ACCIDENT REPORT

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

Report on the investigation of

the ejection of six people

from the rigid inflatable boat

Milly

Camel Estuary, Cornwall

on 5 May 2013

VERY SERIOUS MARINE CASUALTY REPORT NO 5/2014 JANUARY 2014

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

CE	-	Conformité Européenne
CIN	-	Craft Identification Number
CRT	-	Coastguard Rescue Team
DoC	-	Declaration of Conformity
EC	-	European Commission
g	-	acceleration of gravity
GRP	-	Glass Reinforced Plastic
hp	-	horsepower
ILB	-	Inshore Lifeboat
ISO	-	International Standards Organization
kts	-	nautical miles per hour
kW	-	kilowatts
m	-	metres
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
mph	-	miles per hour
RCD	-	Recreational Craft Directive
RCR	-	Recreational Craft Regulations 2004
RIB	-	Rigid Inflatable Boat
rpm	-	revolutions per minute
RYA	-	Royal Yachting Association
UK	-	United Kingdom
UTC	-	Universal Co-ordinated Time
VHF	-	Very High Frequency

Times: All times used in this report are UTC + 1 unless otherwise stated

SYNOPSIS

On 5 May 2013, all six occupants of the 8.0m rigid inflatable boat *Milly* were ejected from the boat into the water as it was making a turn in the Camel Estuary, Cornwall. The engine cut-out 'kill cord' mechanism was not activated as it had not been attached to the driver. Consequently, the boat continued to circle with no-one at the helm, at full power, striking some of those in the water, fatally injuring two and seriously injuring two others.

On the day of the accident *Milly*'s owner, his wife and their four children were using the boat for the first time in 2013. During the afternoon, just prior to returning to the mooring, the adults changed over at the helm but the kill cord was not attached to the new driver. A short time later, the adult who was no longer controlling the boat reached across in front of the driver and operated the helm and engine controls to execute a tighter, high-powered turn, and the accident followed almost immediately.

The accident was witnessed by numerous members of the public, who alerted the emergency services. The emergency response was rapid and local lifeboats, rescue helicopters and other assets were quickly mobilised. A rapid response ambulance was sent to the beach nearest the accident, although the casualties were landed to Padstow harbour.

The investigation found that *Milly*'s owner and his wife had been given a familiarisation trip when they purchased the boat, and had also undertaken RYA powerboat training. However, they were not aware of the dangers posed during high speed turns in such powerful craft and the consequent risk of violent hooking. Post-accident trials of *Milly* showed it to have some undesirable handling characteristics in certain circumstances, which could be mitigated by design changes.

This accident had fatal consequences because the driver was not wearing a kill cord. Previous similar accidents indicate that there is a culture in which a significant proportion of drivers do not routinely attach kill cords when they take the helm. The MAIB therefore issued a Safety Bulletin immediately after the accident to raise awareness of this issue and to alert drivers of the importance of doing so.

Recommendations have been made to the Royal Yachting Association to review its powerboat scheme content to provide additional advice on the potential hazards of high power/high performance operations, and to the manufacturer, APV Marine Limited, to ensure the boat's Recreational Craft Directive documentation is accurate and consistent, and hull design is reviewed to reduce the steep angle of heel the boat adopts in tight turns.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *MILLY* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Milly*
Type	Rigid Inflatable Boat
Registered owner	Privately owned
Construction	Glass reinforced plastic hull with inflatable tubing
Length overall	8.0m
Draught	0.6m
Built	2011
Engine	Yamaha 228kW (300hp), V6, 4.2 litres 4 stroke outboard. Model: F300 BETX
Throttle	Electronic 'drive by wire'
Power	228kW (300hp) at 5500rpm (full throttle range: 5000-6000rpm)
Gear Ratio	1.75:1
Propeller	Yamaha 15.25" x 19" T x 3 blade, stainless steel
MARINE CASUALTY INFORMATION	
Date and time	5 May 2013, 1547
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	Camel Estuary, Cornwall
Place on board	Ejection from boat
Injuries/fatalities	2 fatalities and 3 injured; 2 seriously
Persons on board	6

1.2 BACKGROUND

The Rigid Inflatable Boat (RIB) *Milly* was manufactured in December 2011 by APV Marine Limited, trading as Cobra Ribs. The engine, steering and instrumentation were installed by Rock Marine Services, Cornwall, which sold the boat to Mr Milligan in April 2012.

Milly was used for family trips in and around the Camel Estuary, Cornwall, on about 20 occasions during the summer of 2012 and was placed into winter storage in September that year.

The boat and engine were maintained and serviced during the winter, and on 3 May 2013 *Milly* was removed from storage and placed on a mooring at Rock, by Rock Marine Services, at the request of Mr Milligan. Due to tidal constraints, the boat could only be used 3.5 hours either side of high water. The boat was not used until 5 May.

1.3 NARRATIVE

At 1200 on 5 May 2013, 3 hours before high water, the family arrived at Rock to board *Milly* for a pleasure trip on the Camel Estuary **(Figure 1)**. The family group, which consisted of Mr and Mrs Milligan and their four children, aged 4, 8, 11 and 12 years, all wore lifejackets or buoyancy aids when they set out from Rock at 1225.

Milly was initially taken towards Polzeath and then returned to the estuary for a series of runs between Gun Point and St Saviour's Point. The runs consisted of oval circuits, which were conducted at speeds of about 30 knots (kts). Mr Milligan was driving the boat throughout this period and had the kill cord[1] attached to his leg. Mrs Milligan sat in the stern seats and the children were seated and standing in the forward part of the boat **(Figure 2)**.

At 1414 *Milly* arrived at the Inner Quay, Padstow where the majority of the family left the boat and bought a take-away lunch. Mr Milligan remained with the boat and drank some wine while waiting for his family to return. After lunch the family members again put on their lifejackets and buoyancy aids before, at 1536, the boat left Padstow harbour with Mr Milligan at the helm. The boat was then taken on further runs between Gun Point and St Saviour's Point.

At about 1544 Mr Milligan stopped the boat, removed the kill cord and moved away from the controls. Mrs Milligan then moved to stand in front of the wheel to ensure no one inadvertently knocked the throttle while her husband went to the stern. Mr Milligan then went forward, and Mrs Milligan took the helm, put the engine in gear and began to drive the boat towards Rock, but did not attach the kill cord.

At 1545, *Milly* was near the channel buoy off St Saviour's Point when the decision was taken to turn back towards Gun Point for a further run. At this time a speedboat heading out of the estuary passed to the west of *Milly*. As *Milly* headed towards Gun Point, the adults were in the driver and co-driver positions and the four children were still in the forward part of the boat, standing and seated, enjoying the trip.

[1] Kill cord is a device for stopping a boat's engine if the driver moves away from the controls.

