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AIR, MARITIME AND RAILWAY TRAFFIC ACCIDENTS INVESTIGATION AGENCY
MARITIME TRAFFIC ACCIDENTS DEPARTMENT

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Zagreb, 23 January 2026

FINAL REPORT

VERY SERIOUS MARINE CASUALTY

Fire and Total Loss of the Yacht *Acceptus*

Makarska, Croatia

28 June 2024

Safety investigations are not intended to assign blame or to determine civil, administrative or criminal liability.

This document cannot be used as evidence in court proceedings aimed at determining civil, administrative or criminal liability.

This report is published in Croatian and English. In case of discrepancies between the two versions, the Croatian text shall prevail.

FOREWORD

Air, Maritime and Railway Traffic Accidents Investigation Agency (AIA) conducts investigations of marine casualties and incidents, in accordance with the provisions of the SOLAS, MARPOL, Load Lines Conventions, as supplemented by the provisions of the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code) and applicable resolutions adopted by the International Maritime Organization, as well as Directive 2009/18/EC establishing the fundamental principles governing the investigation of accidents in the maritime transport sector transposed in the Act on the Establishment of the Air, Maritime and Railway Traffic Accidents Investigation Agency (Official Gazette 54/13, 96/18), the Maritime Code, Part III, I.b – Investigations of Maritime Accidents (Official Gazette 181/04, 76/07, 146/08, 61/11, 56/13, 26/15, 17/19) and the Regulation on the Manner and Conditions for Conducting Safety Investigations of Maritime Accidents and Incidents (Official Gazette 122/15).

Air, Maritime and Railway Traffic Accidents Investigation Agency conduct safety investigations of maritime accidents and incidents, independent from all other investigations conducted by other authorities, in order to determine the root causes and contributing factors that led to a marine casualty, with the objective of preventing future marine accidents or incidents and improving the safety and the protection of marine environment.

CONTENT

1. SUMMARY

Upon arrival at Makarska, Croatia on 28 June 2024, three crew members remained on board the yacht Acceptus – the captain, the chief engineer, and one crew member. They immediately connected the shore power cable to the shore cabinet, thereby using the harbour's electrical supply. Later that day, the crew noticed unstable voltage in the network, after which they switched to the yacht's generator, while the shore power cable remained connected to the shore distribution cabinet.

On the same day, at around 11pm, passers-by noticed smoke at the aft section of the yacht. At the same time, the chief engineer, heard the fire alarm signal from the fire control panel. He immediately activated the general alarm, closed the fuel supply valves, and shut down the ventilation. All crew members abandoned the vessel.

Flames were initially observed in the technical area in the lower deck and soon spread to the adjacent underdeck spaces. Shortly thereafter, the municipal fire brigade arrived and commenced firefighting operations. The firefighters were unable to access the compartment where the presumed fire source was located. They therefore attempted to extinguish the fire by directing water from the shore hydrant into a small opening connected to the technical area.

The fire subsequently spread to the yacht's hull structural elements, while at the same time, due to the additional weight of water from the hydrant, the yacht gradually listed to port until the port side rested on the seabed. Burning of the starboard side of the hull continued until the afternoon hours.

There were no injuries and no damage to nearby vessels, while the pollution was immediately contained and remediated by the competent authorities. As a result of the accident, the starboard side of the yacht that remained above the sea surface was severely fire-damaged, while the port side remained submerged, with the yacht resting on the seabed. The wreck was towed to a repair yard, where it was recycled, and the yacht was deleted from the Register of Yachts of the Republic of Malta

The investigation determined that the cause of the fire was the installation of untinned copper conductors and a poor connection between two segments of the shore power cable, which caused burning of the connection point inside the junction box. Therefore, the installation of a power cable of these specifications, along with the configuration of the connection point between its two segments, is a causal factor in this accident. The following contributory factors were also established:

- The yacht's power cable remained physically connected to the shore supply and energized.
- The use of an unapproved extension cable with unverified technical characteristics as an extension cable of the yacht's power cable when connected to the shore distribution cabinet.
- The material of the junction box (PVC), which melted and initially spread the fire.
- The design of the cable ducts and cable routes without fire-resistant partitions and linings.
- The absence of a fixed firefighting system in the technical area and control room.

Two safety lessons were issued: the first concerns the technical safety of the design, installation, maintenance, and use of onboard systems, and the second concerning the necessity of installing fixed fire-extinguishing systems in technical spaces and control rooms. Two safety recommendations were issued to the classification society.

2. FACTUAL INFORMATION

2.1. VESSEL PARTICULARS

Vessel Name:	Acceptus
Official Number:	22174
Flag:	Malta
Call Sign:	9HB9403
MMSI:	256452000
Navigation Category:	Short (60nm from safe haven), A1
Yacht Type:	Commercial Yacht
Yacht Model:	Custom Line 112' Next
Class:	Registro Italiano Navale (RINA)
Class Number:	86977
Class Id:	100-A-1.1 „Y“
Place and Year of Construction:	Ferretti, Italija, 2011
Yacht Owner:	FL Nautika
Hull Construction Material:	Glass-Reinforced Plastic (GRP)
Max Persons Allowed:	16
Max Passenger Number:	10
Length Overall All:	34.16 m
Length Between Perpendiculars::	31.17 m
Breadth:	6,91 m
Side Height:	3.43 mm
Draught:	1.50 m
Freeboard (Summer):	1550 mm
Summer Displacement:	142.7 mt
Gross Tonnage:	213 mt
Net Tonnage:	63 mt
Propulsion Type	Internal Combustion Diesel Engine
Manufacturer and Type of Propulsion Engine:	MTU – Diesel Motor GmbH
Place and Year of Propulsion Engine Construction:	Friedrichshafen, Germany, 2010.
Total Propulsion Engine Power::	4080 kW
Number and Type of Propellers:	2, Fixed Blades
Speed:	27 kt

2.2. MARINE CASUALTY INFORMATION

Type of Casualty:

Very serious marine casualty– Fire and total loss of the motor yacht *Acceptus.*

Location:

Port of Makarska, Republic of Croatia; LAT = 43°17,7' N / LONG = 17°01,1' E

Date and Time:

28 June 2024 11:00 pm

Weather Conditions:

Meteorological reports from the Croatian Meteorological and Hydrological Service, Maritime Meteorological Centre Split, issued on 28 June 2024, are attached as Appendix I to this report. The forecast for the central Adriatic was as follows:

“NW, at night along the coast and NE 6–16 knots. Sea 2–3, initially occasionally 4 in open waters. Visibility around 20 km. Predominantly clear, with a slight chance of showers and thunderstorms where cloud development is stronger.”

Weather conditions at the time of this casualty were favourable, and therefore the influence of meteorological conditions on the sequence of events leading to the casualty can be excluded.

Consequences of the Marine Casualty:

Shortly after the fire broke out at the aft section, it spread throughout the vessel, causing severe damage to the hull, particularly on the starboard side, which remained unsubmerged. The yacht settled on her port side on the seabed in harbour.

Three crew members were evacuated to safety shortly after the fire broke out, and no injuries occurred.

Vessels located in the immediate vicinity of the burning yacht moved away at an early stage, ensuring their safety.

Following the casualty, emergency remediation measures were undertaken to prevent potential marine pollution in the area of the burned yacht, thereby avoiding any environmental impact. One month after the casualty, the wreck was transferred onto a pontoon and towed to a dismantling yard, where the remains of the vessel were finally disposed of.

The motor yacht Acceptus was deleted from the Register of Yachts of the Republic of Malta on 18 February 2025, after which a Deletion Certificate was issued on 21 February 2025.

3. NARRATIVE (RECONSTRUCTION OF THE MARINE CASUALTY)

On 28 June 2024 around noon, the motor yacht *Acceptus*, manned by six crew members, arrived from the island of Hvar to the port of Makarska. This marked the final stage of a cruise for their ten guests. The yacht was moored stern-to the quay where the gangway was installed.

Immediately upon arrival, the yacht was connected via a shore power cable to the port's electrical network. Until late afternoon, the crew carried out routine cleaning and deck-washing tasks, administrative and other regular tasks. After that three crew members disembarked, leaving the captain, the chief engineer, and the hostess on board.

Later that day, the crew noted instability in the shore-supplied electrical voltage, prompting a switch to the yacht's own diesel generator, while the shore connection cable remained physically attached to the shore distribution cabinet.

Shortly after 10pm, the crew retired to their cabins, with the chief engineer remaining awake to complete minor tasks on the flybridge. Around 11 pm, he heard shouts from the quayside, where passers-by were alerting him about the smoke emerging from the aft section of the vessel, specifically from the opening through which the gangway is deployed, connected to a small compartment called technical area above which the gangway is stowed. At the same time, the pre-warning fire alarm activated on the control panel of the fire protection system at the wheelhouse.

The chief engineer triggered the general alarm, shut off the fuel supply, and stopped the ventilation, and immediately began initial firefighting attempts using portable extinguishers. The municipal fire brigade, located only a few hundred metres away, arrived promptly and commenced firefighting operations. All three crew members evacuated the yacht and continued to cooperate with the firefighting team leading the fire suppression operation.

Surrounding vessels moved to a safe distance, while numerous witnesses observed the events from nearby. An unidentified individual disconnected the shore power cable at the quay.

Firefighters were unable to access the technical area on the port side of the aft lower deck. They began directing water from a shore hydrant into the technical compartment through the small opening where smoke had initially been observed, causing the yacht to gradually list to port until it rested on the seabed. The fire spread to the part of the hull that remained above the sea level, including the structural elements of the yacht.

Firefighters continued to douse the starboard side of the burning hull, which continued to burn until the afternoon of 29 June 2024, when the fire self-extinguished when no burning material remained to support the fire.

Following the final cessation of burning of the portion of the hull above the waterline, the wreck of the sunken yacht was moved closer to the shore by tug and remained in that position until its eventual transfer to the *Nauta Lamjana* shipyard.

Figure 1. Motor Yacht Acceptus
(source: crew)

Figure 2. Motor Yacht Acceptus 29 June 2024
(source: crew)

4. ANALYSIS

4.1. MOTOR YACHT *ACCEPTUS*

Originally constructed for private use, the yacht underwent a change of name, flag, and ownership structure during 2023 and has since been employed for commercial purposes.

The hull of the yacht is constructed from glass-reinforced plastic (GRP), consisting of a core (PVC foam) and an outer laminate of vinylester resin, which binds the glass fibres into a rigid structural material. This sandwich construction, specifically its core and resin, is a combustible material.

In terms of vertical arrangement, the vessel can be divided into the following sections:

- Upper deck with the wheelhouse
- Main deck
- Lower deck

The lower deck, viewed from the forward part to aft, comprises crew and guest accommodation (3–19 in Figure 3), the engine room (20), and the aft section of the vessel, which includes the control room on the starboard side (21), the lazarette (1 – jet-ski garage) amidships, and the technical area on the port side (22) (Figure 3).

