Marine Safety Investigation Unit

SAFETY INVESTIGATION REPORT

202301/028 REPORT NO.: 01/2024 January 2024

MV *CAPE KORTIA*
Fire in the engine-room, leading to the loss of all power at the port of Rodman, Panama
30 January 2023

SUMMARY

At around 0850 (LT), a wiper noticed a leak of oil on the second platform inside the machinery spaces. Walking closer to investigate, he discovered a fire and smoke over diesel generator no. 4.

By the time the situation was reported to the bridge and the main engine stopped, dense smoke had already dispersed inside the machinery spaces.

Initial attempts by the crew members to apply boundary cooling helped minimise the spread of the fire but not extinguish it. The fire was extinguished after the release of CO_2.

It was determined that the most likely cause of the fire was a weld fracture on the fuel oil system's mixing tank.

MV *Cape Kortia*

FACTUAL INFORMATION

Vessel

Cape Kortia was a 112,836 gt container vessel, owned by Ainsley Maritime Co., and managed by Costamare Shipping Co. S.A., Greece (the Company). The vessel was built by Hanjin Heavy Industries & Construction Philippines Inc., in 2017. Det Norske Veritas (DNV) acted as the classification society as well as the recognized organization, in terms of the International Safety Management Code, for the vessel.

Cape Kortia had a length overall of 330.00 m, a moulded breadth of 48.20 m and a moulded depth of 27.20 m. The vessel had a summer draft of 16.00 m, which corresponded to a summer deadweight of 134,761.40 metric tonnes (mt), and a container carrying capacity of 11,000 TEU[1]. The accommodation block was located towards the forward of the vessel, and the engine-room towards the aft.

Propulsive power was provided by an 8-cylinder, two-stroke, single-acting, slow speed, MAN B&W 8G95ME-C9.5 marine diesel engine, which produced 42,310 kW of power at 76.9 rpm. This drove a single fixed-pitch propeller, enabling *Cape Kortia* to reach a service speed of 22 knots.

At the time of the occurrence, *Cape Kortia* was loaded with 47,691 mt (3,916 TEU) of containerized cargo, drawing an even keel draught of 10.85 m.

Engine-room layout and fire protection

Cape Kortia's engine-room consisted of three platforms, with the main engine fitted on the bottom (third) platform. The engine-room was protected by Class A fire divisions. The machinery fire control station was located above the engine-room, at the upper deck level (**Figure 2**).

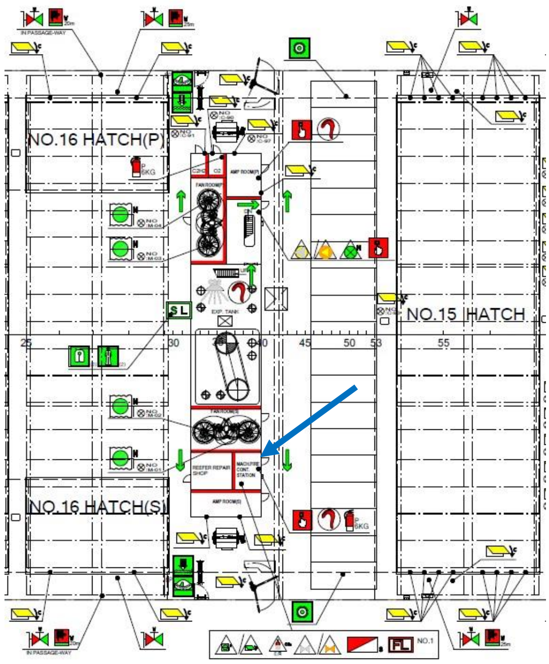

Figure 2: Extract of *Cape Kortia*'s Fire Control and Safety Plan, showing the upper deck level above the engine-room (blue arrow: location of the machinery fire control station)

The engine control room (ECR) was located at the forward, central region of the first platform (**Figure 3**). The medium voltage switchboard (MVSB) room was located adjacent to the port side bulkhead of the ECR, while the duty lounge, followed by the electrical workshop, was located to starboard side of the ECR. The transformer room was located against the port side bulkhead of this platform, aft of the MVSB room, further aft of which was the engine-room store. The first platform could be accessed from the port and starboard side passageways[2].

[1] Twenty-foot equivalent unit.

[2] The engine-room could also be accessed from the upper deck, forward of the funnel casing.