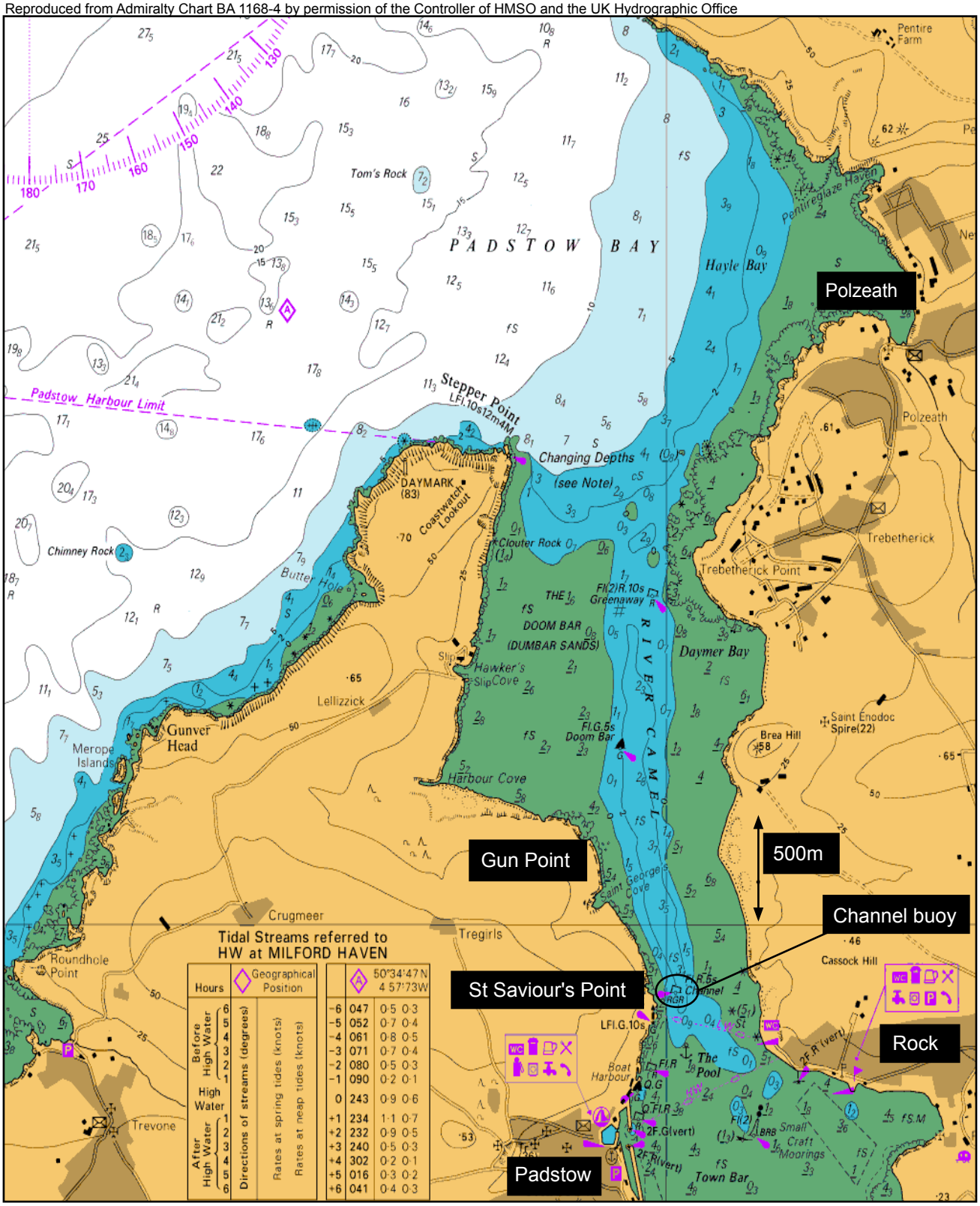

Figure 1: Camel Estuary showing area of the accident

Figure 2: *Milly* seating arrangements

At about 1546, *Milly* was turned off Gun Point back towards Rock. Mr Milligan, who was in the co-driver position, suggested that they should turn to starboard for another run. Mrs Milligan was reluctant to do so as she did not consider there was sufficient space between the boat and the beach. However, due to encouragement from the children and Mr Milligan she began a slow wide turn. Mr Milligan then reached across, in front of his wife, took the helm in his right hand and the throttle in his left, and then increased the engine throttle setting to full as he turned the helm to starboard.

The boat immediately accelerated and heeled into the turn and then suddenly, and violently, rolled back to port and ejected all its occupants out over the port side and into the water. The boat then continued to circle under full power.

The family were on the surface of the water, supported by their lifejackets and buoyancy aids, and the boat circled back towards them, striking several of them. Mr Milligan and Emily, who was 8 years old, were fatally injured; Mrs Milligan and their 4 year old son suffered serious injuries, and one of the other children was also injured.

1.3.1 Post-accident response

The accident occurred on the Sunday of a bank holiday weekend, and there were many people on the nearby beaches and coastal path who witnessed the accident and called the emergency services. From 1548 onwards the emergency services, including Falmouth Coastguard, received multiple telephone calls to report persons in the water and the out of control speedboat in the Camel Estuary.

At 1549 a major emergency response began and within the next few minutes police, ambulance and coastguard assets were directed to the area and two search and rescue helicopters were mobilised.

At 1550 three canoeists who had witnessed the accident arrived at the scene. The canoeists were in two canoes, one single and one double **(Figure 3)**, and at 1551 the single canoeist phoned the emergency services and reported the accident. One of the canoeists in the double canoe was a trained paramedic and immediately began to triage the survivors while her companion attempted to attract the attention of other boats in the area.

The canoeists managed to pull two of the children out of the water onto their canoe while also keeping Mrs Milligan and another child alongside the craft and conscious.

The single canoeist, who was a local surf lifeguard instructor, initially attempted to intercept *Milly*, which was still circling in the vicinity **(Figure 4)**, and at one point his canoe came into contact with the out of control boat. However, once he realised that the boat posed no further threat to the people in the water he went to assist the casualties.

At 1552 *Thunder*, a commercially-operated speedboat, arrived alongside the double canoe to assist and one of its passengers, a doctor, subsequently entered the water to help the survivors.

Figure 3: Canoes (Surf Ski Boats) first to arrive at the scene of the accident

'Still' courtesy of the BBC

Figure 4: *Milly* circling out of control after the accident

At 1556 the Cornwall ambulance control centre contacted Falmouth coastguard to request that a gate to the fields beside St Saviour's Point be unlocked to allow a rapid response ambulance to access the coastal path and beach.

At 1557 Rock inshore lifeboat (ILB) self-launched in response to a telephone call made earlier to one of its crew by a witness who had reported an out of control speedboat in the estuary. Falmouth coastguard was contacted and instructed the ILB to assist the casualties and not to intercept the out of control speedboat.

The ILB arrived alongside *Thunder* at 1600 and the survivors were recovered from the water and off the double canoe onto the ILB and *Thunder* **(Figure 5)**. The crew of the ILB decided that the casualties should be taken to Padstow harbour for medical attention and the ILB and *Thunder* headed towards the harbour.

Figure 5: Rock ILB, *Thunder* and canoeists providing assistance

At 1607 the crew of the ILB informed the coastguard that the survivors would be arriving at South Slip and requested immediate medical assistance.

At 1611 two local boatmen, in another RIB, had manoeuvred close to *Milly* and had thrown a rope into the water in an attempt to slow the boat down. When the other RIB got close enough, one of the boatmen was able to board and gain control of *Milly* **(Figure 6)**.

At 1612 the ILB informed Falmouth coastguard that the survivors were now at South Slip, Padstow harbour, and reiterated the requirement for immediate medical assistance. Ashore, the doctor from *Thunder* continued to provide first-aid treatment to the casualties. The ILB returned to the estuary to assist the remaining casualties, and Falmouth coastguard contacted the Cornwall ambulance control centre to request that all ambulances be sent to Padstow harbour.

