teams had access to the ship and its computers before the parties. Salvage team may have taken possession for salvage related work. It was not provided to investigators by the time of this report so that the ships arrival condition and tank soundings taken from the previous day could be compared to them to post accident. Investigators were unable to determine the amount of HFO, MGO, and LO that was potentially released from the port lube oil storage tank, the starboard diesel oil service tank, the starboard fuel oil service tank, and the starboard fuel oil settling tank and consumed by the fire.

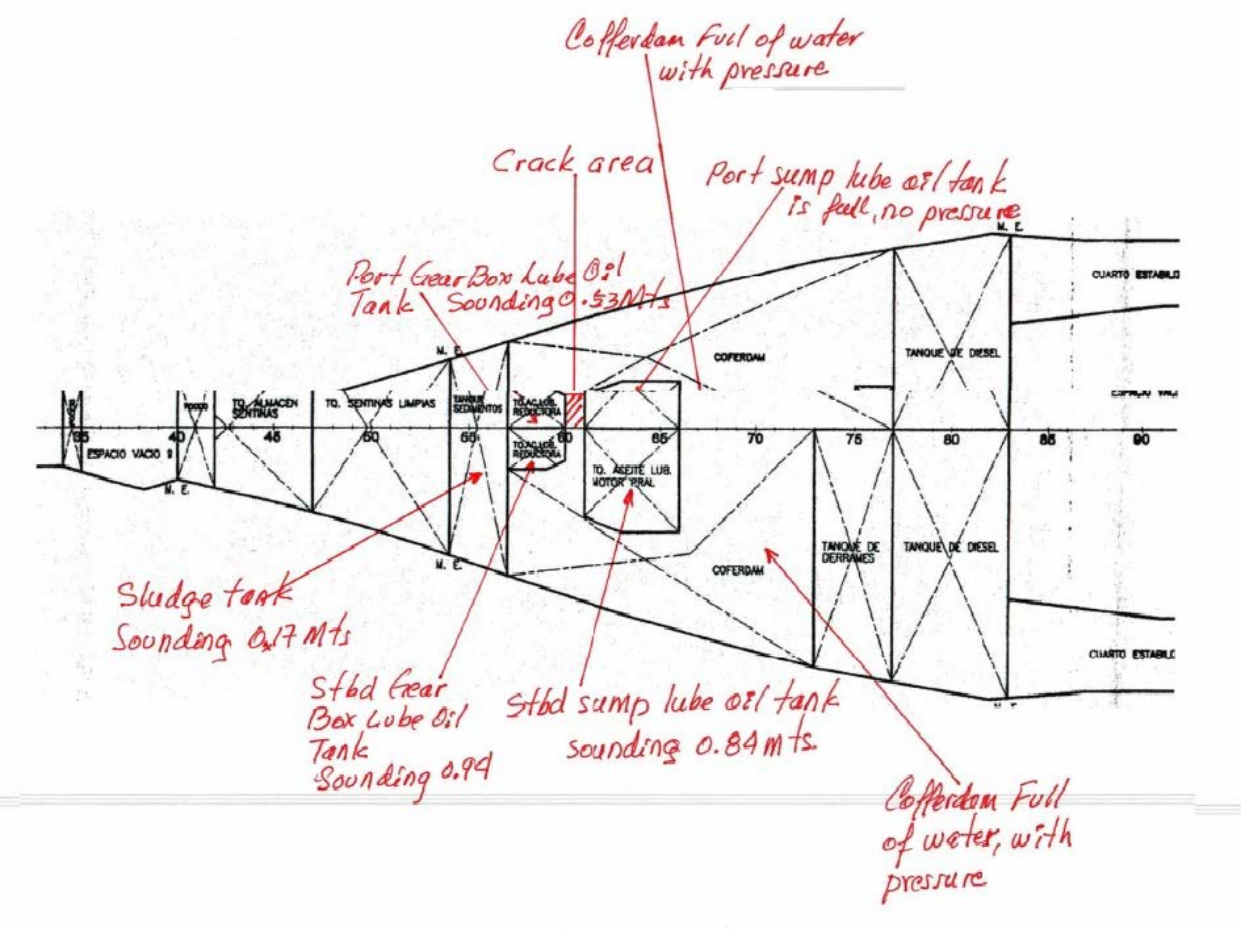
13 *Caribbean Fantasy* Hull Damage

An initial damage assessment was conducted by RINA marine surveyors, an underwater ship repair service provider, and a salvage company. NTSB investigators requested and received final damage surveys, closed conditions of class, service reports, and statement narratives. The scope of this section will be limited to the hull damage below the waterline. See NTSB Materials Laboratory

[29] Party Comment addition from Baja Ferries, S.A. de C.V DPA on 2 March 2018.
[30] Baja Ferries, S.A. de C.V. *Fleet Operations Manual, Volume 2*, "Technical Operations," Section 203, version 1, issued January 2014.
[31] "Chief Engineer's Standing Orders & Engine Department Responsibilities for the First Engineer," signed July 26, 2016.
[32] *Caribbean Fantasy Engine Room Log Book*, FO/DO accounting section, August 11, 2016, pg. 11.

Fire Investigator Factual Report for a list of fire damage by location.[33] The RINA surveyors noted the following damage in reports dated August 24 and September 17, 2016:

> *Caribbean Fantasy* experienced an approx. 750 mm long and 25 mm wide fracture in the bottom plating on the starboard side cofferdam between frames FR60 and FR61. The port cofferdam between frames FR57 and FR77 and starboard cofferdam between frames FR57 and FR73 were full of sea water. All tanks in the vicinity of the fracture were sounded to verify their volume and ensure there was no pressure inside the tanks, an indication of the tank being compromised to sea water entry. The tanks included Starboard and Port Gear Box Lube Oil Tanks, Starboard and Port Sump Lube Oil Tanks, and Sludge Tank.



Location of the Fracture

[33] NTSB Materials Laboratory, *Fire Investigator Factual Report*, No. 17-055.

Figure 30. Modified drawing of *Caribbean Fantasy*'s tank top and the fracture at frames 60-61, illustrated by the red box labeled "Crack area." (Courtesy of Subsea Global Solutions)

END OF REPORT

Luke Wisniewski
Marine Accident Investigator