MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

ACCIDENT REPORT

SERIOUS MARINE CASUALTY | REPORT NO 20/2013 | AUGUST 2013

Engine room fire on board FV *AMY HARRIS III*

South of the Isle of Arran
16 January 2013

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SUMMARY

At 1500 (UTC[1]) on 16 January 2013, the skipper of *Amy Harris III* discovered a fire in the engine room. The crew's initial attack on the fire was unsuccessful. Doors and a hatch that were left open allowed smoke to rapidly spread forcing the skipper and his three crewmen onto the deck. No further attempts were made to suppress or control the fire, and the crew were airlifted off the vessel by rescue helicopter soon afterwards. The vessel was subsequently towed into Campbeltown where the fire was extinguished. *Amy Harris III* was later declared a constructive total loss.

The most likely cause of the fire was the ignition of diesel fuel oil, which had leaked from a flexible pipe supplying the auxiliary engine's fuel lift pump.

The owner has been recommended to: properly support pipework to prevent fatigue failure; ensure crews are fully conversant with the emergency equipment and conduct monthly emergency drills; properly maintain emergency equipment; conduct risk assessments and improve housekeeping standards.

Recommendations have also been made to the skipper to attend a refresher fire-fighting course, and to the Sea Fish Industry Authority to test students' knowledge of fixed fire-fighting systems in its Basic Fire Fighting Course assessment.

[1] Universal Time Co-ordinated

Photo courtesy of Trawler Pictures

Amy Harris III

FACTUAL INFORMATION

Vessel

Built in 1971, *Amy Harris III* was a Campbeltown registered, wooden, twin-rig prawn stern trawler, which had been under her current ownership for the past 12 years. A profile drawing is at **Figure 1**.

The vessel, which predominantly sailed each day to carry out fishing operations, was required to comply with The Code of Safe Working Practice for the Construction and Use of 15 Metre Length Overall to Less Than 24 Metres Registered Length Fishing Vessels (the Code). *Amy Harris III* was last surveyed on 5 November 2010, her UK Fishing Vessel Certificate was due to expire on 31 January 2016 and her mid-term inspection was intended to be conducted in January 2013.

For the 15 months prior to the accident the owner had delegated the authority to operate and maintain *Amy Harris III* to the skipper. He had not been on board during that time.

There was a large amount of redundant equipment and surplus material on board *Amy Harris III*, including spare drums of oil in the engine room, which increased the fire risk and impacted on safe access.

Fire-fighting and salvage equipment

Fire-fighting water was supplied by the main engine-driven deck wash pump. An emergency, hand-operated, diaphragm pump was positioned in the galley. There were no dedicated discharge hoses for the emergency pump, which was found to be defective.

Portable foam extinguishers were located in both the cabin and wheelhouse. Portable dry powder extinguishers were located in both the engine room and galley. The galley was also equipped with a fire blanket. A second portable extinguisher, which should have been in the engine room, could not be found. This was contrary to Section 5.1.6.1 of the Code, which required at least two portable extinguishers capable of dealing with oil fires to be provided in a machinery space.

Two engine room forced-air supply vents were fitted with closure plates, and a single natural exhaust vent was fitted with a plug. These were readily accessible and stowed adjacent to the vent terminals. The two supply fans were controlled from the engine room but could be stopped by tripping electrical mini-circuit breakers (mcbs) located behind an unmarked, hinged cover in the wheelhouse. However, none of the crew was aware of this.

There were three fuel quick shut-off valves to isolate fuel supplies from the port and starboard fuel tanks to the main and auxiliary engines. These were remotely operated from the wheelhouse and were fully functional.

A single-shot, fixed CO_2 fire-extinguishing system for the engine room was fitted under the port side shelter.

A portable salvage pump, together with a spare canister of petrol, was stowed in an enclosed locker under a bench in the port side shelter. No suction hoses could be found. The unit was defective and it had not been tested during the skipper's 15-month tenure.

NARRATIVE

From departing Ardrossan to discovery of the fire

At 0800 on 16 January 2013, *Amy Harris III* started fishing off the east coast of Holy Island. The skipper carried out his routine checks of the engine room at about 1030 and noted nothing untoward. At approximately 1200, the auxiliary engine was started and run for about 50 minutes while the nets were hauled. During the haul, a broken strand was found on the centre warp and the skipper decided it was unsafe to continue fishing. At 1330, he set a course to Campbeltown where he intended to replace the warp.