At 1615 the Padstow coastguard rescue team (CRT) informed Falmouth Coastguard that they were on the path to the beach north of St Saviour's Point with the rapid response paramedics, and requested instructions. The CRT and paramedics were advised to proceed back to Padstow harbour.

At 1616 the first ambulance arrived at Padstow harbour to assist the survivors.

Figure 6: Local boatman about to board and regain control of *Milly*

At 1620 the canoeist in the single canoe telephoned Falmouth Coastguard to advise that he had recovered a body to the beach north of Rock and requested immediate assistance. One of the helicopters and the ILB headed to the scene, and the ILB took the body, which was later identified as Mr Milligan, to the Rock RNLI boathouse.

At 1637 the rapid response ambulance, which had been at St Saviour's Point, arrived on the quayside at South Slip. The Padstow lifeboat, which had been searching in the area, recovered a body, which was later identified as Emily, at this time.

At 1649 the survivors and deceased were transferred from ambulances into the search and rescue helicopters, which had landed on the outskirts of Padstow, for transport to local hospitals.

1.4 ENVIRONMENTAL CONDITIONS

Weather:	Fine and clear, good visibility
Wind:	Westerly, 5 kts
Sea State:	Slight
High water Padstow:	1500, 6.1m
Tidal Range:	4.3m (66% of spring range)
Tidal Stream:	Ebb tide (northerly), about 1.5kts

1.5 *MILLY*: DESIGN, MANUFACTURE AND HANDOVER

1.5.1 Design

The Cobra range was originally designed and developed during the 1980s by Picton Boats Limited, Bridgend. APV Marine Limited purchased that business in 2007. It was estimated that about 1200 Cobra RIBs had been sold since its introduction.

APV Marine Limited, trading as Cobra RIBs, marketed the Cobra RIB range in lengths from 6.6m to 10.6m. The boats were normally built to order for customers either directly or, as in the case of *Milly*, through a third party. The same hull moulding was used for the entire range with the position of the stern bulkhead being adjusted in the mould to produce the desired boat length.

In 2010, the design of the hull was modified with the intention of producing a smoother ride, improved cornering grip and better straight line speed. The hull design modifications **(Figure 7)** were made in-house by APV Marine Limited staff.

1.5.2 Manufacture

Mr Milligan placed the order for *Milly* with Rock Marine Services, Cornwall in October 2011.

The boat was manufactured in December 2011. The glass reinforced plastic (GRP) hull was produced by a sub-contractor in Swanmore, Hampshire, and the inflatable tubes were fabricated and fitted to the hull by a specialist company in Salisbury, Wiltshire. The boat was then delivered to APV Marine Limited in Christchurch, Dorset where the teak decking, customised seating and internal fixtures and fittings were installed.

Milly was then transported to Rock Marine Services Limited, Cornwall, where the engine, steering system and electronic equipment were installed prior to delivery to Mr Milligan.

1.5.3 Handover

Milly was handed over to Mr Milligan on 6 April 2012 at Rock by an employee of Rock Marine Services, who was an experienced powerboat operator. As part of the handover process Mr and Mrs Milligan were given a 3-hour on-water familiarisation, which included a trip in the Camel Estuary and also out to sea. Mr Milligan took the helm during this process and various manoeuvres were performed to demonstrate the boat's handling characteristics. The importance of warning any passengers to be prepared when manoeuvring was emphasised.

1.6 RYA POWERBOAT HANDLING TRAINING

1.6.1 Mr and Mrs Milligan's powerboat training

Mr Milligan had attended a Royal Yachting Association (RYA) level 2 powerboat handling training course in December 2010, at an RYA recognised training centre in Rock. Mr Milligan took the course in the boat he owned at the time - a 5.8m

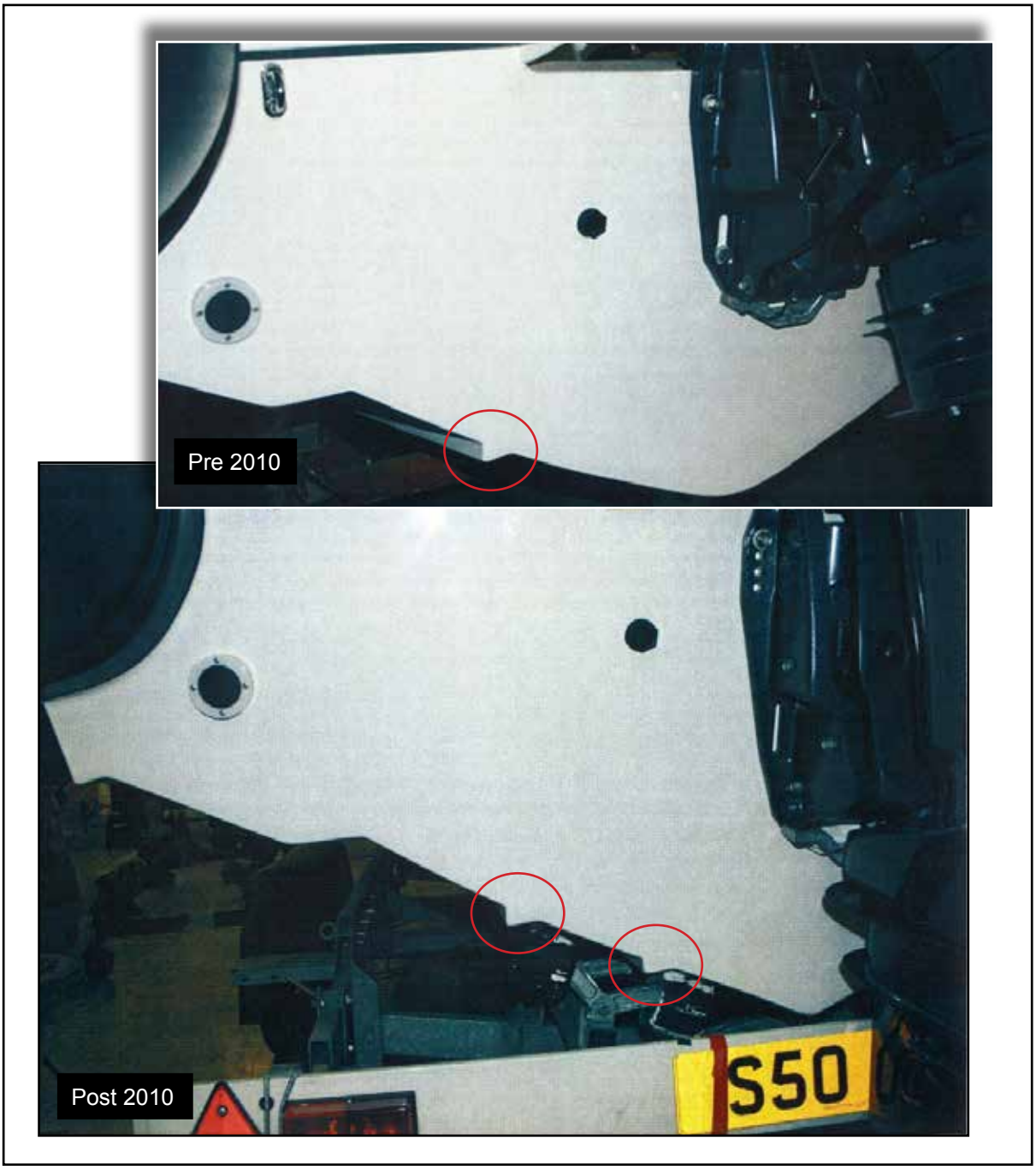

Figure 7: Hull design changes made to Cobra RIBs by manufacturer in 2010

Campion Chase water-ski boat, powered by a 150hp (112kW) engine - which he had also purchased from Rock Marine Services. Attendance on the training course was included in the purchase package for the boat.