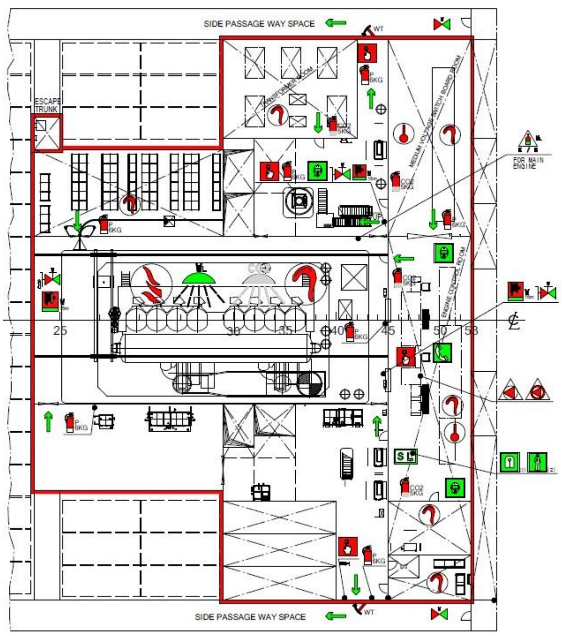

Figure 3: Extract of the Fire Control and Safety Plan, showing the first platform of the engine-room

The engine-room workshop and the four diesel generators (DG) were located on the second platform (**Figure 4**). The DGs were fitted at the forward of this platform, with DG nos. 1 and 2 on the starboard side and DG nos. 3 and 4 on the port side.

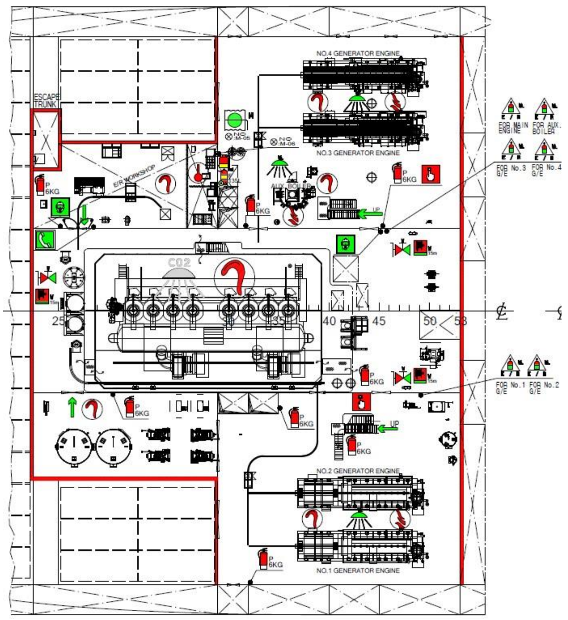

Figure 4: Extract of the Fire Control and Safety Plan, showing the second platform

The emergency generator was fitted on the upper deck level of the accommodation block (**Figure 5**). Another fire control station was located at this level. The fixed, carbon dioxide (CO_2) fire extinguishing system serving the cargo holds and the engine-room[3], was fitted in the CO_2 room below this level.

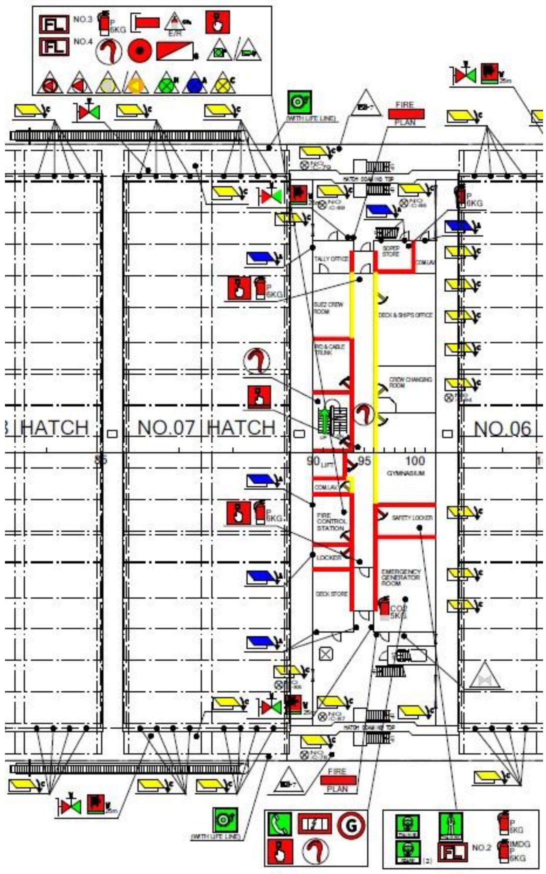

Figure 5: Extract of the Fire Control and Safety Plan, showing the upper deck level of the accommodation block

The CO_2 fire extinguishing system for the engine-room could be activated from the CO_2 room, this fire control station seen in **Figure 5**, as well as the machinery fire control station seen in **Figure 2**.