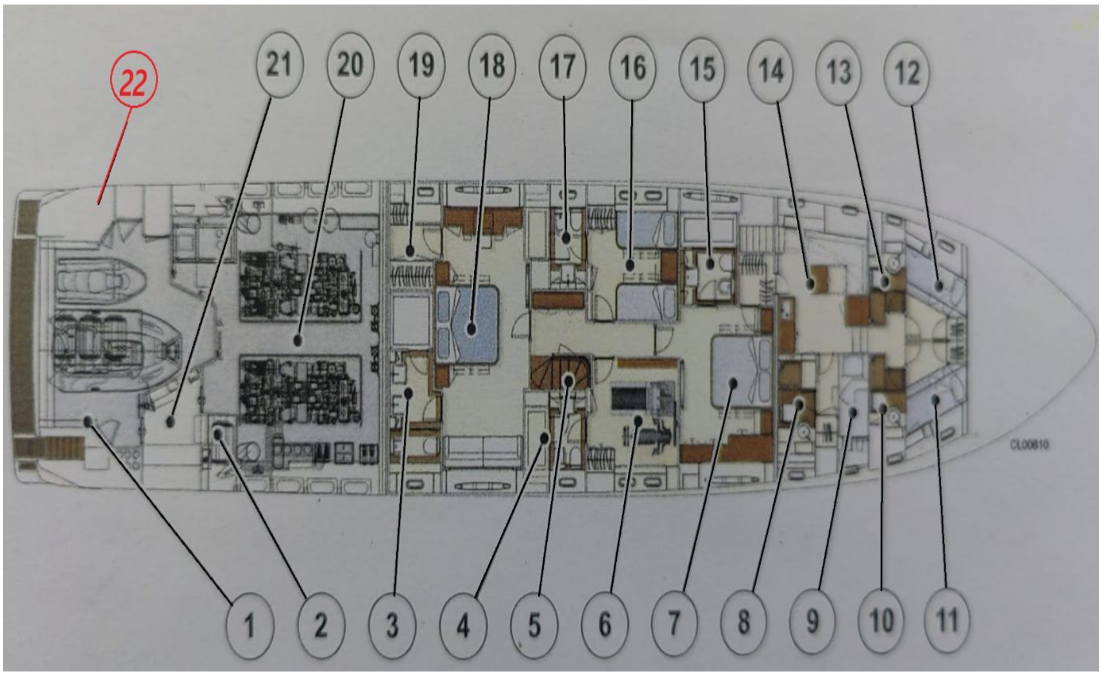

Figure 3. Plan view of the lower deck cross-section of the yacht Acceptus (source: Yacht User Manual)

Based on the information gathered during the investigation, the focus of this investigation is on the aft section of the lower deck (Figure 4), the segments of which are described in detail later in this report.

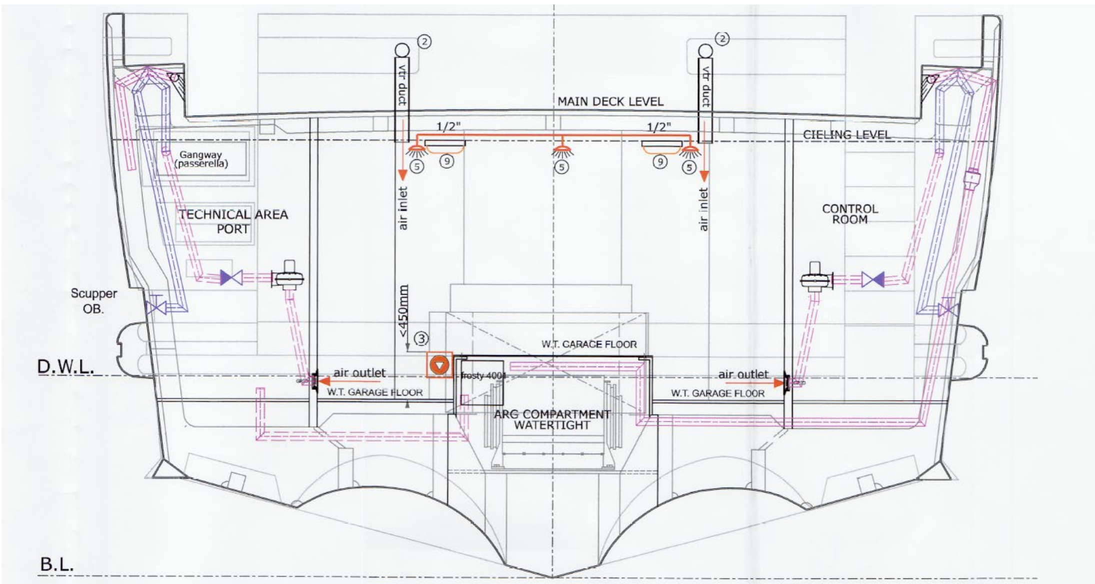

Figure 4. Transverse section of the aft lower deck (source: excerpt from the drawing "Garage Fire Safety")

4.1.1. Technical Area

This space, marked red "22" in Figure 3 and referred to as the "Technical Area Port" in Figure 4, is a small compartment approximately 4 metres in length, up to 1.5 metres in width, and up to 2 metres in height. It is located on the port side of the aft lower deck and is accessed directly from the lazarette, from which it is separated by an internal bulkhead (Figure 5).


Figure 5. Technical area – aft section, on the sister yacht and on the burned yacht (source: AIA[1])

[1] The photograph on the left is from an identical sister yacht, so minor deviations from the actual layout are possible; however, the dimensions of the space and the general arrangement of the main equipment remain accurate.

This space houses equipment and systems with their associated installations, including:

- Segment of the shore power connection cable, together with the PVC junction box.
- Wastewater treatment system with chemicals (Hamman).
- Fire-fighting pump with diesel fuel supply and self-priming, which feeds the hydrants in case the main electric fire pump cannot be activated.
- Air compressor.
- Electrical voltage and control equipment with backup battery power for the hydraulic gangway.
- Electrical equipment for the yacht's gyroscopic stabiliser.
- Electrical equipment for underwater lighting.
- Hydraulic equipment for deploying and retracting the shore connection cable.
- Air extractor from the lazarette (port side).
- Oil tank for the stern thruster.

Directly above the technical area is a narrow compartment separated by a bulkhead, where the gangway is stowed when not in use.

On the outer bulkhead of this space, there are inlets for water, drainage, and electrical services into the yacht. Openings in the hull are fitted with access covers secured with a cylinder lock for controlled access. Lifting the outer hatch provides access to:

- shore power connection (the end of the shore connection cable)
- water inlet with valve
- sewage tank discharge connection.

Cable routes are routed in a separate compartment, while service hatches are in the floor. There is also a direct interconnection between the technical area and the control room on the opposite side of the lower deck via an installation duct that runs beneath the lazarette, specifically under the lazarette access ramp.

This area contains highly flammable materials – hydraulic oil, diesel fuel, and potentially chemicals and other combustible materials. The exact inventory of materials present in the aft lower-deck area is not fully known, and it is possible that additional flammable materials were present beyond those regularly stored there. This assumption is indicated by the fact that the vessel does not have a dedicated storage area for various liquids necessary for routine maintenance and operation.

The investigation established that the fire originated from this space, as discussed in greater detail in the following sections of this report.

4.1.2. Lazarette

This garage space, marked as "1" in Figure 3, is centrally located in the aft section of the lower deck. At the time of the fire, it was occupied by two jet-skis, two sea-bobs, (with the fuel) and other leisure equipment. It is bordered by:

- engine room (forward, separated by a B-15 fire-resistant bulkhead)
- technical area (port side, separated by a bulkhead and a door)
- control room (starboard, separated by a bulkhead and a door)
- electro-hydraulic ramp (opening outward)

Below the hydraulic ramp and the access platform located beneath the ramp, an interconnection was installed between the technical area and the control room. Through this installation floor duct, a segment of the shore connection cable also passed, from the PVC junction box on the inner wall of the technical area all the way to the transformer in the control room.

Access to the lazarette is through the control room via a WR100-WT type door. The same door type also connects this space with the technical area on the port side of the yacht's lower deck. The status of these two doors (open or closed) could not be definitively determined. However, considering that the bulkheads separating these spaces are not fire-resistant, nor are the doors themselves, the investigation considers that the status of the aforementioned doors did not have a significant impact on the spread of the fire itself.

Shortly after the fire broke out, the lazarette was engulfed in flames, which then intensified due to the presence of flammable fuels and materials, causing severe damage to all equipment.

4.1.3. Control Room

This space ("21" on Figure 3; "Control Room" on Figure 4) serves as the vessel's main control and monitoring hub for various onboard systems. It houses the transformer where the shore connection electrical cable terminates, as well as the main distribution board (MDB), which controls the vessel's electrical system. In addition, this space contains:

- The right-hand air extractor from the lazarette.
- Control panels for the air extractor.
- The ship's steering control panel.
- Electro-hydraulic control unit (motor, pump, oil tank).
- Carbon dioxide fire suppression system for the engine room (compressed CO_2 cylinders).
- Control panels for black and grey water systems.
- Secondary distribution cabinets.

The control room's flammable materials quickly ignited, resulting in extensive damage and destruction of numerous components.

4.2. SURVEY OF THE FIRE DAMAGED YACHT

The aft section of the vessel suffered the most extensive fire damage, with the starboard side (control room) being particularly affected. The bulkheads between the aft compartments were burned up to approximately half their height, while the floor covering of the lazarette, beneath which the floor installation duct is located, was completely destroyed.

Almost the entire starboard side of the yacht was fire-damaged, especially in the area where the superstructure joins the hull. Compared to the aft section, the engine room exhibited visibly less fire damage. The teak layer on the horizontal bulkhead separating the lower deck from the main deck showed no signs of fire penetration, whereas the lower parts of that bulkhead, covered with metal sheeting, were completely burned.

The electrical cabinets in this section of the vessel were completely destroyed, both externally and internally, indicating prolonged exposure to fire. All cables were burned, leaving only copper conductor bundles, with no traces of insulation layers remaining.

In the technical area, equipment located closer to the exit doors sustained more significant damage. All equipment in this area, including the electrical cabinets of the gyroscopic stabilization system and the sanitary water treatment system, was completely burned on the outside.

Evidence that these cabinets were not the source of the fire is shown by the uniform external burning of their surfaces, with PVC cladding displaying signs of melting rather than combustion.

The flame impact was more pronounced in the upper part of the compartment, while damage intensity decreased toward the stern; cabinets at the aft end of the space remained nearly unaffected by fire and heat, despite being made of plastic.

Signs of fire exposure were also visible on piping and installations – those near the doors were heavily damaged, whereas the pipe distribution at the bottom of the compartment, including valves and insulation, remained almost intact.

The more severe flame impact in the forward part of the technical space may be associated with the location of the fire pump and its fuel tank.