Mr Milligan was the only student on the training course, which was given by an RYA qualified powerboat instructor who described Mr Milligan as a keen, confident and responsible boat handler. The procedure for changing drivers while a boat was underway, by stopping the engine and attaching the kill cord to the new driver before restarting the engine, was one of the items covered during the course.

Mrs Milligan attended an RYA level 2 powerboat handling training course, in *Milly*, in August 2012. This training course was also undertaken at the RYA training centre in Rock and Mrs Milligan was the only student on the course. The instructor covered the full syllabus, including the correct fitting of a kill cord and the procedure for changing drivers while underway. Mrs Milligan was described as a very attentive student with a good level of risk awareness.

1.6.2 RYA Level 2 Powerboat Handling Course

The syllabus for the RYA level 2 *Powerboat Handling* course **(Annex A)** incorporated preparation, boat-handling and manoeuvres, and theory and background.

The courses attended by Mr and Mrs Milligan, which were each 2 days in duration, incorporated the content from the level 1 *Start Powerboating* course, which provided a practical introduction to boat-handling skills.

The RYA powerboating scheme booklet stated that: *Due to time constraints and variations in course location and equipment not all the subjects covered by the syllabi can be covered in great detail or practically on the water.* The RYA had specified three levels to indicate the depth to which each part of the syllabus would be covered:

- KNOWLEDGE of the subject.

  The subject will be briefly explained.

- UNDERSTANDS the subject.

  The subject will be covered in greater depth.

- CAN demonstrate a level of proficiency in the subject.

  The subject will be covered in great depth, including background theory, practical demonstrations by the instructor and repeated practice by the student until they are able to demonstrate good skills in the subject.

The use of a kill cord was included both in the level 1 *Start Powerboating* course syllabus and at level 2. Both syllabi required students to demonstrate proficiency in *the use of an appropriate length of kill cord at all times*.

The RYA guidance for changing drivers while a boat is underway strongly recommends that the engine should be turned off before transferring the kill cord from one driver to the other. It also states that the engine should only be restarted when the kill cord has been securely attached to the new driver.

At level 2, students were required to understand *the importance of boat control in waves and adequate seating to minimise the possibility of back injury*. An understanding of handling a boat at planing speed, use of the power trim, propeller angle and immersion were also covered.

1.7 POST-ACCIDENT INSPECTION OF *MILLY*

1.7.1 Initial inspection

Milly was inspected at the Bodmin Police Hub on the day after the accident. This inspection consisted of a forensic investigation of data from the boat's electronic chart plotter and its engine management system, together with a thorough visual inspection of the hull, engine, propeller and steering system.

Data was obtained from the engine management system, which provided information on the performance of the engine at the time of the accident. Historic positional information relevant to the accident could not be recovered from the chart plotter as the unit had not been set up to save this data to its internal memory.

No evidence of damage was found on the hull or engine with the exception of a small, oxidised, abrasion mark on the engine skeg **(Figure 8)**.

The steering system was tested and found to be fully operational with all oil levels normal.

Figure 8: *Milly* - abrasion mark found on engine skeg post-accident

1.7.2 Naval architect's inspection

Milly was subsequently removed to secure storage, and the MAIB commissioned a naval architect with specialist knowledge of small high speed craft to undertake a detailed examination of the boat **(Annex B)**.

The objectives of this inspection were to establish the set-up of the boat, hydrodynamic properties of the hull, and the suitability and functionality of its engine and steering systems.

The height and position of the engine's anti-cavitation/ventilation plate above the transom bottom and the setting of the adjustable trim tab on the underside of the plate were recorded. The anti-cavitation/ventilation plate was found to be set at an acceptable position while the trim tab was set in a central position height with no apparent allowance for the side thrust generated by a right-hand turning propeller. This setting meant that with no hand on the helm the craft might have displayed a tendency to turn to starboard, which would need to be investigated by a controlled trial.

The boat's hydraulic steering system was inspected and measurements were taken of the static force required to move the helm to port and starboard. No significant difference between the two directions was found.

The inspection found no inherent problems which were likely to have been causal in the accident.

1.8 BOAT TRIALS

The MAIB undertook on water trials of the boat so as to gain a better understanding of the accident scenario.

1.8.1 Participants

The trials were conducted in June 2013 and were based at the Weymouth and Portland National Sailing Academy. A professional powerboat driver and co-driver were at the helm throughout the trials, which were conducted in conjunction with the RYA, Portland Harbour Authority and Yamaha, all of whose assistance is gratefully acknowledged.

The boat's loading on the day of the accident was replicated for the trials. The Naval Architect who had undertaken the detailed examination of the boat was contracted to measure and weigh the boat prior to the trials and also to provide a report on the conduct of the trials **(Annex C)**.

1.8.2 Data acquisition and recording

A unit from the University of Southampton was commissioned to record onboard motion measurements during the trials. Data was acquired from two tri-axial accelerometers fitted forward and aft inside the boat and recorded through an acquisition laptop.

The resultant findings were tabulated to provide a time referenced record of the forces acting on the boat during the various manoeuvres conducted in the trials. The engine manufacturer, Yamaha, was represented and its engineers provided time referenced data from the engine management system. A number of fixed video cameras were set up on the boat, and the various runs were filmed from the control boat to record the conduct of the trials.

The data collected was combined and then analysed in conjunction with the verbal feedback received from the driver and co-driver at the end of each run to inform the analysis of the boat's performance.

1.8.3 Conduct of trials

On the day of the trials a safety briefing was held with all participants to review the event's risk assessment and control measures. Both the driver and co-driver were connected to the engine kill switch with separate kill cords for the duration of the trials.

An area of Portland harbour was designated as the trials area and a marker buoy was laid to provide a datum for the various test runs.

Trial runs were conducted at speed and trim settings in accordance with the trials programme **(Annex D)** which required a number of different manoeuvres to be undertaken to assess the boat's manoeuvrability.

During the initial straight line runs the boat's speed was increased in a series of 10 knot increments from 20 kts to the maximum speed obtainable on the day, which was 46.2 kts. Subsequent runs were made during which the boat was turned to port and starboard at various speeds, which were increased in 5 kt increments.

The engine was set at various trim settings in accordance with the trials programme. On a scale of 0 (zero) to 42, where 0 was fully trimmed-in and 42 was the maximum workable out trim. The neutral trim setting, at which the line of propeller thrust was parallel with the keel, was found to occur at a setting of 18.

The trim settings were displayed on the engine console panel and controlled by the trim adjustment switch located on the throttle handle **(Figure 9)**. The trim setting of the engine at the time of the accident was known from evidence obtained to have been in the region of 10-12.