[3] The CO_2 fire extinguishing system consisted of a total of 654 bottles of 45 kg each, all of which could be used to extinguish a fire in the cargo holds, while 526 bottles could be used for the engine-room.

Crew
The Minimum Safe Manning Certificate of *Cape Kortia* prescribed a crew of 15[4]. At the time of the occurrence, there were 25 crew members on board, comprising of Greek, Romanian, Ukrainian and Filipino nationals, and three security guards of various European nationalities.

The master was a 36-year-old Greek national. He had about 18 years of seafaring experience, all of which were served with the Company. He had three years of experience in the rank of a master with STCW[5] II/2 qualifications. His certificate of competency was issued by the Hellenic Maritime Administration, in February 2020. He had joined *Cape Kortia* on 14 December 2022, at the port of Rotterdam, the Netherlands. This was his second employment term on *Cape Kortia*, having previously signed off from the vessel in July 2022.

The chief engineer was a 45-year-old Greek national. He had about 27 years of seafaring experience, 25 of which were served in the Company. He had 15 years of experience in the rank of a chief engineer with STCW III/2 qualifications. His most recent certificate of competency was issued by the Hellenic Maritime Administration, in August 2020. He had joined *Cape Kortia* along with the master, and this was his third employment term on this vessel.

The second engineer was a 31-year-old Greek national. He had about 11 years of seafaring experience, all of which were served in the Company. He held STCW III/2 qualifications for a second engineer and his certificate of competency was issued by the Hellenic Maritime Administration, in June 2022. This was his first employment term as a second engineer, and he had joined *Cape Kortia* on 03 October 2022, at the port of Southampton, UK. This was his second employment term on *Cape Kortia*.

Environment
The vessel's records indicated that, at the time of this occurrence, the sky was clear, and the visibility was about 12 nautical miles (nm). A moderate breeze was blowing from the North Northeast and the sea state was recorded as 'slight', with no swell. The air and sea temperatures were recorded as 33 ℃ and 28 ℃, respectively.

Pre-accident events[6]
On 30 January 2023, *Cape Kortia* was *en route* to the port of Rodman, Panama. At about 0154, in preparation for the vessel's arrival at the port, the engine-room crew members commenced the fuel oil change-over procedures, from very low sulphur fuel oil (VLSFO) to marine gas oil (MGO), for the diesel generators, followed by the main engine and the auxiliary boiler. The change-over procedures were completed by 0454.

At the end of the vessel's sea passage, at 0600, the main engine was put to stand-by (for manoeuvring), following which, pre-arrival checks and tests were conducted by the crew members.

At 0622, Flamenco Signal Station, Panama, contacted *Cape Kortia* over the VHF radio[7], with instructions to drift at a bearing of 112° and 4.0 nm from Flamenco Island Lighthouse.

At around 0654, the vessel arrived at the location and commenced drifting, following

[4] Provided that the unmanned machinery space (UMS) and the bridge control systems were operational, and at least two deck officers held Global Maritime Distress and Safety System (GMDSS) General Operator's Certificates.

[5] IMO. (2020). *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978* (Consolidated ed.). London: Author.

[6] Unless otherwise specified, all times in this safety investigation report are local (LT = UTC + 8).

[7] Very high frequency, fixed, two-way radio.

which, a Panama Canal inspector boarded *Cape Kortia*. Free pratique was granted to the vessel at 0732 and 10 minutes later, the Canal inspector disembarked from the vessel.

At 0800, following instructions from Flamenco Signal Station, the vessel proceeded towards the Pacific Sea Buoy to receive the pilot for arrival.

Narrative

On 30 January, at 0824, a pilot boarded *Cape Kortia*, and the vessel commenced its approach towards the port of Rodman. All engine-room crew members were present in the engine-room, with the ECR manned by the chief engineer, second and third engineers, the electro-technical officer (ETO) and an oiler.