4.2.1. INSPECTION OF THE SHORE CONNECTION POWER CABLE

During the inspection, a segment of the shore connection power cable that remained after the fire was examined. The shore connection power cable passes through power outlet opening on the exterior wall of the yacht toward the shore connection and continued via an additional extension cable connected to the shore-side distribution cabinet. This additional extension cable was found to be severed during the inspection (Figure 6).

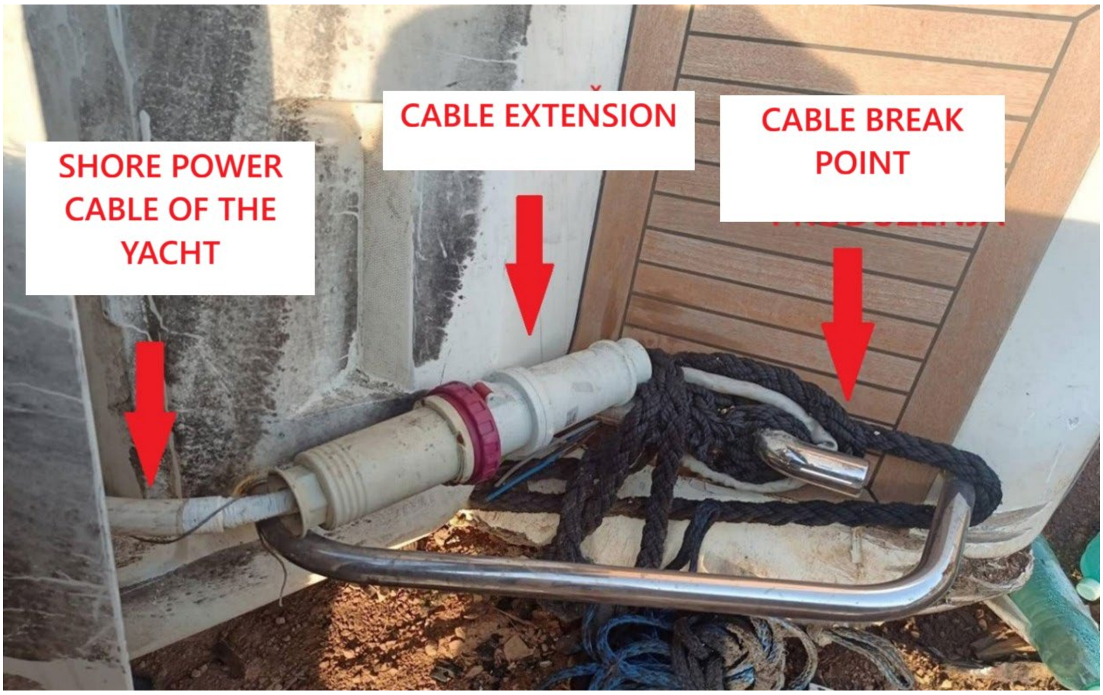

Figure 6. Shore connection cable with the installed extension cable (source: AIA)

The connector mounted on the shore connection low-voltage cable bears a marking indicating that it is a three-phase connector rated at 125 A. The user manual specifies that the connector is rated at 80 A, and the cable, 5×25 mm² copper, has a nominal rating of 100 A, meaning that the maximum fuse intended to protect the cable against short circuits should be 80 A (approximately 70 kW). This corresponds with the nominal current of the secondary winding of the isolation transformer.

Next is the point where the cable enters the vessel, i.e., the technical area of the lower deck. The cable passed over the hydraulic winch guide rails before entering a PVC container where it was coiled. At the bottom of the container, there was an opening through which the cable exits. Immediately after exiting, a break in the cable was observed. The cable end retained the shape intended for mounting in the cabinet. The cable still had the cable gland through which it entered the PVC cabinet. Up to this point, the cable had not been fire-damaged or thermally deformed. Behind the rubber gland, which was partially heat-damaged, the cable separated into conductors that were completely burned; the conductor insulation and copper wires had melted and fused together near the gland (at the bottom of the box). The ends of the conductors, found without insulation, still showed screw connectors.

All this indicates that the event occurred inside the PVC junction box in the technical area, since the remaining portion of the cable entering the box shows no signs of exposure to heat or flames. The PVC cabinet itself was destroyed.

Of the equipment that had been in the junction box, only the screw connectors for joining the two cables – supply and outgoing – were preserved. No remnants of switching or protective equipment were found, suggesting that none had been installed. The junction box was intended solely for joining the two cables and was located immediately adjacent to the hydraulic winch in the technical area. Further inspection traced the end of another segment of the shore connection cable, leading to the isolation transformer in the control room.

Apart from the PVC junction box, no electrical cabinets or equipment in that part of the technical area sustained such damage, including a PVC cabinet located 1.2 m away. All equipment in the room was visibly fire-damaged externally to a similar degree, indicating that the flames acted uniformly. All cables in the destroyed cabinets in the forward part of the technical space were burned, while this shore connection cable remained undamaged, except at the ends in the PVC junction box, which was completely destroyed. This indicates that the center of the event was precisely in that cabinet, while the rest of the equipment was damaged by secondary flame spread.

The final 50 cm segment of the shore connection power cable was analyzed in detail. It was found that the conductors were intact, indicating that no insulation between conductors had been destroyed. Therefore, there was no overload or short circuit at this location that would have left traces on the individual wires. Two instances of cable insulation damage were identified. The first was mechanical crushing, as part of the insulation was scraped off. The second damage was not visible, but a 30 cm section of the cable was wrapped with white insulating tape. Beneath this tape were several layers of other colored insulating tapes, and the cable insulation itself was cut over a length of approximately 7 cm. The tape layers were not well-adhered or had come loose during use and bending. The cable conductors inside the cable were not visibly damaged.

The cable insulation is multilayered, with each layer serving a specific function: enhancing mechanical protection of the energized conductors, preventing moisture and water ingress, providing final protection against external mechanical effects, and limiting the bending radius. Damage to any layer of insulation allows moisture ingress, which, in the presence of voltage, can result in localized heating within the cable. Moisture spreads through the insulation, causing further damage – first corrosion of the copper conductors, reducing their effective cross-section and electrical conductivity. This further increases conductor heating and damages insulation of other phases until an interphase or phase-to-ground short circuit occurs. Therefore, whenever insulation damage is observed, the cable must be immediately replaced or repaired using proper electrical connection and insulating materials with heat-shrinkable outer layers. The use of insulating tape is not permitted on cables of this type and purpose.

The two mechanical insulation damages described are not directly related to the cause of this fire or the spread of flames. However, such damages, discovered beneath the cable's outer sheathing, indicate systemic maintenance issues regarding the vessel's electrical equipment.

4.3. POWER SUPPLY SYSTEM

The vessel's electrical power system is divided into alternating current (AC) and direct current (DC) systems.

The direct current (DC) system is intended for the vessel's safety, control, and communication systems (monitoring, control, etc.) that are not widely used for general consumption. The power source for this system consists of 12 V batteries, located in the engine room and near the main control station.

The alternating current (AC) system (230/400 V, 50 Hz) is available throughout the vessel to provide users and passengers with access to electrical power, enable operation of various loads with minimal transmission losses, and increase flexibility in equipment installation on board.

The power cabinet containing the isolation transformer and the main distribution board (MDB) is located in the control room. Its function is to consolidate and monitor the AC voltages and currents supplied from available power sources on the vessel, as well as to control the voltage and current delivered to the ship's low-voltage network.

Based on the vessel's operational requirements, the MDB determines the priority power supply, which is then distributed further into the vessel's electrical network. AC power is subsequently routed to secondary distribution boards, which incorporate connection, switching, and protective equipment.

The secondary distribution boards are located in various parts of the vessel according to function and consumer zones.

4.3.1. AC Voltage Sources

The MDB connects the appropriate power source from the available AC power supplies.

The first source is the shore connection with a nominal power of 56 kW, which supplies electrical energy to the yacht via the shore connection power (AC) cable. This cable features a three-phase industrial connector (63 A, 230/400 V, 50 Hz) on the shore side and is connected on the other end to the power cabinet, which houses the isolation transformer.

The transformer allows for control of the voltage and phase sequence at the input, and, if necessary, phase reconfiguration to ensure correct phasing of the vessel's AC system.

The second power source consists of two diesel generators located in the vessel's engine room, each with a nominal power of 50 kW.

4.3.2. Cables

Most of the electrical power cables on the yacht were FG7R cables, available with one or more conductors. This is a 0.6/1 kV power and signal flexible cable, insulated with hard EPM rubber and sheathed in PVC. It is intended for static use underground, underwater, inside buildings, or in cable ducts, in conditions where the cable is not exposed to sustained mechanical stress or significant tensile forces. It is used in industrial facilities or domestic installations where higher current and thermal loads are expected (conductor operating temperature up to 90 °C) and where greater flexibility and improved fire resistance are required.

Along the trays carrying power and signal cables, F/UTP 4P 24AWG 100 OHM Cat 5e cables were also observed. These are electronic communication cables primarily used for transmitting control, communication, and network signals.

Cables and all connecting points must be compatible with the systems they serve and suitable for the environmental conditions in which they are installed. The marine environment[2], due to its physical and chemical properties, makes copper conductors more susceptible to corrosion. Therefore, marine cables are typically made with tinned copper conductors[3], which prevent corrosion at connection points and along the conductor strands.

Connection and extension points must be located only on equipment or within distribution boards and junction boxes installed in accessible and visible locations. When selecting connection equipment, the possibility of galvanic corrosion between materials with different electrochemical potentials must be considered, and appropriate connection hardware should be used.

The examination of the subject yacht revealed that the cables installed on the vessel were not designed for marine applications; that is, the conductors were not made of stranded tinned copper wires.

Furthermore, the cable terminations were not executed using crimped closed connectors with additional insulation and heat-shrinkable insulating equipment. Electrical cable connections must provide a secure and durable connection without the risk of screw connections loosening due to vibrations or load changes and must not mechanically damage the connection hardware.

[2] RINA Rules for the Classification of Yachts (Pt C, Ch 2, Sec 2), clause 1.1.1: The environmental conditions are one set of variables including climatic conditions (e.g. ambient air temperature and humidity), biological conditions, conditions dependent upon chemically active substances (e.g. salt mist) or mechanically active substances (e.g. dust or oil), mechanical conditions (e.g. vibrations or inclinations) and conditions dependent upon electromagnetic noise and interference, and another set of variables dependent mainly upon location on vessels, operational patterns and transient.

[3] Coated with a thin layer of tin to provide corrosion protection and improve solderability.

4.3.3. Shore Connection Power Cable

The shore connection power cable on the yacht *Acceptus* (Figure 7) consisted of two segments. The first segment begins at the connection equipment for linking to the shore-side electrical cabinet. The cable then passes through a gland on the hull and enters the technical area, where it connects to the PVC junction box. Before entering this box, the cable is coiled in a barrel-shaped PVC container, which is wound via the hydraulic winch to regulate the cable length toward the shore. Using the cable while it is coiled creates an inductive loop that increases heating of the cable and connections, which over prolonged operation likely imposed additional thermal stress on the cable.