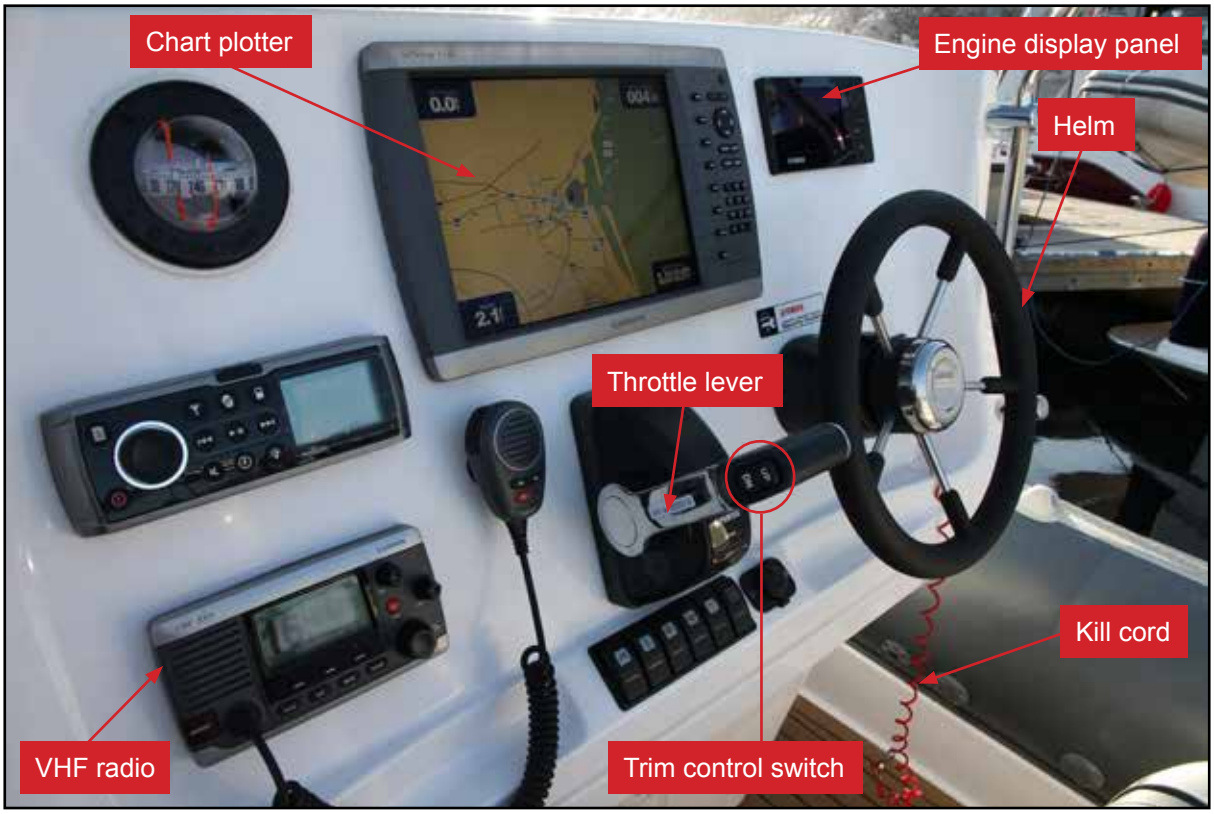

Figure 9: *Milly* - steering console

1.8.4 Boat's performance

During the runs it was noticed that the boat took up a high angle of inward heel when it was turned.

It was also noted that when turned tightly at certain speeds the RIB's heel angle would increase until the aft end of the hull lost grip in the water and slid sideways, leading to a 'hook'.

The hook rapidly took the boat from its original course as the hull executed a sideways slide across the water, until the boat's keel gripped and the sideways motion was suddenly stopped, causing the craft to roll violently upright from its banked attitude.

The driver and co-driver reported that they needed to be well prepared for this hooking action by being seated, braced and holding on to handholds, as the forces generated were considerable. The driver suggested after one test turn that an increase in RIB speed of 5 kts would have been sufficient to result in his ejection from the boat, despite being prepared.

During the final test runs the ballast which had been located forward to represent the weight distribution at the time of the accident was moved to the aft seating area. The driver noted an improvement in the boat's handling characteristics after the weight had been moved aft.

The measurements obtained when the hooks occurred, with entry speeds of about 20 kts, gave transverse acceleration forces of 1.3g at the forward seating area and 1.2g at the helm position **(Figure 10)**.

Angles of roll up to 40° during these turns were recorded and a change in roll angle of 30° in half a second was also registered as the boat hooked **(Figure 11)**.

The video recordings obtained during the trials were synchronised with the data to produce a visual reference of the boat's performance during the various hook events. Photographs from the videos were included in the figures to aid understanding of the boat's performance at the time the measurements were taken.

1.8.5 Naval architect's trials report

Heel angle:

In his report of the trials, the naval architect noted that:

> *"during the trials it was noted that at intermediate to fast speeds during relatively tight turns the craft, which takes up a relatively high heel angle (estimated at 25°-30°) could suddenly increase heel (to an estimated 35°- 40°) whereupon the stern would slide away and the craft would start to spin. It is significant that this apparent heel is greater than the hull deadrise[2] angle".*

The deadrise of *Milly*'s hull was measured at 22°.

[2] Deadrise is the transverse inclination of the bottom of a boat. A flat bottom boat would have a deadrise of 0° while a deep V shaped hull will typically have a deadrise angle of at least 20°.