At 1500, the Zone 1 (engine room) fire alarm sounded. The skipper tried to reset the fire panel, but the alarm continued. As he entered the galley to descend the vertical ladder to the engine room he smelled smoke, as did the mate who had joined him.

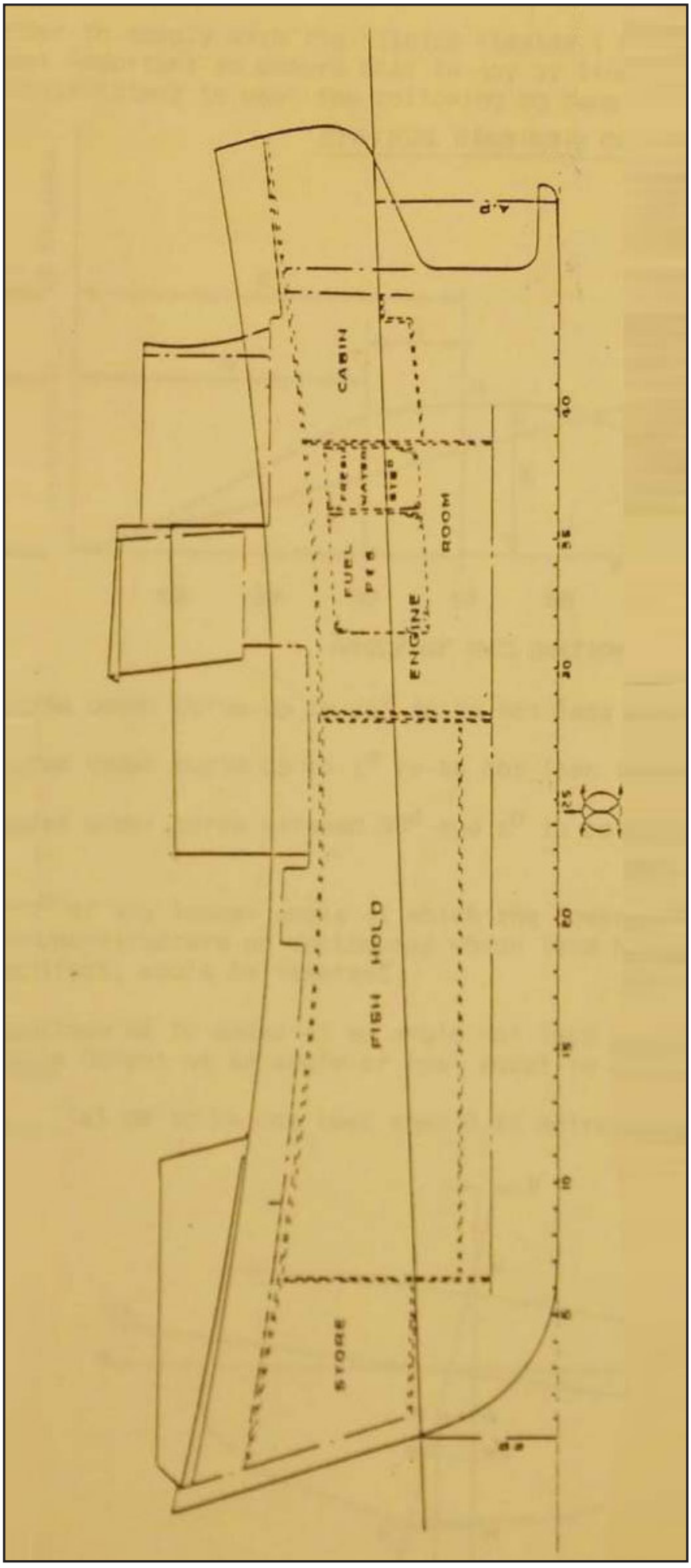

Figure 1: Profile of *Amy Harris III*

Fire-fighting

Once inside the engine room, the skipper and mate saw a pool of yellow flames, about 60cm in diameter and about 20cm high, directly under the shut-down auxiliary engine[2]. They did not notice any hydraulic oil or fuel leaks. Because the fire was small, the skipper opted to clutch-in the deck wash pump so the crew could fill a bucket with water which he intended to use to quench the fire.