At about 0845, during a routine round in the engine-room, the second engineer observed oil on the first platform, in the vicinity of the transformer room. He went to the ECR and informed the chief engineer about this matter. The chief engineer telephoned the bridge and informed the master about the leak.

At about 0848, during a separate routine round in the engine-room, the wiper noticed oil on the second platform, in the vicinity of DG nos. 3 and 4. Approaching closer, he observed flames and smoke rising over DG no. 4. While rushing up from the second platform to inform the other crew members, the wiper activated the manual call point of the vessel's fire alarm system (**Figure 6**).

On reaching the ECR, he informed the other crew members of the fire. The chief engineer telephoned the bridge and relayed the information to the master. He also advised the master that the main engine would need to be stopped. The master conveyed the information to the pilot and, after receiving the pilot's confirmation, he stopped the main engine from the bridge.

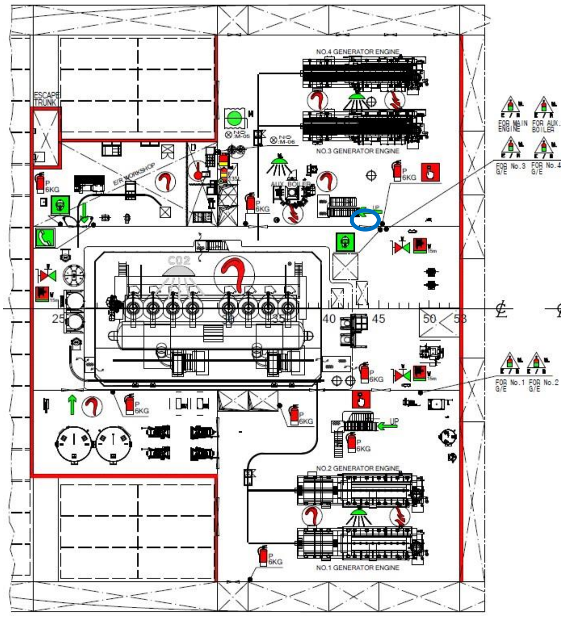

Figure 6: The location of the manual call point (blue circle)

Once the main engine was stopped, the engineers switched off the MGO supply and circulation pumps. As dense smoke had already spread through the engine-room, the chief engineer instructed all crew members to evacuate the engine-room. After evacuating the engine-room, the engineers activated all the emergency stops and quick-closing valves for all engine-room machinery, which resulted in the loss of all electrical power on board. Shortly after, the emergency generator automatically started, thereby supplying power to the steering gear system.

The crew members then prepared and commenced boundary cooling of the engine-room. By 0855, a fire team consisting of the third engineer and an able seafarer – deck, entered the engine-room from the starboard side passageway, to extinguish the fire.

Around the same time, a tugboat each was made fast at the starboard bow and quarter of the vessel, in an attempt to control the vessel's drift towards the pier, where other vessels were moored. However, they were ineffective, and *Cape Kortia* continued drifting towards the moored vessels. Anchor stations were called and soon after, the crew members dropped the port anchor at 0858.

Nonetheless, at 0900, *Cape Kortia*'s starboard bow made light contact with the starboard bow of the Portuguese-registered general cargo vessel, *Ernst Oldendorff*. Both vessel's sustained minor dents and paint scratches due to this allision. At 0906, both anchors of *Cape Kortia* were dropped.

At 0915, the fire team returned from the engine-room and advised the master that the fire could not be controlled. Two additional tugboats arrived at 0920 and were made fast to the vessel.

At 0936, personnel from the local fire brigade boarded the vessel along with the harbour master. Following discussions with the master, it was decided to use the vessel's fixed CO_2 fire extinguishing system. After confirmation from the crew members that all doors and ventilation to the engine-room had been shut, the master instructed the chief officer and the chief engineer to release the CO_2. At 0952, the chief officer and the chief engineer activated the CO_2 system[8].

Between 1024 and 1048, the crew members released both anchors from their bitter ends, to allow for the tugboats to tow the vessel to a nearby, vacant pier. At around noon, the chief engineer and the shore fire brigade confirmed that the fire had been extinguished.

Post-accident events

By 1212, *Cape Kortia* was brought alongside a pier. Confirmation to moor was received at 1418 and the vessel was eventually made fast at 1650. All tugboats were cast off.