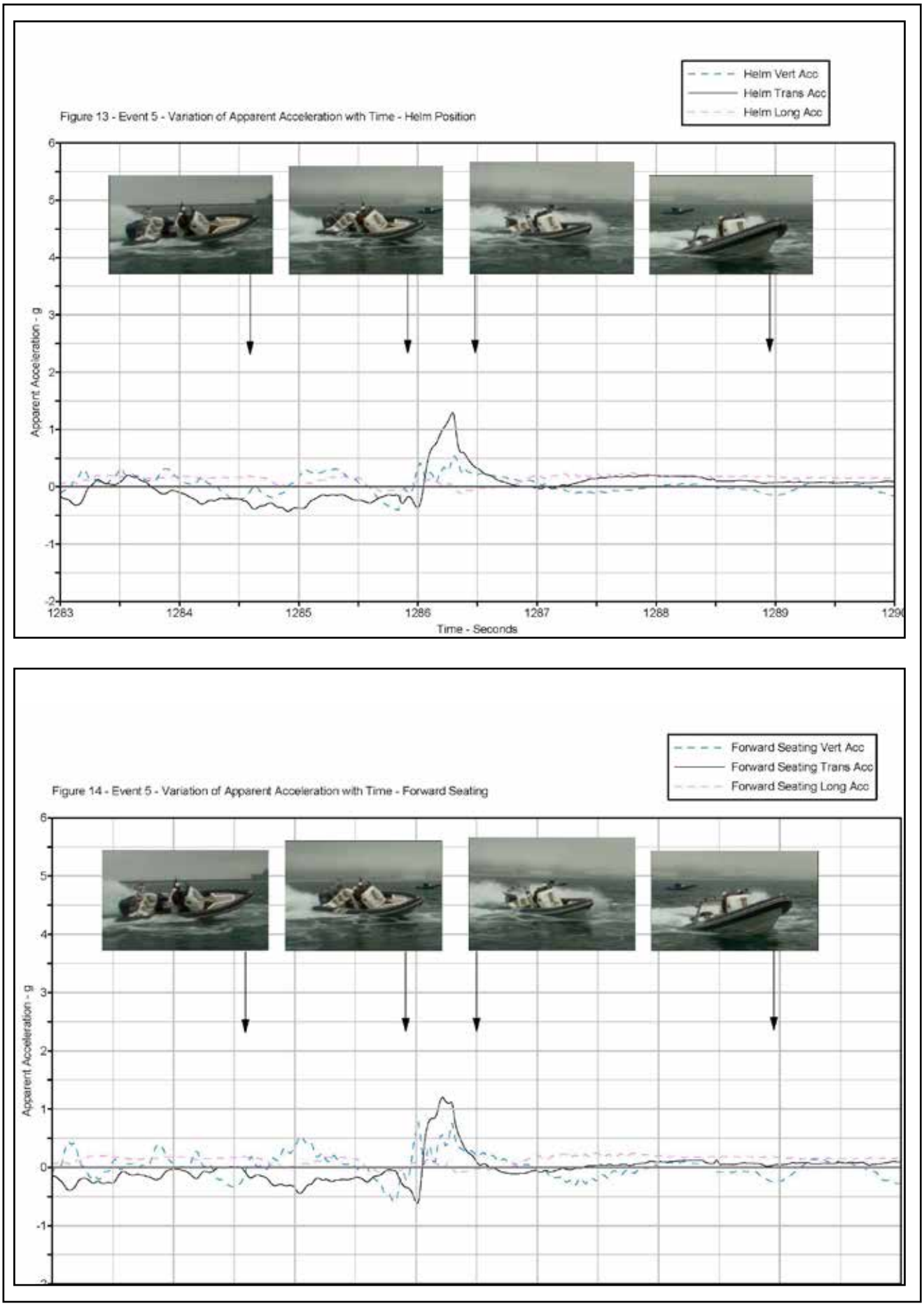

Figure 10: Graphs showing acceleration data obtained during trials

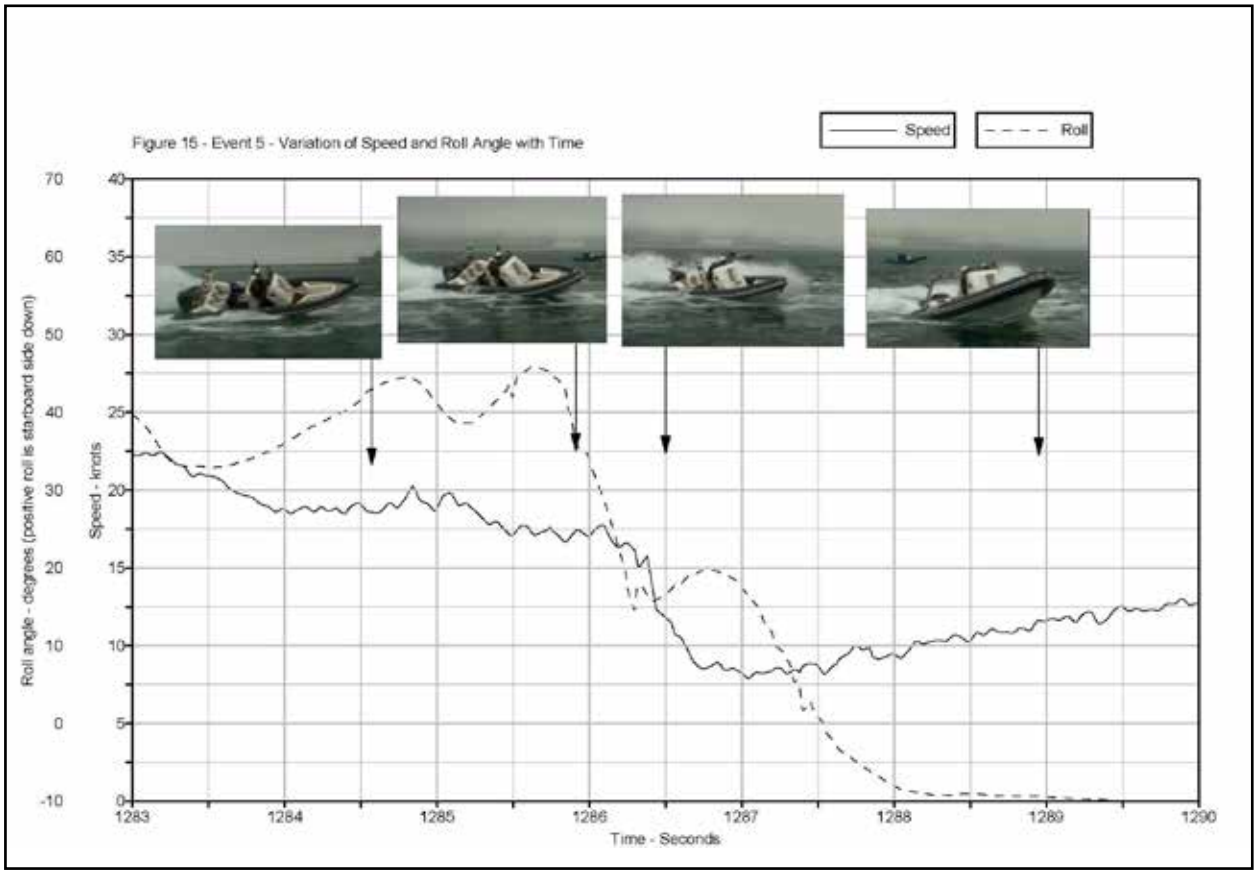

Figure 11: Graph showing change of roll angle against time

High speed turns:

Some of the test runs required the driver to execute turns at high speeds. Reporting on those turns the naval architect noted that:

> *"When executing the turns, the craft initially would take up a high heel angle. It would proceed to turn, but if the speed was slightly higher than a particular threshold and the turn tighter than a certain degree, the heel angle would increase during the turn, and the aft end would lose grip and slide – thus initiating a 'partial spin' or 'hook' since the bow did not slide by the same amount.*
>
> *This rapidly took the craft to a position which was appreciably diverted from its original course. The craft would execute a sideways slide and grip suddenly when it landed. Thus the hull's sideways motion was suddenly stopped. Also, since the sudden grip was applied at the keel, the craft would violently roll upright from its banked attitude. It was noted that on these occasions the engine rpm would increase dramatically, indicating that the heel was so great, the propeller was losing grip on the water"* **(Figure 12)**.