Once the bucket had been filled and passed to him, the skipper threw the water onto the fire. However, instead of extinguishing the fire it broke it up into a number of smaller pools of flames, which then started to progress up the turn of bilge, outboard of the auxiliary engine. A second bucket of water was passed down by the mate, who noticed the fire had rapidly grown suggesting that it was constantly being fed. The mate then went to the cabin to fetch the portable foam extinguisher while the skipper threw the water onto the rapidly growing fire, again with no effect.

Intense smoke from the fire forced the skipper out of the engine room. The mate tried to close the wooden engine room door before climbing up the ladder to the galley and into the wheelhouse, but the hold-back hook was seized. The mate then also had to escape to the galley as the smoke levels increased, leaving the engine room door open as he left.

At 1505, *Amy Harris III* was 2.9 nautical miles south of the Isle of Arran when the skipper transmitted a voice “Mayday” message on the VHF[3] radio. He did not press the Digital Selective Calling (DSC) button. As the smoke density increased, the skipper had to evacuate from the wheelhouse. He did not have time to collect the hand-held VHF radio, stop the main engine, close the wheelhouse’s starboard forward window, or operate the three fuel quick shut-off valves.

As the skipper re-entered the galley, he met with the mate and one of the two other crewmen. The dense smoke drove the crew out of the deckhouse, leaving open the wooden hatch between the galley and the engine room lobby. This provided a route for the fire to spread from the engine room to the galley and wheelhouse. However, the mate did manage to close the galley’s external steel door as he reached the outside deck.

Post-fire actions and recovery

While the crew waited on deck for the emergency rescue services, they decided to move the liferaft from the wheelhouse roof and lash it to the port bulwark in case the vessel had to be abandoned. While doing so, the skipper managed to put his arm through the open wheelhouse window and disengage the gearbox from the main engine. Unfortunately, he could not reach the button to stop the engine.

As the smoke level increased under the shelter the crew decided there was nothing they could do to bring the fire under control. Smoke then emerged from the fish hold hatch as the fire intensified, indicating that the wooden bulkhead between the engine room and fish hold had started to burn.

At 1522, the mate managed to talk to the crew of rescue helicopter R177, from Prestwick, using his mobile telephone linked through Belfast Coastguard, who advised they would be on scene shortly. The mate then decided to soak his hat with water, place it over his nose and mouth, then enter the wheelhouse, re-engage the gearbox and turn the vessel into wind in an attempt to aid the rescue by the helicopter crew. After he did so, he disengaged the gearbox but was unable to stop the engine before he was forced from the wheelhouse by the smoke, leaving the external galley door open.

At 1532, R177 hovered overhead and the down-draught turned *Amy Harris III* back onto her original heading. The crew were quickly winched from the vessel and landed at Macrihanish Airport on the Kintyre peninsula. Apart from minor smoke inhalation, there were no injuries.

Towage and extinguishing the fire

Amy Harris III was later taken under tow to Campbeltown. At 2100 when *Amy Harris III* arrived in port she was still burning, the galley door was open and the main engine was running.

[2] The auxiliary engine drove the hydraulic pump supplying the winch and power block.

[3] Very High Frequency

The owner briefed Strathclyde Fire and Rescue Service (FRS) on the vessel's layout and, at 2200, an FRS team wearing breathing apparatus closed the three engine room vents, the air supply fans having previously stopped because of fire damage. Once in the galley, they shut the wooden hatch giving access to the engine room lobby. They then operated the fuel quick shut-off valves, shut the open wheelhouse window and pressed the engine stop[4]. The external steel galley door was shut and the engine room fixed CO_2 system was then operated. Soon afterwards, the FRS's thermal-imaging cameras detected that the fire was reducing. The FRS cooled the area overnight and declared the vessel safe at 1200 on 17 January.

Damage

The forward section of the engine room suffered extensive fire damage. The fire's locus was at the starboard forward corner where the fire had partially burnt through the deckhead and the engine room/fish hold bulkhead. The majority of overhead electrical cabling had been consumed by the fire, as had the switchboards located at the port forward section of the engine room. The heat layer had melted the tops of three of six, 25-litre plastic drums containing hydraulic oil that were located in the bilge and on the floor plates forward of the auxiliary engine. However, there was no evidence that the exposed oil surface had been involved in the fire. There was also extensive smoke damage throughout the after section of the vessel.