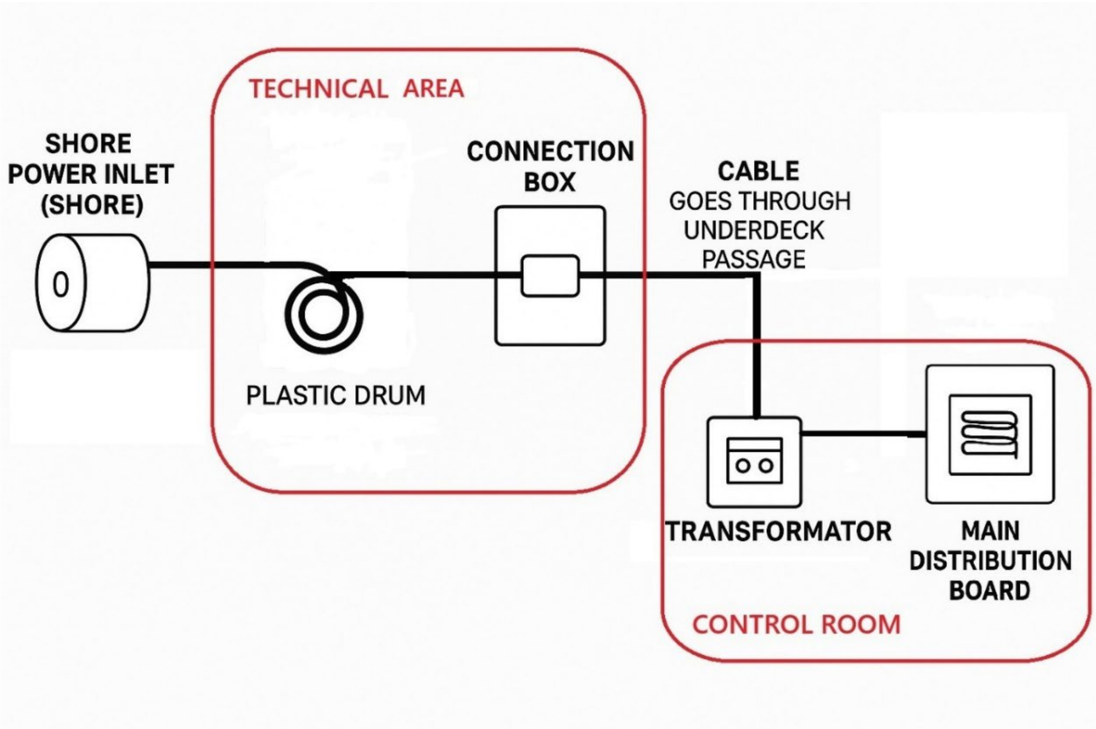

Figure 7. Shore connection cable (Source: AIA)

The PVC junction box housed the electrical equipment for connecting the two cable segments. The cabinet was mounted on the inner wall of the technical area, in close proximity to the hydraulic winch. This segment of the cable is frequently exposed to mechanical stress and potential damage during use, as confirmed by the damages identified during the inspection, described in Section 4.2.1.

The second segment of the shore connection power cable starts at the PVC junction box in the technical area and continues through the floor installation duct to the isolation transformer in the control room. Along its route, the cable was installed in an electrical conduit and fixed in place, preventing exposure to mechanical damage. The position of the floor installation duct exposes this segment of the cable to the marine environment, making the untinned copper conductors more susceptible to the effects of salt and moisture, which increases material corrosion.

During the investigation, the sister yacht was also examined, where it was observed that the shore connection cable was installed as a single continuous length, without a PVC junction box in the technical area.

This difference in design suggests that the PVC junction box on Acceptus was installed after the yacht's delivery. This is supported by information received from the Class, indicating that no approved survey or documentation submitted to RINA exists for modifications involving such a junction. Furthermore, the available vessel manuals make no reference to an additional junction box in the technical area. While this modification may simplify cable maintenance and operation, it is essential that established electrical engineering standards are adhered to during its implementation.

Although the yacht was using its own diesel generator as the power source at the time of the fire, the shore connection power cable remained physically connected to the shore low-voltage distribution cabinet, and therefore was energized.

Consequently, AC voltage from the shore low-voltage network was present from the shore distribution cabinet, through the vessel's shore connection cable, all the way to the MDB in the control room.

Since the voltage from the shore connection was not further supplied to the vessel's electrical installation, no current flowed along the cable route. However, keeping the shore connection cable physically connected to the shore power source maintained this segment under voltage. This increased the risk of fault currents and potential voltage effects on damaged or degraded parts of the cable., which is why this arrangement is considered by the investigation to be a contributing factor.

4.3.4. Protection of the Shore Connection Power Cable

The safety protection of the shore connection power cable is provided by the protective equipment in the shore side electrical cabinet, but this protection is valid only up to a certain distance and load rating from the connection point. Each vessel's shore connection cable is designed according to its requirements, ensuring proper operation of the protective devices at the point of connection.

Electrical protection of the power transmission cable consists of overcurrent protection, short-circuit protection, and residual-current (differential) protection (protection against electric shock and faults). All protections are related to current magnitude and time, i.e., the rate of change of the occurring events.

The protective equipment in the shore distribution cabinet comprised the following devices:

(Upper row)

- A four-pole circuit breaker rated at 63 A with a residual current of 0.003 A. It is intended to protect against touch voltage and faults manifesting as asymmetry exceeding 30 mA from this point to the end user connected downstream of the breaker.

– A three-phase 63 A circuit breaker, characteristic "B", manufactured by ETI. It is intended to protect against overloads and short-circuit currents in the cable/conductors located in the cabinet from the breaker to the downstream automatic fuses.

(Lower row) Single-pole and three-pole circuit breakers (automatic fuses) intended to protect against overloads and short-circuit currents from them to the end consumers:

– 5× single-pole 16 A, characteristic "B"

– 1× three-pole 40 A, characteristic "C"

Since the voltage from the shore connection was not supplied to the vessel's main distribution board and thus not to the vessel's loads, no current flowed through the vessel's shore connection cable. In this state, the protective equipment in the shore distribution cabinet, in the form of automatic fuses, remains in the normal operating position, i.e., closed circuit allowing voltage.

However, current flow can still occur under such circumstances. Any faults in equipment or installation caused by insufficiently tightened screws, corroded connections, inadequately insulated joints, cable sheath damage, conductor insulation damage (e.g., due to torsional twisting of the cable), and similar issues, can lead to faults that result in current flow. The magnitude of such current depends on the type and extent of the fault, i.e., the contact resistance. Typically, these currents are small, below the nominal rating of the protective equipment, and do not need to be continuous, since their occurrence is not dependent on load operation but on the type and extent of the fault. A fault may occur intermittently, under specific conditions such as moisture/water presence, salt deposits on equipment, mechanical movement, or vibration. These hidden faults are often the origin of major failures and may be a source of fire, as low currents or very short high currents can thermally stress (heat) the fault location, further damaging and melting the materials involved.

Overcurrent and short-circuit protection provided by automatic fuses cannot detect these faults or transient currents and thus cannot interrupt the circuit, as the currents are within normal rated values. For such protection, residual-current devices are intended. However, even these would not function adequately if the fault location is beyond the electrical reach of the protective device, determined by its nominal rating, cable material, conductor cross-section, and the planned protection level. Therefore, the use of extension cables without prior technical verification (calculations) in the electrical system is prohibited. During the investigation, no evidence was found of technical verification for the extension cable through which the yacht was connected to the shore cabinet.

All of these factors contributed to a reduction in the effectiveness of protection and increased the risk of faults or fire. Consequently, the investigation considers the use of an extension cable with unknown or unverified technical characteristics between the vessel's shore connection cable and the shore distribution cabinet a contributing factor to this casualty.

4.3.5. Routing of Electrical Cables

The electrical cables on the vessel were routed along at least three main cable runs, using metal cable trays. The trays were perforated to reduce weight and allow cooling of the cables. The cables were laid in bundles along these trays (Figure 8).

Figure 8. Routing of cable bundles in a metal cable tray (source: AIA)

Cable routing involves laying individual cables and/or bundles directly on the substrate or employing supplementary equipment such as metal or PVC ties and supports, metal trays, metal conduits, PVC conduits, and ducts.

On the yacht *Acceptus*, routing involved cables laid individually, in pairs, or in large bundles, mostly without additional routing aids. Metal cable trays were used, generally one tray per cable bundle, which required a tray of larger dimensions, approximately 300 mm in width. Such arrangement does not ensure adequate separation between cables of different voltage levels and functions, which is intended to reduce thermal and electromagnetic effects.

When routing and laying cables, it is crucial to ensure proper cooling during operation, especially for main power cables and cables intended for high-power loads. Such cables are laid separately from others and at the prescribed safe distance from other installations.

In addition, no dedicated fire-resistant sectors were built along the routes, and penetrations between the yacht's compartments were not fire sealed. This design was confirmed during the inspection of the sister yacht, which revealed identical design solutions for cable routing.

4.4. ORIGIN OF THE FIRE

The investigation established that the fire started inside the PVC junction box of the shore power cable, located on the inner bulkhead of the technical area. At the very center of the fire, a distinctive trace of conductor breakage and fusion of the multi-stranded copper conductor was observed, clearly indicating a technical failure of the shore power connection cable (Figure 9).

This failure is the result of the absence of tinned copper conductors on board (see Section 4.3.2) and the improper connection of the two segments of the shore power cable within this box.