Meanwhile, at about 1618, cargo unloading operations had commenced, following which, several shore personnel representing the Company, charterers, Class, insurers, port, local agents, *etc*. boarded the vessel.

Three days later, the engine-room was declared safe for entry. During a thorough inspection of the engine-room, the chief engineer observed that the area outside the transformer and MVSB rooms, as well as the area around DG no. 4 on the platform below, had been affected by the fire. The rest of the engine-room did not show signs of any heat and smoke damages.

Damages

Due to the fire, the following structural damages were observed:

- deformation of the funnel casing on the port side, in line with the 'A' deck of the accommodation;
- deformation of the upper deck plating and associated stiffeners above the engine-room, forward of the funnel casing;
- deformation of the structure of the engine-room access from the upper deck, forward of the funnel casing;
- deformation of the upper deck plating and associated stiffeners above the MVSB and transformer rooms; and
- deformation of the plating between the MVSB and transformer rooms, on the first platform.

Additionally, the following damages were observed in the main electrical power system:

- the ECR and MVSB room were heavily contaminated with soot, CO_2 and acids (**Figure 7**);
- the 440 V and 6.6 kV power cables and other cables passing through the MVSB and transformer rooms, the open spaces on the first platform and the area in the vicinity of DG nos. 3

[8] The crew members stated that the CO_2 had to be released twice to extinguish the fire: first for about two to three minutes and then for about five minutes.

and 4, were completely burnt, along with their cable trays (**Figures 8** and **9**);

- the automation and alarm system cables that passed through the above-mentioned areas were also burnt, due to which, the main engine and auxiliary engines' control and monitoring system and the engine-room alarm system were inoperative;
- DG no. 4 was significantly damaged and was rendered inoperative;
- several lighting fixtures had melted (**Figure 10**); and
- the fire detection and alarm systems were damaged by heat and the fire.

Following the completion of temporary repairs and subsequent sea trials, *Cape Kortia* departed in ballast condition from Rodman, on 16 March 2023. The vessel proceeded to a shipyard in Shanghai, China, for permanent repairs. The vessel eventually resumed trading in May 2023.

Figure 7: The MVSB room

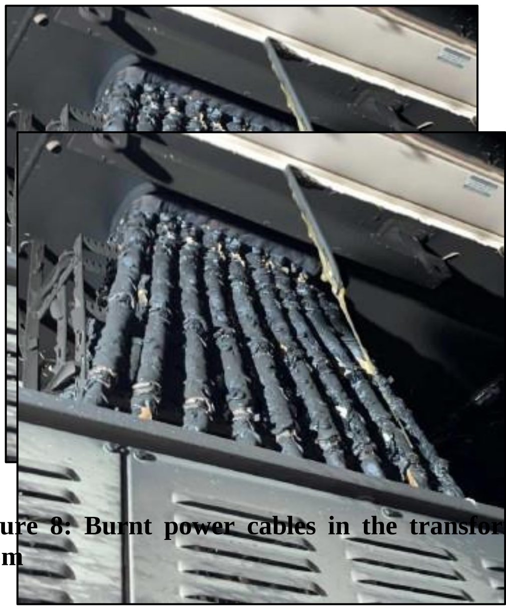

Figure 8: Burnt power cables in the transformer room

Figure 9: Burnt power cables outside the MVSB room

Figure 10: Burnt power cables and a lighting fixture outside the transformer room

Cape Kortia's fuel oil system

The fuel oil system on board (**Figure 11**) was a conventional one, fitted with settling and day tanks for ultra-low sulphur fuel oil, fuel oil and MGO. All tanks, except for the MGO day tank, were fitted with heating coils.

Depending on the choice of fuel, the settling tanks would supply the purifiers. After separation, clean fuel oil is pumped into the day tanks (service tanks), ready for consumption. All tanks were fitted with self-closing drain valves for the draining of water and any accumulated sludge. All day tanks were fitted with non-return valves and the operation of these valves would allow the main engine to be operated on different fuels.

Fuel oil is drawn from the respective day tanks by a fuel oil supply pump through a course filter and discharged into an auto filter at a pressure of about 4.0 bar. The oil is then directed into a flowmeter marine gas oil cooler (which can be by-passed) and into a fuel oil circulating pump.