Crew

The skipper of *Amy Harris III* was 62 years of age and held a Second Hand (Special) Certificate of Competency issued on 25 April 1973. He had previously sailed with the owner and had skippered the vessel for the previous 15 months. The mate, a Filipino national, and an 18-year-old local fisherman had worked on board for 2, 7 and 9 months respectively. The Filipino crewman was a salaried employee and the remainder were share fishermen. All the crew had completed the mandatory safety training courses[5].

[4] Because of the damaged wiring, the engine probably stopped because the fuel quick shut-off valves had been operated and not because stop button was pushed.

[5] The skipper completed his basic fire-fighting course in 1988.

Engine room fuel and electrical systems

A schematic of the engine room layout, and fuel and electrical systems is at **Figure 2**. On sailing, the main and auxiliary engine fuel supplies were provided from the starboard fuel tank. The port fuel tank supply valve was shut. Notably, the copper pipe supplying fuel to the auxiliary engine was unsupported throughout its length.

ANALYSIS

Fire - fuel and ignition sources

From witness evidence and inspection of the fire pattern and damage, the locus of the liquid-based fire was determined to be under the auxiliary engine. There were three potential liquid fuel sources in the vicinity: engine oil, hydraulic oil and diesel fuel oil.

The engine oil was at its correct running level and was therefore not causal. There was no obvious indication of hydraulic oil leakage. The Total MEP Hydraulic Oil ISO 32 in use has a flashpoint of >210°C and is not easily ignited spontaneously unless it is finely atomised under pressure. At the time of the fire, the hydraulic system was fully de-pressurised. Therefore, hydraulic oil is not considered to have been the fuel source.

When the auxiliary engine fuel quick shut-off valve was opened, diesel fuel oil, under the pressure of gravity, flowed into the bilge from the braided, flexible pipe that connected the starboard fuel tank to the engine fuel lift pump **(Figure 3)**. The flexible pipe, located on the outboard side of the engine and therefore out of the line-of-sight of the skipper and mate, was easily disconnected from the engine lift pump but was tight at its junction to the copper pipe running from the starboard fuel tank. Following the accident, the copper pipe passed a 20 psi pressure test, but laboratory examination of the flexible pipe determined it had suffered severe chafing in numerous areas. This was due to the connecting copper pipe being inadequately supported, which had allowed the fuel supply pipework to move excessively. There were also many areas of electrical arc damage, with copper