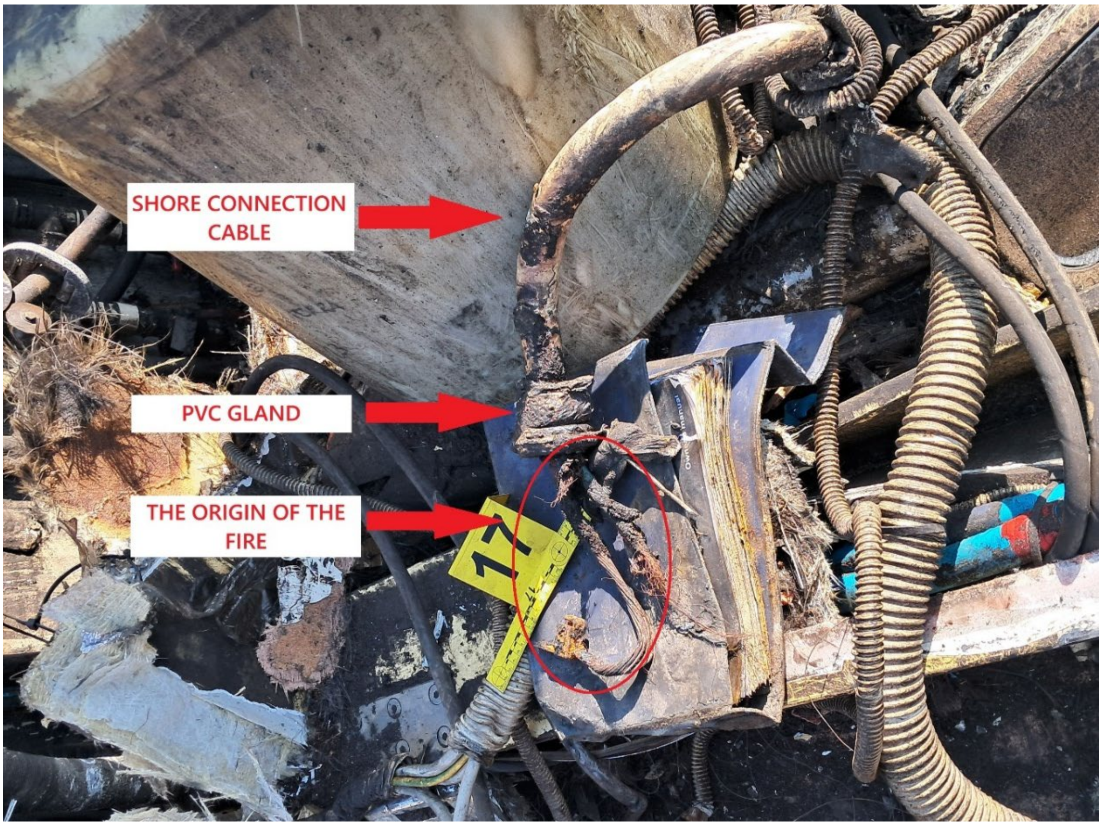

Figure 9. The origin of the fire on the shore connection cable (source: AIA)

Such connection inside the box led to the heating of the connection point, resulting in cable melting and smoke generation. As the melting process progressed, sparking occurred.

Following the occurrence of sparking, the temperature within the PVC junction box increased further, causing deformation and melting of the box itself, as well as melting of the cable insulation, accompanied by the release of a significant amount of smoke.

The appearance of open flame suggests that the decomposition products came into contact with combustible materials and got ignited. Since the bare cable conductors located immediately behind the PVC gland were found fused together, it can be assumed that the thermal process had advanced long enough for the insulation melting to reach the cable entry zone into the box. In this section, the conductors are positioned side by side, which led to a short circuit, during which the strong transient event caused fusing of the wire strands.

After a short circuit, if the fault location falls within the operating range of the protective equipment in the shore distribution cabinet to which the vessel is connected, that section would be de-energized, and current would cease. However, considering the sequence of events, if this occurred, it did not happen during the initial ignition process that could have been interrupted, but followed the early local spread of flames.

Damages on an energized cable under low loads behave normally, making them difficult to detect. Under higher loads at such a connection point, the increased contact resistance causes a rise in temperature. This leads to further heating of the connection, and as the event intensifies, sparking may occur, which further increases the temperature at the joint. Exposed materials melt due to sparking, and the cable insulation begins to produce significant smoke during melting. The fault site temporarily stabilizes when cable load decreases, and normal operation resumes until the load increases again.

This process continues until the connection fails, interrupting the circuit, or until a single-phase or three-phase short circuit occurs, which would trigger the protective equipment. During this period, transient sparks may appear, initially small and accompanied by characteristic popping sounds. Over time, both the frequency and intensity of these sparks can increase, as each spark creates conditions for additional sparking. This process at poor connection points can persist over an extended period, not necessarily continuously, depending on load usage and the electrical stress on the cable and connection.

An early indicator of this developing situation was the “low voltage” at the shore connection, prompting the crew to switch to the vessel’s generators. Low voltage may indicate issues with the shore low-voltage network, the vessel’s shore connection cable (insufficient cross-section or excessive length), or a poor connection on the cable (mechanical damage, corroded joint, etc.).

Although the shore network’s contribution to the problem on the day of the fire aboard *Acceptus* cannot be completely ruled out, considering the subsequent sequence of events, it can be concluded that this voltage drop was primarily caused by processes occurring within the PVC junction box of the shore connection cable.

Switching the yacht to its own generators resolved the low-voltage issues on the onboard network, but the shore connection cable remained physically connected to the shore distribution cabinet. Consequently, the segment from the MDB to the shore connection remained energized, keeping the fault location under voltage and allowing fault current to occur, as explained in Section 4.3.

4.5. FIRE SPREAD

As described in the previous section, the PVC junction box melted because of processes occurring inside it, after which surrounding materials ignited, including fuel located in the forward part of the technical area. The flames spread simultaneously in several directions.

After the PVC junction box was compromised, the next key fire spread route outside the technical area was via the floor installation duct toward the control room. This room contained flammable materials and liquids, allowing the flames to propagate rapidly.

The lower-deck compartments are not separated by fire-resistant bulkheads or doors, enabling the fire to overcome obstacles quickly and easily. From the lower deck, the fire further spread throughout the vessel via cable routes and degradation of bulkheads.

Fire propagation throughout the vessel begins once the flames reach the structural and other surfaces, as spread occurs through smouldering and burning of the construction (Figure 10). When the fire involves the vessel's structure itself—specifically the inner layer of the sandwich panels and vinylester—the fire can spread uncontrollably to other areas of the yacht.

Figure 10. Fire spread to the structural component of the yacht (source:DP)

Under such conditions, flames can continue to spread even if the hull surface is heavily sprayed with coolant, as the fluid cannot reach the combustible materials within the sandwich construction.

Key electrical design factors contributing to fire spread were:

- Material of the junction box in the technical area – The PVC cabinet did not confine the fire within its enclosure but melted, allowing flames to spread to surrounding surfaces and combustible materials, particularly considering its purpose: connecting two high-power cable segments.

- Design of the floor installation duct – The duct lacked fire-resistant bulkheads and appropriate fireproof linings.

- Cable routing design – The layout contributed to the rapid spread of fire to other areas of the vessel.

These factors are therefore considered contributing factors of this casualty.

4.6. FIREFIGHTING MEASURES

4.6.1. Attempts to extinguish fire

According to video recordings available to the investigation, as well as eyewitness and witness statements, it was determined that, at the very beginning, smoke was emerging from the opening directly connected to the technical area. Furthermore, the initial flames were observed only in this compartment. Very soon after that, the smoke spread to the adjacent spaces.

At that moment, the chief engineer heard an early warning signal from the fire detection system, most likely from a smoke detector in the technical area, but did not have time to investigate further, as smoke was already visible. He immediately closed the fuel and ventilation valves, shutting down the diesel power generator, and then proceeded to initiate fire-fighting actions and alert his colleagues.

Seeing that the aft section of the lower deck was filled with smoke, the chief engineer attempted to extinguish the fire using carbon dioxide and dry powder extinguishers, through a small opening at the stern from which smoke was coming out.

Firefighters, who arrived on the scene very quickly, also immediately attempted to access the source of the fire, which they assumed was located in the area from which the smoke was coming (Figure 11). In the initial phase of the fire, the service hatch on the main deck leading into the engine room was opened, where it was visually confirmed that the source of the fire was not located in this space.

Figure 11. Fighting the fire on Acceptus (source: crew of Acceptus)

Access to the technical area was possible only through the lazarette, where at the time of the fire recreational crafts were stored, obstructing access to the port side of the lower deck, particularly under conditions of severely reduced visibility in the control room and lazarette due to heavy smoke accumulation.

As the electro-hydraulic ramp, which allows the lazarette to open toward the stern, could not be operated due to the power failure, firefighters decided to cut a small section of the ramp on the port side to access the fire-affected lower-deck area. However, the flames soon spread throughout the aft section of the vessel.

Firefighting efforts continued with continuous attempts to suppress the fire by applying water from fire hoses connected to shore hydrants, both through the opening leading to the technical area and along the external hull surfaces of the aft section.

As water was continuously applied to the port side, the vessel gradually listed. The fire affected the starboard side more intensely, while the port side increasingly submerged in seawater until it eventually reached the bottom (Figure 12).

Figure 12. Submerged yacht Acceptus after the burning stopped (source: AIA)

From that point onward, firefighting activities were limited to preventing fire spread beyond the burned vessel by dousing its external surfaces. The portions of the vessel remaining above the water continued to burn as long as combustible material was available.

The fire did not spread to any other vessel or to nearby operational areas onshore.

In conclusion, control over the fire was effectively lost once it reached the structural components of the vessel. The fire propagated within the core of the sandwich panels, which is insulated from external water or any other extinguishing medium.

Initial firefighting efforts were significantly limited by the fact that the space where the flames originated lacked a fixed fire suppression system, whether manual or automatic, which could have initiated fire extinguishing without the presence of personnel in the area.

4.6.2. Firefighting Systems Onboard

This yacht is equipped with a fire hydrant network supplied with seawater pressurized by fire pumps. Fire hoses and nozzles, stored near the hydrant outlets, are connected to the hydrants. The system is served by two fire pumps. The main fire pump is electrically driven and located in the engine room, while the emergency fire pump is powered by a diesel engine and located in the forward part of the technical area. After appropriate valve reconfiguration in the piping system, the emergency fire pump can also be used for bilge pumping. Both fire pumps have their own seawater intakes. The fire hydrant system can also be connected to an external hydrant network.

Among the fixed systems, the yacht is fitted with a fixed carbon dioxide fire-extinguishing system for the engine room, which is separated from other spaces by B15 fire bulkheads, including a fire door leading to the control room. There is also a fixed sprinkler system covering the lazarette.

The yacht is equipped with portable fire extinguishers of various sizes and extinguishing media (carbon dioxide, dry chemical powder, foam), distributed across all decks in accordance with the approved fire and safety plan (Figure 13).