The oil is discharged at a pressure of about 10.0 bar into a fuel oil heater. Viscosity is controlled by a fuel oil viscotherm which is fitted after a duplex fuel oil hot filter. A pressure regulating valve enables the oil to be either circulated to the main engine fuel oil supply pump or the system's vent pipe (buffer tank). Excess fuel oil from the main engine injection system is also returned to the buffer tank.

The fuel oil system was fitted with several redundancies. Both sets of pumps (supply and circulating) were in duplicate. The main engine fuel oil heater was also fitted in duplicate, together with a by-pass valve which could be used when the heaters were not required (*e.g.*, when the main engine is running on MGO).

The fuel oil auto filters (cold filter) were also fitted with a manual by-pass filter, which allowed for the cleaning / inspection of the auto filters whenever necessary. The system also included several safety devices and venting arrangements.

The vent pipe[9] (highlighted in yellow in **Figure 11**) which is always full, has several functions, including:

- moderates pressure fluctuations;
- minimises the risks of thermal shocks during fuel change over due to different temperatures between fuel oil and marine diesel oil;
- receives excessive fuel (return);
- allows for the gradual variation in fuel quality during the changeover of fuels;
- vents gases from the system;
- prevents vapour locks by venting out any generated vapour; and
- provides the necessary pressure head.

[9] The vent pipe is also known as the standpipe, buffer tank, pig tank, or mixing tank.