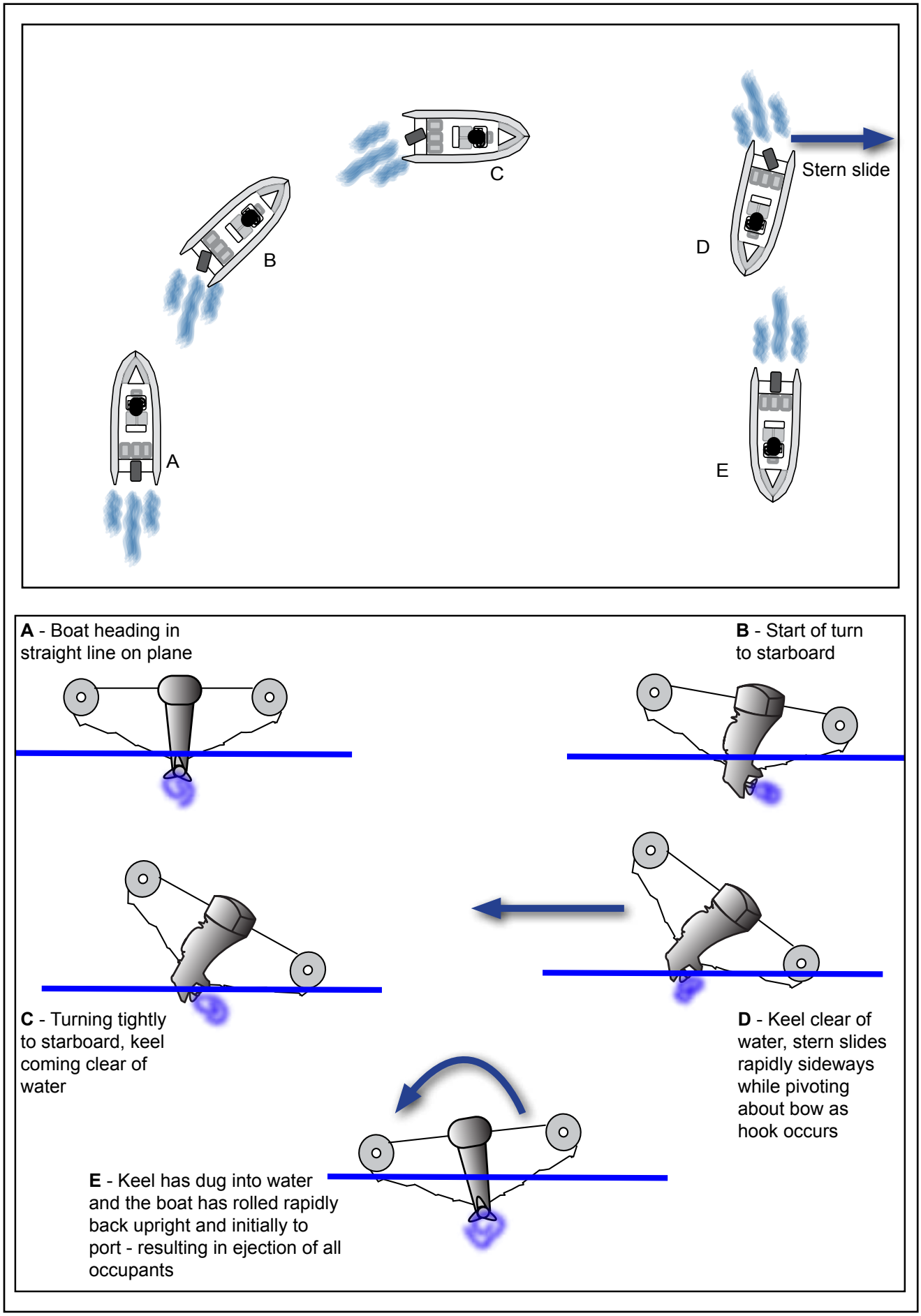

Figure 12: Diagram showing a hook during a turn

1.9 BOAT TEST, RIB INTERNATIONAL MAGAZINE

In March 2008 the specialist RIB boating magazine, RIB International, published an article on a boat test of a Cobra 8.6m RIB fitted with a 350hp Yamaha outboard engine **(Annex E)**.

The author of the article, who had previous experience of driving Cobra RIBs, observed that the buoyancy tubes had been raised significantly at the aft end compared with earlier versions of the boat. The report stated that:

> *"When placed in a tight turn the boat adopted a very steep angle of heel before the tubes came into contact with the water. Once they had touched the water the stern of the craft appeared to lose grip, perhaps because air had become trapped between the hull and the tube, creating an air pocket on which the craft balanced. Cornering at speed made the whole craft go light and send the craft sideways in an alarming manner"*.

1.10 PASSENGER SAFETY ON SMALL COMMERCIAL HIGH SPEED CRAFT

In 2010 the RYA published guidance notes for passenger safety on small commercial high speed craft **(Annex F)**, which contained advice on the importance of passengers using correct handholds and adopting a good posture.

Also included was advice to operators that the magnitude of impact and movement is greater at the bow and reduces towards the stern.

1.11 RECREATIONAL CRAFT DIRECTIVE

1.11.1 General

Directive 94/25/EC, as amended by Directive 2003/44/EC, was introduced by the European Commission (EC) to harmonise the European Union Member States' differing national legislation for recreational craft, which are defined as boats intended for sports and leisure purposes of a hull length between 2.5 and 24 metres.

In the UK, the Recreational Craft Regulations 2004 (RCR) brought the Recreational Craft Directive (RCD) into UK law. The regulations required manufacturers and suppliers of recreational craft in the UK to demonstrate their product's conformity with the RCD through meeting certain essential safety requirements.

1.11.2 Essential safety requirements

The essential safety requirements of the RCD stipulate the safety, health, environmental and consumer protection requirements for recreational craft. The manufacturer was responsible for ensuring the craft met these essential requirements, which included:

- identification marks
- strength of construction
- stability

- handling characteristics
- owner's documentation.

Boats were required to be Conformité Européenne (CE) marked and carry an identification mark, known as the Craft Identification Number (CIN), and a builder's plate which showed the CE-mark and basic information about the design of the boat, and the category of waters in which it was designed to operate.

The CE-mark was displayed on *Milly*'s builder's plate **(Figure 13)** together with references to the harmonised International Standards Organization's (ISO) standard used for its construction, ISO 6185-3:2001.