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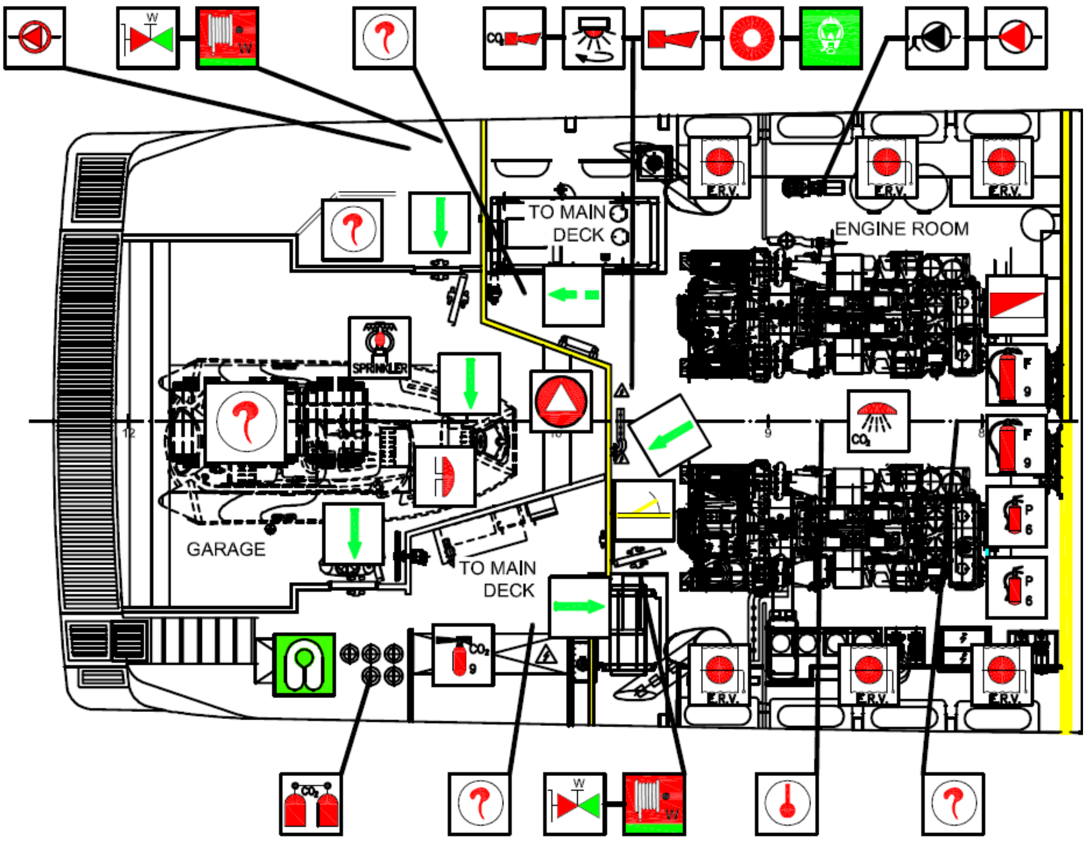

Figure 13. Extract from Fire Control and Safety Plan (source: yacht Acceptus)

The technical area is covered by a hydrant connection with a fire hose and nozzle. This space, however, is not protected by any fixed fire-extinguishing system.

The control room is likewise not protected by a fixed fire-extinguishing system. It has no hydrant connection, although a hydrant is located in the engine room immediately adjacent to the control room entrance.

The CO_2 fixed fire-extinguishing system for the engine room is controlled from the control room. On the main deck level, at the entrance to the stairway leading down to the control room, the following controls are located: CO_2 release controls, fuel and air shutoff devices, electrical power shutdown devices, lazarette ventilation shutdown, and the remote start unit for the fire pumps.

Regarding fire detection, smoke detectors are installed in the engine room, control room, lazarette, and technical compartment. In addition, the engine room is fitted with a heat detector. One of the detectors—most likely the smoke detector in the technical area—was activated at the onset of the fire.

The absence of a fixed fire-extinguishing system in the technical area, where the fire originated, as well as in the control room, where it first spread, significantly limited the ability to suppress the fire. While the hydrant system is available in the aft lower deck area, its use requires the rapid intervention of a trained individual—either a firefighter or a crew member—in a smoke-filled, confined, and fire-affected space. Under such conditions, gaining access is neither simple nor safe. This method of firefighting presents a serious risk to responders, especially to crew members, who, although trained for onboard firefighting, lack the practical experience of professional firefighters.

The issue of inaccessibility of the entry into the technical area was central to the initial firefighting phase. Adverse conditions, including heavy smoke, rapid fire spread to adjacent spaces, and narrow access routes, prevented quick and effective intervention at the source.

Opening the lazarette would have facilitated access to the technical area but would also have provided additional oxygen to the materials and liquids already engulfed in flames. Moreover, operation of the ramp under the given circumstances was not possible, as the fuel supply to the vessel's power generators had been shut off upon fire outbreak, which is the correct procedure in such situations. Therefore, this investigation concludes that fire suppression via a fixed system would have been a far more effective and safer solution in this type of fire.

The investigation determined that the sprinkler system in the lazarette was not activated. It is assessed that its activation could have partially slowed the fire spread. However, since this system covers only the lazarette, such activation would not have altered the final outcome of the incident, given that the fire originated in the technical area and first spread to the control room, neither of which is covered by a fixed fire suppression system.

The need for installation and use of a fixed (automatic or remotely activated) system in the technical area and control room is further highlighted by the presence of flammable materials and liquids in these areas, such as fuel for the fire pump and hydraulic oils. These spaces also contain numerous electronic systems, control panels, and the shore power cable with its junction box.

The hydrant system is not suitable for extinguishing fires involving electrical installations or flammable liquids, for which more appropriate extinguishing media exist.

The sprinkler system, which also uses seawater as a medium, is not ideal for these types of fires but is more effective than the hydrant system, as it lowers the temperature of the space and equipment. Combined with restricting the airflow, it can be an effective means, at least during the initial phase of fire suppression.

A fixed system can be activated immediately and without risk to personnel, once the responsible person ensures that all crew members and passengers are clear of these areas, particularly for systems that reduce oxygen levels or otherwise pose a health risk.

In conclusion, the investigation finds that the absence of such a system in the technical area and control room is a contributing factor, allowing the fire to persist long enough to involve structural parts of the vessel. This led to uncontrolled fire to spread to other areas, rendering any firefighting efforts unable to prevent further propagation and consequential damage to the vessel.

4.7. CREW

At the time of the fire outbreak, the captain, the chief engineer, and one additional crew member were on board.

The captain had been in command of the yacht for slightly over one year, having served as a yacht captain since 2021. At the time of the fire, he was in his cabin. He quickly evacuated the vessel along with his colleagues and subsequently remained in the immediate vicinity of the yacht.

The chief engineer was serving on this yacht in that capacity for the first time. At the time of the fire, he was on the upper deck (flybridge). He heard shouts from bystanders who had noticed smoke, after which he activated the fire alarm, closed fuel valves, and shut down the ventilation system.

In addition, he initially attempted to extinguish the fire using portable fire extinguishers; however, due to dense smoke, he could not safely approach the source of the flames and soon handed over firefighting efforts to the fire brigade.

4.8. TECHNICAL STANDARDS

At the time of the accident, the applicable RINA classification rules for the yacht *Acceptus* were contained in *The Rules for the Classification of Pleasure Yachts (RES.6 1995)*. These rules were withdrawn on July 1, 2024, and replaced by a new document titled *Rules for Classification of Yachts (RES.31).* Both RES.6 and RES.31 were analyzed, with particular emphasis on the latest version, as the purpose of the safety investigation is, among other objectives, to identify system elements that could be upgraded to enhance overall industry safety standards.

4.8.1. Electrical Installations

Electrical installations are regulated in Chapter 2 of *Rules for Classification of Yachts (RES.31).* In relation to the investigation of this casualty, the following subjects are particularly noteworthy to be analysed.

4.8.1.1. Shore Cable Connection

In section 3.8.1 (Pt C, Ch 2, Sec 3), it is stipulated that where arrangements are made for supplying the electrical installation from a source on shore or elsewhere, a suitable connection box is to be installed on the yacht in a convenient location to receive the flexible cable from the external source.

The connection box must include a circuit breaker or switch-distributor and fuses. Furthermore, the connection to the shore power source must be protected against short circuits and overloads; however, overload protection can be omitted in the connection box if it is provided on the main or emergency distribution panel (3.8.4).

The requirement for protection of the shore power cable is reiterated in section 6.12 (Pt C, Ch 2, Sec 3): “Permanently fixed cables connecting the shore connection box to the main switchboard are to be protected by fuses or circuit-breakers.”

4.8.1.2. Electrical Equipment Enclosures

In clause 5.1.4 (Pt C, Ch 2, Sec 2) it is stated: “Enclosures for electrical equipment are generally to be of metal; other materials may be accepted for accessories such as connection boxes, socket-outlets, switches and luminaires. Other exemptions for enclosures or parts of enclosures not made of metal will be specially considered by the Society”.

Clause 5.1.6. mandates all nuts and screws used in connection with current-carrying parts and working parts to be effectively locked. Also, it is the requirement for all equipment generally to be provided with suitable, fixed terminal connectors in an accessible position for convenient connection of the external cables.

The next clause, 5.2, specifies the requirement for protecting enclosures against the ingress of foreign objects and water. The minimum required degree of protection, depending on the installation location, is generally as listed in Annex II (Minimum Degree of Protection Table).

According to Class, RES.6 (1995) version of Rules, applicable at the time of construction of the yacht Acceptus, explicitly permitted the use of nonmetallic accessories and junction boxes, including PVC, provided that they matched the required protection degree for the installation location.

In the latest version of Rules (RES.31), the use of PVC connection boxes is permitted, such as the one installed in the technical area where the fire originated.

4.8.1.3. Structural Requirements for Ship Cables (Conductors)

The structural requirements are contained in Section 9 (Part C, Chapter 2) of the Rules. At the beginning of this section, the standards according to which cables must be designed are specified[4]. As stated in 1.2.2, "individual conductor wires of rubber-insulated cables are to be tinned or coated with a suitable alloy" (Annex III).

According to the Class, this requirement was not valid at the time of construction of the yacht Acceptus, and the installation of tinned or suitably alloy-coated cables was therefore not required.

4.8.2. Fire Protection

Fire protection, detection and extinction is regulated in Part C – Machinery, Systems and Fire Protection, Chapter 4. The following points highlight the key elements of this chapter relevant to the investigation:

4.8.2.1. Fire Prevention

As per clause 1.1.2 in the *Fire Prevention* section of the Rules (Pt C, Ch 4, Sec 2), "combustible materials and flammable liquid excluding fuel oil necessary for the propulsion engines are not to be stowed in the engine space".

This provision protects the engine room from fire hazards and raises the safety standards for this space. However, the Rules contain no specific clauses, within the context of fire prevention that regulate fire control measures in spaces where such flammable materials and liquids are stowed.

As established in Chapter 4.1 of this report, the technical area and the control room contain numerous flammable materials and liquids, including the fire pump with its associated diesel fuel tank.

[4] The compliance with the following standards: IEC 60092-350, 60092-360, 60092-352, 60092-353, 60092-354, 60092-370, 60092-376

The potential storage of such materials and liquids in these spaces (in the absence of an adequate alternative location) presents an additional risk to the safety of the vessel.

4.8.2.2. Fire Containment

Section 3 of this chapter regulates fire containment, with the purpose of restricting a fire to the space of origin. The following functional requirements are listed:

- The yacht is to be subdivided by thermal and structural boundaries.
- The insulation of these barriers should consider the fire risk of each space and nearby areas.
- The fire integrity of the division is to be maintained at openings and penetrations.

In the same section, clause 3.1.1 contains the definitions of specific spaces on the yacht:

- Other machinery spaces: "Spaces so defined, excluding machinery spaces of category A[5], sprinkler, drencher or fire pump spaces.
- Control stations:
- Service spaces (high risk): "Galleys, pantries containing cooking appliances, paint and lamp rooms, lockers and storerooms having areas of 4 m^2 or more, spaces for the storage of flammable liquids, workshops other than those forming part of the machinery spaces, and spaces containing vehicles or craft with fuel in their tanks, or lockers storing such fuels and storage lockers for gaseous fuels for domestic purposes".
- Service spaces (low risk): "Lockers and storerooms not having provision for the storage of flammable liquids and having areas less than 4m^2, and drying rooms and laundries."