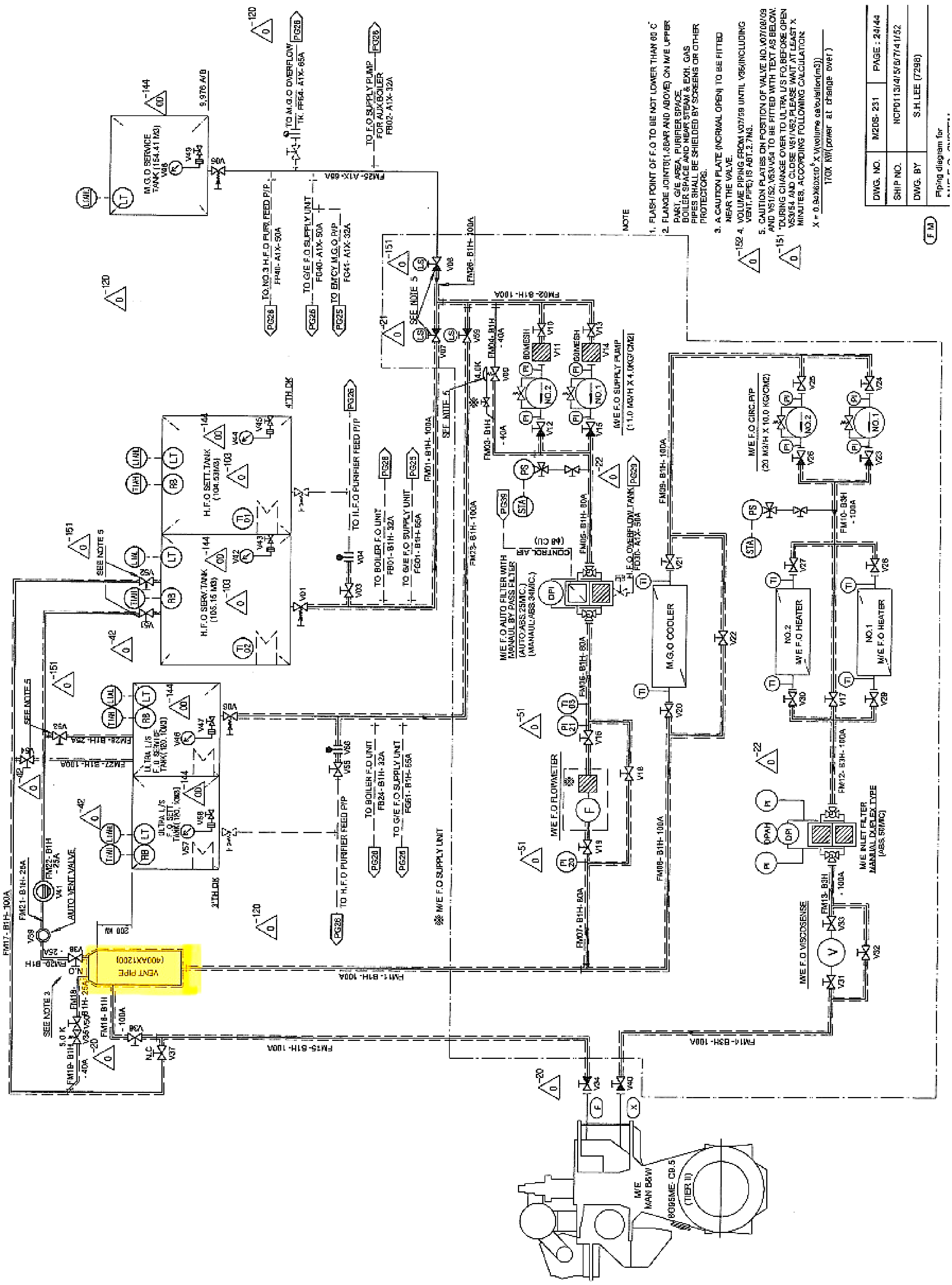

Figure 11: *Cape Kortia*'s fuel and diesel oil system

ANALYSIS

Aim

The purpose of a marine safety investigation is to determine the circumstances and safety factors of the accident as a basis for making recommendations, and to prevent further marine casualties or incidents from occurring in the future.

Fire – fuel and source of ignition

Several days after the fire, when it was safe for the crew members to access the machinery space accompanied by a chemist, damages were observed on the vessel's fuel oil system mixing tank, located high above platform no. 1. It was eventually determined that a failure of the weld seam on the mixing tank caused the leak (**Figure 12**).

Several crew members confirmed that although the leak which they had observed was near DG no. 4, the DG was not the source of the leak. In fact, they also confirmed that the leak was coming from somewhere on the first platform, which was the platform above the generators' platform.

Figure 12: Cracked welding seam on the mixing tank

At the time, however, there was only that much that they could have observed, considering the numerous fuel lines passing through the first platform (and above the generators' platform) to supply the main engine and vessel's auxiliary machinery. One of the crew members, however, did recall that the leak seemed to him to be MGO. At the time of the leak, the vessel was manoeuvring and therefore the main engine was burning MGO, corresponding with the observations of the crew member.

Then, the events developed dramatically fast and within a few minutes from the time the leak was observed, the fire had erupted, and the machinery spaces filled up with intense smoke.

Observed damages to the fuel oil system mixing tank

The safety investigation did not have access to the damaged mixing tank. Moreover, the Company reported that no metallurgical tests were carried out to determine the technical cause of the weld failure. To this effect, the MSIU could only hypothesise the cause of the weld seam failure.

Given that the mixing tank was not analysed, the quality of the weld that was done during the manufacturing stage could not be investigated. It may be stated, however, that the mixing tank had been installed for several years and there were no reported issues with it, until the day of the fire. It was also understood that prior to the initial installation, the mixing tank was certified that the correct steel had been used, it had been tested, and the necessary weld penetration had been achieved.

Information from the vessel did not suggest that an explosion had occurred inside the mixing tank. The tank was fitted with the necessary venting pipe to ensure that there was no dangerous build-up of flammable vapours. No explosion had been heard by the crew members. Moreover, the damages to the mixing tank were not compatible with those which one would expect, had an explosion taken place, accompanied with a catastrophic structural failure of the tank. Even more, a catastrophic failure would have spilled the marine gas oil across a wider area in the ship's machinery spaces, rather than the spill which was concentrated around the alternator of DG no. 4.

One of the factors, which the safety investigation considered as a potential problem was corrosion / pitting of the weld metal. Various studies have cautioned that the presence of microbes, additives and other chemicals may be a cause for concern with respect to corrosion, especially within those fuel systems (like this one) which store and / or process ultra-low sulphur fuel.

Humidity (and the presence of water due to condensation inside the tank[10]), especially in the vapour spaces, can be a matter of extreme concern due to the risk of corrosion. Not only it may lead to corrosion *per se*, but also allows for corrosive substances in the fuel to remain in contact with the material, for a longer period of time.

Yet again, since the weld failure was not analysed, the failure propagation could not be determined. Although the condition may have deteriorated over a period of time, it was not excluded that its failure was sudden, given that prior to the day of the accident, the crew members had not reported any unexplained spills inside the machinery spaces.

The safety investigation also concluded that without an evident cue of leakages, it would have been impossible for the crew members to detect the possible structural deterioration of the mixing tank.