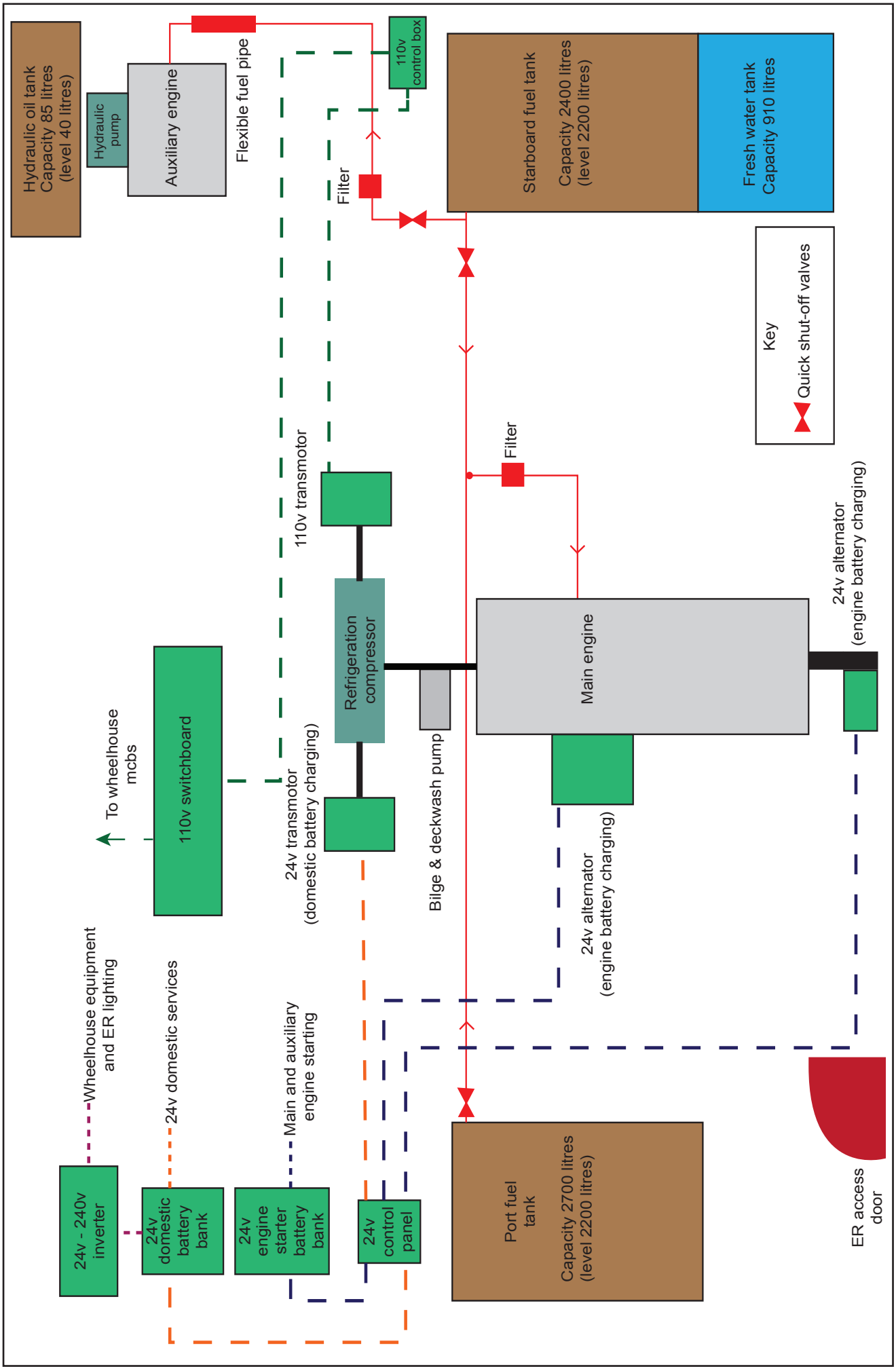

Figure 2: Schematic of the engine room layout, and fuel and electrical systems

Figure 3: Auxiliary engine braided flexible fuel pipe

deposit inclusion, to the outer stainless steel braiding. This is likely to have been caused when the electrical cables fell from the cable trays above the auxiliary engine as the fire developed. While the areas of chafing and electrical arc damage did not fully penetrate the bore of the polymer pipe, a section of the polymer pipe in the vicinity of the lift pump end connection had melted. Because of the absence of material, it was not possible to determine if there was also pre-existing damage in this area.

The auxiliary engine had been shut down for over 2 hours before the fire was discovered. The engine room was well ventilated and, while there would have been some residual heat, this would have been mainly around the area of the engine exhaust, which was distant from the area of probable fuel oil leakage. However, above the fire site, there was evidence of heavy arcing of the steel cable carrier where the 110 volt positive supply cable, from the control box to the switchboard, changed direction around a sharp edge of the carrier. The cable core had melted through causing heavy beading to the exposed ends **(Figure 4)**. The molten material from the cable is considered to be the possible source of ignition.

In summary, it is most likely that the fuel source for the fire originated from leakage from the auxiliary engine's flexible fuel supply pipe. This was ignited by arcing deposits from the 110 volt positive supply cable when the insulation was abraded against the sharp edges of the steel cable carrier.

Fire-fighting

The initial attack on what was obviously a liquid-based fire using buckets of water was poorly considered, and was contrary to basic fire-fighting practices. Although only one portable dry powder fire extinguisher was evident in the engine room, it was adjacent to where the bucket of water was thrown. Had the dry powder extinguisher been