Based on the aforementioned definitions, the technical area where the fire originated should be classified as "other engine spaces" due to the presence of the emergency fire pump and its fuel tank in the forward section. The lazarette is a high-risk service space, while the control room, according to these definitions, can be categorized as a control station. During the investigation, no official documentation was found confirming that the aft lower-deck spaces – technical space, lazarette, and control room – had been classified in accordance with these definitions.

The Rules do not contain a requirement for these spaces to be separated by fire-resistant bulkheads of a specific category. Such a requirement exists only for engine rooms, which on this yacht were constructed in accordance with the Rules, following the exemptions applicable to yachts under 500 gross tons (Annex VII). Specifically, Section 2.1.1 provides that an A-type engine room on yachts operating on shorter voyages may be enclosed by B-15 bulkheads, as was actually implemented.

Accordingly, the fire-resistant bulkheading on the subject yacht was executed in compliance with Class requirements.

[5] As defined in 1.4 Definitions (Pt C, Ch 1, Sec 1) of Rules for Classification of Yachts (RES.31)

4.8.2.3. Protection of Spaces Containing Recreational Craft and Associated Fuel

This part of the Rules (Pt C, Ch 4, Sec 6) prescribes fire protection measures for spaces containing vehicles or craft with fuel in tanks having a flash point equal to or lower than 55 °C, as well as for storerooms where such fuel is kept. The Rules recognize different types of spaces where such craft may be located, including enclosed garages (enclosed vehicle spaces). The section stipulates that these spaces must be equipped with at least two fire detectors, with smoke detectors required in the case of enclosed garages. Garage spaces must also be fitted with a water spray or sprinkler system designed to deliver 3.5 l/m² × min. The water spray system may be connected to the main fire line. Alternatively, a system providing an equivalent level of protection may be installed, subject to Class approval.

In accordance with these requirements, the yacht Acceptus was equipped with an automatic fixed sprinkler system in the lazarette.

4.8.2.4. Fire Applications

This part of Rules regulates onboard fire appliances, detailing number and specification of appliances in the table 1 (Annex IV) in clause 1.1.1 (Pt C, Ch 4, Sec 8).

The specifications of the main and emergency fire pump are outlined in this table under 2 & 3, and additionally, in clause 2.1 (pt C, Ch 4, Sec 8), requiring pumps are to be installed in two different spaces together with their own source of power and sea connection. On yachts of less than 500 GT, the emergency fire pump may be portable, provided it is fitted with a fixed sea suction. The fire pumps on the subject yacht were constructed in accordance with the aforementioned regulation.

According to the same table, a fixed fire-extinguishing system is mandatory for machinery spaces only. There is no requirement to have it installed in other machinery spaces or service spaces. Detailed clarification is on the fixed systems is provided in the clause 3 of this section (Annex V).

A fixed fire-extinguishing system is to be provided in machinery spaces of category A and in all other machinery spaces containing a fuel oil settling tank or fuel oil unit. Since this refers exclusively to fuel intended for the propulsion of the yacht, there is no obligation to install such system in “other machinery spaces” without the above-mentioned tank or equipment (as defined in Annex VI). Clause 3.2 sets out the provisions regarding the installation and use of such systems in superstructures, technical spaces, and control rooms. These provisions stipulate the mandatory installation of an automatic sprinkler system, fire detection, and fire alarm in the mentioned spaces. However, yachts of less than 500 GT are exempted from this obligation (Annex VII).

In conclusion, with regards to fixed fire-fighting system, the yacht *Acceptus* was constructed in accordance with the applicable Rules and, accordingly, did not have a fixed system installed in the technical area and control room.

5. CONCLUSION

The investigation determined that the fire originated in the PVC junction box located in the lower-deck technical area of the yacht, on the bulkhead separating this space from the adjacent lazarette. At this location, due to a poor connection and the use of untinned ordinary copper conductors, an electrical fault occurred, resulting in deformation and melting of the connection point, followed by melting of the plastic junction box and heat transfer to the immediate surroundings.

Therefore, the installation of a power cable of these specifications, along with the configuration of the connection point between its two segments, is a causal factor in this casualty.

At the time the fire started, the vessel's shore power cable remained physically connected to the shore supply and remained energized. This increased the risk of fault current and potential voltage effects on damaged or degraded parts of the cable, and this practice is therefore regarded as a contributing factor to the accident.

The fault location should have been protected by the shore-side distribution board's protective devices. The use of an unapproved and unverified extension cable with unknown technical characteristics as a continuation of the yacht's power cable to the shore distribution board potentially impaired the operation of the protective devices, which the investigation also considers a contributing factor.

The initial flame melted the PVC junction box in which the fire started, allowing the fire to spread into the surrounding technical area. Therefore, the material from which the junction box was made is considered a contributing factor.

Further fire propagation was facilitated by the installation of the underfloor installation duct and cable routes without fire-resistant bulkheads or adequate fireproof linings, which accelerated the fire's spread to other parts of the vessel, also qualifying as a contributing factor.

The absence of a fixed fire suppression system in the technical area where the fire originated, as well as in the control room where it first spread, limited firefighting capabilities.

Therefore, the investigation concludes that the lack of such a system in the technical area and control room is a contributing factor, which allowed the fire to persist long enough to involve the structural parts of the yacht, after which it spread freely throughout the vessel.

6. SAFETY LESSONS

Based on the results of the safety investigation into the marine casualty of the motor yacht *Acceptus* and following the analysis and conclusions of this report, the Agency for the Investigation of Accidents in Air, Maritime, and Railway Transport issues the following safety lessons:

AIN05-SL-2/2026: Safety Standards of the Electrical Installations on Vessel

Electrical installations are a frequent source of fires. Therefore, the proper design, installation, maintenance, and use of onboard systems are essential for the vessel's fire safety.

Cables installed on vessels must be technically compatible with the corresponding systems, but even more importantly, they must be suitable for the specific environmental conditions in which they operate. For the safety of the vessel, it is important to use only cables specifically designed for marine and shipboard applications.

The key difference lies in the conductor construction – marine cables use tinned copper wires, which significantly reduce the risk of corrosion at the connections and within the conductors themselves. Cables must also have appropriate insulation that does not support combustion and serves as fire-resistant insulation.

All power cables must only be connected inside junction boxes or cabinets with enhanced protection levels. Even in this case, connection points within the cabinets must be further protected with coatings against condensation and salt retention from the air. Elevated protection of distribution cabinets does not guarantee complete safety against the ingress of air, and thus moisture and salt. These substances deposit on surfaces after evaporation, creating hygroscopic layers that attract additional moisture.

Junction boxes must be made of materials that can prevent, or at least effectively slow down, the spread of flames originating inside them. Additionally, various technical solutions can be applied to reduce the negative impact of the marine environment, such as anti-corrosion sprays, boxes with controlled internal overpressure, and similar measures. Since these locations can be sources of sparking, regular inspections must verify the tightness of screw connections, not only mechanically but also by checking for conductor pull-out resistance.

When not used for power transmission, the shore power cable must be physically disconnected from the shore distribution panel to reduce the risk of voltage effects on damaged or degraded parts of the cable.

Cable routes should be installed according to class rules, providing adequate fire protection, with the aim of preventing the spread of fire. This applies especially to cables intended for the high-power transmissions, from one panel to another, or to larger consumers.

Such routes should be enclosed, and all cable penetrations through bulkheads must be executed using protective barriers, in accordance with the manufacturer's instructions. Routes containing cables of different voltage levels must be separated by a safe distance.

Any additional interventions on the electrical installations must be carried out by authorized personnel, with the knowledge and approval of the classification society. The proper installation and operation of the electrical system must be checked during the vessel's construction and throughout its service life.

Recipients: This safety lesson is intended for classification societies, flag state maritime administrations, yacht owners and managers, yacht crews, charter companies, and port authorities managing marinas and yacht harbours.

AIN05-SL-3/2026: Fire Protection of Technical Areas and Control Stations

Fire protection must primarily focus on prevention. However, if a fire does occur, it is essential to ensure that flames cannot spread rapidly and that the fire can be brought under control as effectively as possible.

This is achieved by dividing the vessel into fire zones, using fire-resistant bulkheads and fire doors, implementing early detection and alarm systems, and installing fire-extinguishing systems.

Fire-extinguishing systems include:

- Initial-phase firefighting devices (e.g., portable fire extinguishers, sprays, and passive systems in transparent containers that release their contents when exposed to high temperatures—particularly suitable for electrical cabinets).
- Developed-fire suppression systems, such as sprinkler systems, water mist systems, CO_2 systems, NOVEC 1230 gas systems, and similar technologies.

Apart from the engine room, which is particularly critical due to the equipment and flammable materials present but is usually adequately covered by fire protection systems, attention must also be given to other spaces that require additional fire protection. Areas containing significant electrical equipment, fuel, or hydraulic oils should be equipped with fixed fire-extinguishing systems (automatic or remotely activated). Early activation of these systems can significantly improve the chances of successfully controlling a fire on the vessel and may even fully extinguish it in its initial stage.

The installation of such systems is especially important on vessels with sandwich-structure construction. When flames and high temperatures reach the inner layer of the structure, the suppression of the fire spread becomes extremely challenging, as the outer, non-combustible layer insulates the flammable core from the action of fire-fighting agents.

Recipients: This safety lesson is intended for classification societies, flag state maritime administrations, yacht owners and managers, yacht crews, charter companies, and port authorities managing marinas and yacht harbours.

7. SAFETY RECOMMENDATIONS

Safety recommendations are intended for those recipients who are most competent for their implementation, with the aim of preventing future accidents and incidents and improving safety in general. Safety recommendations in no case create a presumption of liability or blame for the accident.

Based on the results of the safety investigation of this accident, and derived from the analysis and conclusions of this report, the *Air, Maritime and Railway Traffic Accidents Investigation Agency* issue the following safety recommendation:

AIN05-SR-2/2026: It is recommended that *RINA Classification Society* amend the *Rules for the Classification of Yachts* so as to extend the existing requirements for fixed firefighting systems of appropriate specifications in technical areas and control spaces containing highly flammable materials and liquids to all yachts, regardless of size.

AIN05-SR-3/2026: It is recommended that *RINA Classification Society* amend the *Rules for the Classification of Yachts* to require high-capacity power cables on yachts to be installed exclusively within enclosures and cabinets constructed of materials that effectively limit the spread of flames originating within them.

8. APPENDIX

Annex I: Weather Report on issued on 28 Jun 2024 (source: DHMZ)

Upozorenje:
Na južnom i dijelu srednjeg Jadrana mjestimice udari NW i W, tijekom noći uz obalu i NE vjetra 35-40 čvorova. Još danas postoji vrlo mala mogućnost za neverin i to uglavnom uz obalu.