[10] Generally, the accumulation of water is not only restricted to condensation but can also be due to water infiltration and temperature-affected solubility (which determines the amount of water which the fuel can hold in solution).

Actions taken by the crew members

The intensity of the fire was significant, and it posed a significant challenge to the crew members. It is legitimate to submit that within a few minutes from the time the spill was noticed, the fire erupted. The crew members barely had the time to reach the ECR to report the spill, which they observed behind the alternator of DG no. 4.

Therefore, by the time the crew members reported the spill inside the machinery spaces, some of the MGO must have come in contact with a hot surface (possibly in way of DG no. 4) and auto ignited. Moreover, before they could fight the fire locally and effectively, the area had already been engulfed in intense smoke.

Notwithstanding the smoke and fire damages which would have been expected, the fire *per se* was restricted and contained within the proximity of DG no. 4, with other areas of the machinery spaces not being affected directly by the fire and high temperature.

The initial attack on the fire was also critical to the successful containment of the fire, albeit not successful to extinguish the fire. Restricted with the rapid diffusion of dense smoke inside the machinery spaces, the crew members' actions remained coherent, and they applied boundary cooling after closing all the quick closing valves to ensure that the fire was not fed with more fuel. In so doing, the crew members did not expose themselves in unnecessary risks and were able to withdraw safely when it became evident that the fire would not be controlled locally.

The timely activation of the fixed CO_2 fire extinguishing system was carried out in an organised manner, following the necessary precautions which had to be taken by the crew members. These actions were pivotal to extinguish the fire, minimising as much as possible the extent of damages inside the machinery spaces and beyond.

CONCLUSIONS

1. In all probability, the immediate cause of the fire was a marine gas oil leak coming in contact with a hot surface on DG no. 4.
2. The source of the marine gas oil leak was a weld failure on the vessel's fuel oil system mixing tank;
3. The possibility of weld material corrosion was not excluded;
4. Without an evident cue of leakages, it would have been impossible for the crew members to detect the possible structural deterioration of the mixing tank;
5. The initial attack on the fire was also critical to the successful containment of the fire, albeit not successful to extinguish the fire;
6. The crew members' actions remained coherent and applied boundary cooling after closing all the quick closing valves;
7. The timely activation of the fixed fire installation and the release of the CO_2 was carried out in an organised manner.

SAFETY ACTIONS TAKEN DURING THE COURSE OF THE SAFETY INVESTIGATION[11]

As soon as it was determined that the fuel oil system mixing tank had a weld failure, a circular letter was issued to the vessel's under the management of the Company.

The mixing tanks installed on board four sister vessels were thoroughly inspected. The lagging was removed, and welding seams were checked for cracks. Repairs were carried out, where necessary.

[11] **Safety actions shall not create a presumption of blame and / or liability.**

RECOMMENDATIONS

Taking into consideration the actions taken by the Company, the MSIU has not issued any recommendations.

SHIP PARTICULARS	
Vessel Name:	*Cape Kortia*
Flag:	Malta
Classification Society:	Det Norske Veritas
IMO Number:	9727613
Type:	Container vessel
Registered Owner:	Ainsley Maritime Co.
Managers:	Costamare Shipping Co. S.A., Greece
Construction:	Steel – Double Hull
Length Overall:	330.00 m
Registered Length:	316.42 m
Gross Tonnage:	112,836
Minimum Safe Manning:	15
Authorised Cargo:	General cargo in containers
VOYAGE PARTICULARS	
Port of Departure:	Callao, Peru
Port of Arrival:	Rodman, Panama
Type of Voyage:	International
Cargo Information:	47,691 mt of containerized cargo (3,916 TEU)
Manning:	25
MARINE OCCURRENCE INFORMATION	
Date and Time:	30 January 2023, at 08:51 LT
Classification of Occurrence:	Serious Marine Casualty
Location of Occurrence:	Rodman, Panama
Place on Board	Engine-room; starboard bow – above the water line
Injuries / Fatalities:	None
Damage / Environmental Impact:	Structural damages and damages to several electrical components, in the engine-room; minor dents on the starboard bow
Ship Operation:	Manoeuvring, under pilotage
Voyage Segment:	Arrival
External & Internal Environment:	Clear sky and good visibility. North Northeasterly moderate breeze, with ‘slight’ sea and no swell. Air and sea temperatures: 33 ℃ and 28 ℃, respectively.
Persons on board:	28