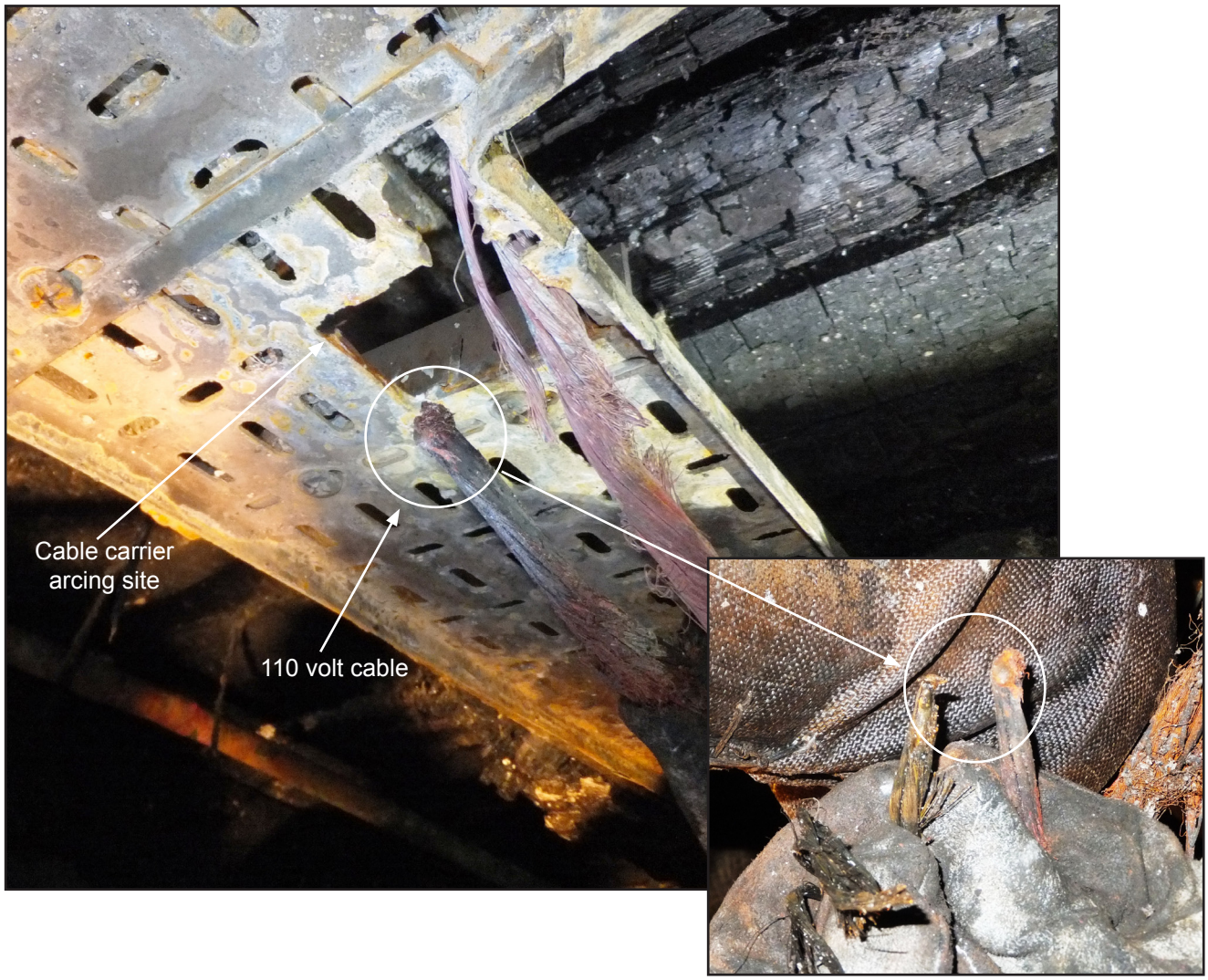

Figure 4: 110 volt cable carrier and cable beading

used promptly, it would probably have put out the fire. After seeing that the first bucket of water was ineffective, the escalation of the fire should have prompted the skipper to use the dry powder extinguisher. Had the extinguisher been used, even at this stage, it would probably have still extinguished the fire.

Containing the fire and establishing an effective smoke boundary are fundamental to being able to effectively tackle a fire. In this case, the fire was not contained because the engine room door could not be shut and the hatch in the galley was not closed. Had they been closed, the skipper would have had more time to close the open wheelhouse window, stop the engine and operate the fuel quick shut-off valves, and so eliminate the risk of feeding the fire with diesel fuel oil. Because the quick shut-off valves were not operated, the fire was continually fed with diesel fuel oil when the auxiliary engine flexible polymer fuel hose melted.