Prognoza za srednji Jadran:
NW i W vjetar 6-16, od sredine dana će jačati na 10-20, na jugoistoku područja mjestimice do 28 čvorova, tijekom noći će uz obalu skretati na NE 6-16, na jugoistoku područja mjestimice do 20 čvorova. Još tijekom jutra uz obalu tiho ili vjetar promjenjivog smjera 4-12 čvorova. More 1-2, ponegdje 3, prema večeri na jugoistoku područja moguće 4. Vidljivost 10-20, još u početku ponegdje moguća oko 5 km zbog sumaglice. Pretežno vedro, ponegdje umjerena naoblaka. Još danas uz povećanu naoblaku postoji vrlo mala mogućnost za kišu ili poneki pljusak s grmljavinom, uglavnom uz obalu.

Upozorenje i prognoza PMC-a Split objavljena 28.06.2024. godine u 12:00 sati i vrijedi do 29.06.2024. u 12:00 po lokalnom vremenu:

Upozorenje:
Na srednjem i južnom Jadranu mjestimice udari NW i W vjetra do 35 čvorova. Postoji mala mogućnost za neverin.

Prognoza za srednji Jadran:
NW, noću uz obalu i NE 6-16, a poslijepodne NW i W do 22 čvora. More 2-3, poslijepodne na otvorenom 3-4. Vidljivost oko 20 km. Pretežno vedro, uz jači razvoj naoblake postoji mala mogućnost za pljusak s grmljavinom.

Upozorenje i prognoza PMC-a Split objavljena 28.06.2024. godine u 18:00 sati i vrijedi do 29.06.2024. u 18:00 po lokalnom vremenu:

Upozorenje:
Postoji mala mogućnost za neverin.

Prognoza za srednji Jadran:
NW, noću uz obalu i NE 6-16 čvorova. More 2-3, još u početku na otvorenom ponegdje 4. Vidljivost oko 20 km. Pretežno vedro, uz jači razvoj naoblake postoji mala mogućnost za pljusak s grmljavinom.

Annex II: Minimum Degrees of Protection

(source: RINA Rules for the Classification of Yachts (Pt C, Ch 2, Sec 2))

Table 2 : Minimum Degrees of protection

Example of location	Generators	Motors	Transformers	Swichboard and control gear	Instruments	Switches	Luminaires	Accessories
Steering gear room (above floor) and control rooms	I P 22	I P 22	I P 22	I P 22	I P22	I P 22	I P 22	I P 44
Battery rooms							I P 44+(Ex)	
General store; provision rooms		I P 22				I P 44	I P 44	I P 44
Closed navigation bridge		I P 22	I P 22	I P 22	I P22	I P 22	I P 22	I P 22
Dry accommodation space		IP 20	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20
Damp or humid spaces; ventilation pipes and engine room (above floor)	I P 44	I P 44	I P 44	I P 44	I P 44	I P 55	I P 44	I P 55
Engine rooms (below floor) **(1)**		I P X8			I P X8	I P X8	I P X8	
Open deck		I P 56		I P 56	I P 56	I P 56	I P 56	I P 56
(1) Electrical equipment is not to be installed below floor plates in engine rooms, except as indicated above.								

Annex III: Conductors

(source: RINA Rules for the Classification of Yachts (Pt C, Ch 2, Sec 9))

1.2 Conductors

1.2.1 Conductors are to be of annealed electrolytic copper with a resistivity not exceeding 17,241 Ω mm^2/km at 20°C according to IEC 60228.

1.2.2 Individual conductor wires of rubber-insulated cables are to be tinned or coated with a suitable alloy.

1.2.3 All conductors are to be stranded, except for cables of nominal cross-sectional area 2,5 mm^2 and less (provided that adequate flexibility of the finished cable is assured).

1.2.4 For the minimum nominal cross-sectional areas permitted, see Sec 3, [9.10].

Annex IV: Fire Appliances

(source: Rules for the Classification of Yachts (Pt C, Ch 4, Sec 8))

Table 1 : Fire appliances

Num	Appliances	Number and specifications
1	Provision of water jet	1 Sufficient to reach any part of the vessel
2	Primary power-driven fire pump	1 The pump is to be driven by the propulsion engines or other different engines
3	Additional independent power-driven fire pump	1 The pump, power source and sea connection are not to be fitted in the same space as the pump listed in item [2]. The capability of this pump is to be not less than 80% of the capability of the pump listed in item [2].
4	Fireman & hydrants	The number of hydrants and the arrangement of the fireman are to be capable of supplying at least one water jet to any point of the yacht with a single length of hose.
5	Hoses - with jet/spray nozzles each fitted with a shut-off facility	at least 2
6	Portable fire extinguishers	At least one portable fire extinguisher is to be fitted for each deck. The type of medium and quantity are to comply with the following items.
7	Fire extinguishers for a machinery space other than cat. A containing internal combustion type machinery	The following appliances are to be provided: a) one portable fire extinguisher type D-II; b) one portable fire extinguisher type F-II.
8	Fire extinguishers in machinery space of category A	a) a fixed fire-extinguishing system in conformity with the requirements of item [3] b) one portable fire extinguisher type D-II; c) one portable fire extinguisher type F-II.
9	Fire extinguishers and appliances in other service spaces	**Radio room or wheelhouse:** 1 portable fire extinguisher type F-II near radio equipment or electrical apparatus; **Galley:** 1 portable fire extinguisher type E-II fitted near the exit; 1 fire blanket **Storerooms:** 1 portable fire extinguisher type E-II fitted near the exit Fire extinguishers of CO_2 type are not permitted in the storerooms

Annex V: Fixed Fire-extinguishing System

(source: Rules for the Classification of Yachts (Pt C, Ch 4, Sec 8))

3 Fixed fire-extinguishing system

3.1

3.1.1 A fixed fire-extinguishing system is to be provided in machinery spaces of category A and in all other machinery spaces containing a fuel oil settling tank or fuel oil unit.

3.1.2

The system is to be in compliance with the IMO FSS CODE and with the requirements given in Annex 2 if carbon dioxide is used as fire extinguishing medium. Systems using other extinguishing medium (e.g. FM200, Novec 1230) may be accepted if certified in accordance with IMO requirements.

RINA Rules for the Classification of Yachts 2025 **510**

Pt C, Ch 4, Sec 8

3.2 Fire Detection and Fire Fighting system for accommodation, service space, control stations

3.2.1 Each separate zone in all accommodation and service spaces, except spaces which afford no substantial fire risk such as void spaces, sanitary spaces, etc, is to be provided throughout with an automatic sprinkler, fire detection and fire alarm system of an approved type and complying with the requirements of SOLAS, Part C regulation II-2/7 and the IMO FSS Code, Chapter 8, or an equivalent standard accepted by the Society. The system is to be designed to enable simultaneous operation of all sprinklers fitted in the most hydraulically demanding area. The minimum area for simultaneous operation may be taken as the largest area bounded by A0 class divisions or the breadth of the vessel squared, whichever is the greater. In addition, a fixed fire detection and fire alarm system of an approved type complying with the requirements of SOLAS II-2/7 and the IMO FSS Code, Chapter 9 is to be installed and arranged to provide smoke detection in corridors, stairways and escape routes within accommodation spaces.

Annex VI: Fuel Oil Unit

(source: Rules for the Classification of Yachts (Pt C, Ch 1, Sec 1))

1.4.3 Fuel oil unit

Fuel oil unit is the equipment used for the preparation of fuel oil for delivery to an oil fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 0,18 N/mm^2.

For the purpose of this definition, inert gas generators are to be considered as oil fired boilers and gas turbines are to be considered as internal combustion engines.

Annex VII: Alternatives, Relaxations and Additional Considerations for Yachts below 500 GT (source: Rules for the Classification of Yachts (Pt C, Ch 4, App 1))

1 Fire prevention (Sec 2)

1.1 General

1.1.1 With reference to Sec 1, [7.1.3] the vapour barrier are to have low flame spread characteristic as far as it is practicable.

2 Fire containment (Sec 3)

2.1 Class divisions

2.1.1 *(1/7/2025)*
With reference to Sec 3 as an alternative to [3.1.2] to [3.1.5] what below may be applied. For unrestricted yachts category A machinery spaces are to be totally enclosed by A-30 class boundaries. For short range yachts of any gross tonnage, category A machinery spaces are to be enclosed by B-15 class divisions. For unrestricted yachts and for yacht of more than 300GT in short range navigation the galley to be totally enclosed in B-15 class boundaries (bulkheads, side shell and deck heads). Windows within the exterior hull or superstructure within this boundary are not expected to meet "B-15" standards. The side shell and deckheads beneath exterior decks for those vessels constructed from steel need not to be insulated.

2.1.2 *(1/7/2025)*
With reference to Sec 3, [3.2.1] and [3.2.2] are not mandatory.

2.1.3 *(1/7/2025)*
With reference to Sec 3, [3.2.3] for yacht of less than 300 GT is not mandatory.

2.2 Ventilating systems

2.2.1 *(1/7/2025)*
With reference to Sec 3 as an alternative to [4.1.2] what below may be applied. Ventilation ducts serving category A machinery spaces, galleys, spaces containing vehicles or craft with fuel in their tanks, or lockers containing fuel tanks are not to cross accommodation spaces, service spaces or control stations unless the trunking is constructed of steel (minimum thickness 4 mm). The ducting within the accommodation is to be fitted with fire insulation required in [2.1.1] for the machinery space of category A or galley to a point at least 5 metres from the machinery space of category A or galley. A material other than steel duly insulated to reach the required fire class in [2.1.1] may be also acceptable.

2.3 Sauna

2.3.1 With reference to Sec 3, [3.3.3] what below may be applied. The insulation of sauna may be reduced to A-30.The insulation of sauna may be reduced to B-15 in case of short range yachts.

2.3.2 With reference to Sec 3, [3.3.3] what below may be applied. As an alternative to the automatic sprinkler system, a manual water spray system giving a coverage of 3.5 ltr/m2/min over the total area of the floor may be provided. Such a system may be taken from the fire main or be independent. Electrically driven fire pumps shall be provided with an emergency power supply.

2.4 Steam Room

2.4.1 *(1/1/2025)*
With reference to Sec 3, [3.4.3] in case of yachts of less than 300GT the A-0 class may be replaced by B-0.

3 Means of Escape (Sec 5)

3.1 Means of escape form accommodation

3.1.1 In general the main and emergency means of escape have to be fully independent. In some exceptional situation there can be maximum of 4 meters of shared escape way.

3.1.2 *(1/7/2025)*
With reference to Sec 5, [4.1.3] at least one of the two stairways required as means of escape is to be of steel or other equivalent material (alluminum alloy suitably insulated).

4 Fire applications (Sec 8)

4.1 Fire pumps

4.1.1 With reference to Sec.8 [2.1] and [2.3] the emergency fire pumps may be portable but with fixed sea suction.

4.2 Fire Fighting system for accommodation, service space, control stations

4.2.1 With reference to Sec.8 [3.2] sprinkler system is not mandatory.