Once the crew were on the outside deck, consideration should have been given to closing the engine room vents. Had this been done, as later proven in Campbeltown, the CO_2 system could have been operated successfully. However, use of the CO_2 system was not considered at all during the emergency despite it being the most effective method of fighting the fire.

There was also no consideration given to establishing any form of boundary cooling as a means of containing the fire. Given that the deck wash pump was still running, there was an opportunity to use this more effectively. Although the crew did not know that the salvage pump was defective, it could also have been considered for boundary cooling use.

Mate's action

The mate's decision to re-enter the wheelhouse to steer the vessel's head to wind, served no purpose and should have been prevented. The wheelhouse was known to be smoke-logged, and re-entering it without the use of breathing apparatus severely compromised his safety. Holding his soaked hat across his face provided him with virtually no protection against smoke. In his urgency to get back into fresh air the mate left the external galley door open, which provided an uninterrupted oxygen supply for the fire. This, coupled with the leaking diesel fuel oil, only served to escalate the fire.

Emergency preparedness

The crew of *Amy Harris III* were totally unprepared to deal with the fire, which compromised their safety and the survivability of the vessel. Section 8.1.2 of the Code required the skipper to ensure that drills were carried out monthly so that the crew were familiar with the equipment and knew where it was stowed. The reference also required that details of the drills were recorded for future inspections.

Effective drills are essential in helping crew deal with an emergency in an instinctive, competent and confident manner. A successful outcome following an emergency is far more likely to be achieved if drills have been carried out regularly. MGN[6] 430 (F) – Fishing Vessels: Checks on Crew Certifications and Drills, provides surveyors with guidance on the conduct of drills, which can also be used by owners and skippers. None of the crew had been involved in drills on board *Amy Harris III*, and the last time the skipper had conducted a drill was 5 years previously. In this case, two crewmen did not know the whereabouts of the salvage pump or CO_2 system, or how to use them.

Had fire drills been carried out, it is likely the defects associated with the engine room door hold-back hook, the defective salvage pump, the need to mark up the engine room supply fan electrical mcbs, and the shortcomings in the crew's knowledge could have been identified and addressed.

The Sea Fish Industry Authority's mandatory Basic Fire-Fighting Course covers a range of fire-related situations, including the use of fixed fire-fighting systems. In 2012, an end-of-course assessment was introduced. The merit of this is fully recognised. However, knowledge of fixed fire-fighting systems is not currently assessed. As this case demonstrates, its inclusion would be beneficial.

Vessel management

The standard of general housekeeping on board *Amy Harris III* was weak. There was an abundance of surplus equipment, including flammables loosely stowed around the vessel, potentially compromising her safe operation. There were also many items of redundant equipment and associated electrical cabling on board. It is good practice to remove such items to reduce clutter and unnecessary cabling, and to avoid potential confusion over the operational status of equipment.

The owner's initiative to provide a dedicated, weatherproof enclosure for the salvage pump would have prevented the well-known problem of the pump seizing due to exposure to the weather. However, the pump had not been run during the skipper's time on board and, although not seized, the engine could not be started. Stowing the petrol canister in the same location as the pump presented a fire risk because it could not have been easily jettisoned in an emergency as required by Section 5.1.8.8.4 of the Code.

Section 1.3.7 of the Code requires owners or their delegated representatives, in this case the skipper, to sign an annual self-certification declaration, commencing one year after the issue of the full term Fishing Vessel Certificate. In signing, the person declares, among other items, that the fire-fighting appliances and safety equipment are suitably maintained, that risk assessments are appropriate and that crew training is valid. Neither the owner nor the skipper had made the required declarations for 2011 or 2012. Had this been done, the deficiencies related to the above items might have been identified and rectified.

[6] Marine Guidance Note

The MCA[7]'s publication - Fishermen's Safety Guide - provides wide-ranging guidance on vessel management issues. It is a useful reference for owners, skippers and crew, and it is helpful if a copy is carried on board fishing vessels.

Risk assessments

Because the Filipino crewman was salaried, he was a "worker" as defined in Statutory Instrument (SI) 1997 No 2962 – The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 as amended[8]. There was, therefore, a duty on the "Company", in this case the owner, to assess the risks to workers. There was no evidence that any risk assessments had been made of the activities on board *Amy Harris III.* Had a thorough risk assessment been undertaken, it is probable that fire risks relating to the stowage of the salvage pump petrol canister, drill requirements, and the need for fire-fighting equipment familiarity and maintenance would have been identified and acted upon. The crew would then have been better prepared to deal with emergencies.

The Sea Fish Industry Authority's Fishing Vessel Safety Folder is available on application and provides comprehensive guidance on conducting risk assessments.

CONCLUSIONS

- The fire was probably caused by diesel fuel oil leaking from the flexible fuel supply pipe to the auxiliary engine, which was ignited by electrical arcing deposits.
- The auxiliary engine fuel supply pipework was unsupported, which led to chafing, increasing the risk of diesel fuel oil leakage and fire.
- Electrical cabling was secured against sharp edges, increasing the risk of insulation damage and electrical arcing.
- The crew's knowledge of fire-fighting techniques, smoke containment and system isolations was weak and contributed to the spread of the fire. No consideration was given to the use of the engine room fixed CO_2 fire-extinguishing system.
- The crew had not carried out any drills to help them prepare for the emergency.
- The salvage pump was defective. It was not subjected to regular operation or maintenance, two crewmen were unaware of its location, and the position of the petrol canister increased the fire risk.
- The mate's action in re-entering the smoke-filled wheelhouse severely compromised his safety and led to the fire escalating as he left the external galley door open.
- There were significant shortcomings in the management of *Amy Harris III*, including: the absence of risk assessments and annual self-certification declarations; poor housekeeping standards; and an accumulation of redundant equipment all leading to increased risk.
- The Sea Fish Industry Authority's Basic Fire Fighting Course assessment does not include fixed fire-fighting systems.

[7] Maritime and Coastguard Agency

[8] The contents of the SI are also reflected in MGN 20 (M+F) – Implementation of EC Directive 89/391 Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997

RECOMMENDATIONS

The owner of *Amy Harris III*, Galbraith Trawlers Limited, is recommended to:

2013/222 Improve the safety of its fishing vessels by taking measures to ensure that:

- Fuel supply and other high-risk pipework is properly supported to prevent chafing and fatigue.
- As far as practicable, electrical cabling insulation is protected against abrasion from sharp surfaces.
- Monthly emergency drills are carried out and recorded.
- Salvage pumps are regularly tested and maintained for immediate use, and associated petrol canisters are stowed in accordance with Section 5.1.8.8.4 of The Code of Safe Working Practice for the Construction and Use of 15 Metre Length Overall to Less Than 24 Metre Registered Length Fishing Vessels.
- Risk assessments are undertaken and control measures applied.
- The standard of housekeeping is improved to reduce the risk of fire and personal injury.
- The MCA's publication - Fishermen's Safety Guide – is brought to the attention of skippers and crew.

The skipper of *Amy Harris III* is recommended to:

2013/223 Attend a fire-fighting course to update his knowledge of fire-fighting techniques and equipment.

Sea Fish Industry Authority is recommended to:

2013/224 Test students' knowledge of fixed fire-fighting systems in the assessment examination of its Basic Fire Fighting Course.

SHIP PARTICULARS

Vessel's name	*Amy Harris III*
Flag	United Kingdom
Classification society	Not applicable (MCA surveys)
Fishing numbers	CN 35
Type	Twin-rig prawn stern trawler
Registered owner	Galbraith Trawlers Limited
Manager(s)	Galbraith Trawlers Limited
Year of build	1971
Construction	Wood
Length overall	19.92 metres
Registered length	18.71 metres
Gross tonnage	37.12
Minimum safe manning	Not applicable
Authorised cargo	Not applicable

VOYAGE PARTICULARS

Port of departure	Ardrossan
Port of arrival	Campbeltown
Type of voyage	Coastal
Cargo information	Single haul of prawns
Minimum safe manning	Not applicable

MARINE CASUALTY INFORMATION

Date and time	16 January 2013 at 1500
Type of marine casualty or incident	Serious Marine Casualty
Location of incident	55º 23.55'N 005º15.3'W 2.9 nm south of the Isle of Arran
Place on board	Engine room
Injuries/fatalities	Minor smoke inhalation
Damage/environmental impact	Vessel – constructive total loss No environmental damage
Ship operation	On passage
Voyage segment	Mid-water
External & internal environment	South-easterly wind force 4, slight sea state, 0.1 knot south-easterly tidal stream, good visibility
Persons on board	4