Photograph taken from report by Lorne Campbell

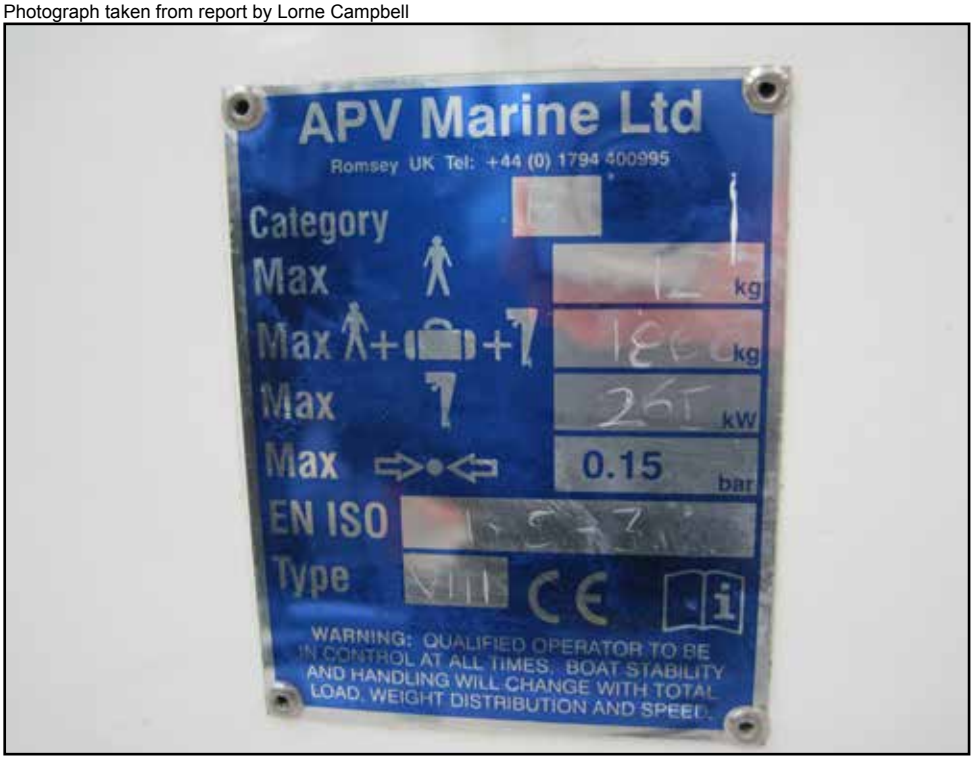

Figure 13: *Milly* - builder's plate

1.11.3 Design categories

The RCD defines four design categories (A to D) for recreational craft, based on wind and wave conditions likely to be experienced, which were: A - Ocean, B - Offshore, C - Coastal and D - Sheltered Waters.

Milly was designed to the Category B - Offshore standard:

> *Designed for offshore voyages where conditions up to, and including, wind force 8 (Beaufort) and significant wave heights up to, and including, 4 m may be experienced.*

1.11.4 Conformity assessment

The assessment of a boat's conformity with the essential requirements of the RCD was dependent on its design category and length. Boats such as *Milly*, in categories A or B with a hull length from 2.5m to 12m, had to conform to either the internal production control plus tests (module Aa) or the EC type-examination (module B).

The manufacturer was required to declare that the requirements of the RCD had been fully met by placing a CE marking on the boat and issuing a written Declaration of Conformity (DoC).This could be achieved through the application of harmonised standards, which gave a presumption of compliance with the RCD.

1.11.5 Declaration of Conformity

The DoC for *Milly* **(Annex G)** was issued on 4 December 2011 and indicated that module Aa had been used for the boat's construction assessment.

This module required the manufacturer to appoint a Notified Body[3] to undertake a stability assessment of one or several of the boats representing its production. The manufacturer was responsible, by self-certification, for ensuring that the remainder of the RCD essential requirements were met.

Milly's DoC listed the name of the authorised representative[4] as 'CE Proof – Human Improvements Limited'. There was no record on the DoC of the Notified Body that undertook the stability assessment.

1.11.6 ISO 6185-3:2001 Inflatable Boats

ISO 6185-3 **(Annex H)** applied to inflatable boats with a maximum power rating of 15kW (20hp) and greater, and was the standard used by the manufacturer to demonstrate compliance with the RCD for:

<u>Protection from falling overboard</u>

This required that boats were equipped with a safety rope and/or handles which offered a firm hold to each of the permissible number of persons when occupying the seating, standing or kneeling positions provided. All handholds were required to be designed to ensure, by their nature and arrangement, that the permissible number of persons could hold them, even for long periods, without the risk of injury.

<u>Handling characteristics</u>

This provided a formula for maximum power, which for a boat of *Milly*'s dimensions was 175kW (234hp). It also permitted RIBs capable of a top speed of >30kts, supplied with a remote steering system installed by the manufacturer as standard equipment, to increase the maximum power if they were able to conform to the manoeuvring test specified in ISO 11592.

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[3] Notified Bodies are appointed by EU Member States to support the implementation of Directives, including the Recreational Craft Directives. Notified Bodies will have been assessed to ensure their competence in determining whether or not a product complies with the requirements laid down in the regulations.

[4] An authorised representative is a person appointed by the manufacturer to act on his behalf in carrying out certain tasks required by the RCD that have been delegated to him by the manufacturer.

1.11.7 ISO 11592:2001

Manoeuvring test

ISO 11592 paragraph 7 **(Annex I)** specified the manoeuvring test to be carried out on outboard powered craft to determine the boat's maximum engine power. The test required that boats with a maximum speed of >30kts should be able to conduct a number of turns, with heading changes of 90°to port and starboard, at maximum speed within a specified distance of advance.

As the Cobra 8.0m RIB had a maximum speed exceeding 30 kts this test was applicable to *Milly*.

In 2009 the manufacturer performed an avoidance line test, in accordance with ISO 11592, on an 8.0m RIB fitted with a 261kW (350hp) Yamaha engine **(Annex J)**. The maximum speed of the boat was recorded as 51.8 knots, which gave a maximum allowable distance of advance to pass the test, of 91.6m.

Several turns were made during the test and the average distance of advance was recorded as 77.3m, which enabled the manufacturer to market the boat with a maximum engine power of 261kW (350hp)[5].

1.11.8 Owner's manual

An owner's manual **(Annex K)** was provided by Cobra RIBs when the boat was delivered. The provision of the manual was included in the essential requirements and was reported to meet the standards laid down in ISO 10240.

Section 6.2 Handling Characteristics, provided safety information for the owner, which included:

- maximum engine power: 336kW 450hp
- maximum speed: 50 kts 56mph
- Ensure all crew are informed about the craft's behaviour. Before conducting any rapid acceleration or high speed manoeuvres passengers must be warned to sit and hold on.
- The helmsman may have to take sharp avoiding action at any time. Passengers should therefore be seated and holding on when underway.

This section also listed cautions, which included:

- Avoid making sharp turns at speed.
- Be aware that factors such as load and engine trim may affect performance.

[5] *Milly* DoC gave the maximum power as 264kW, while the builder's plate gave a figure of 261kW.

1.12 TECHNICAL FILE

The manufacturer or person responsible for placing a RIB on the market was required to produce and maintain a technical file that would show how the vessel conformed with the RCD. This file was required to include reference to the design, manufacture and operation of the boat.

The technical file for the Cobra RIB range was based on a 8.5m long boat with a maximum recommended power of 336kW (450hp) and contained the stability and buoyancy assessment required by the RCD. The file was prepared in 2007 for the previous manufacturer, Picton Boats Ltd, by HPI Verification.

The technical file included a copy of the craft's DoC **(Annex L)**, which stated that no ISO standard was applicable to the essential requirement for handling characteristics as ISO 11592 applied only to craft up to 8m in length. There was no reference to a manoeuvring test in the file.

The technical file contained a reference to ISO CD 6185-4:2004 which specified the minimum safety characteristics required for the design, materials, manufacture and testing.

1.13 ISO 6185- 4:2011 INFLATABLE BOATS – 8-24M

ISO 6185-4 applied to boats with a hull length of between 8m and 24m with a motor power rating of 15kW and greater, and came into effect on 4 January 2012. The 2004 CD version of this standard was the reference used in the technical file for the Cobra range but was not used as the standard for the construction of *Milly*.

> The ISO standard gave a formula to determine the maximum power to be fitted to a boat: $P = length(max) \times beam(max) \times \sqrt[3]{light\ craft\ weight}$

If this formula had been applied to *Milly,* the maximum engine power which should have been installed in the boat was 226kW or 303hp unless a manoeuvring test was conducted.

There was also a requirement, for boats capable of a top speed of 26kts or greater, for the determination of a *maximal manoeuvring speed*. If, following the specified tests, the maximal manoeuvring speed was found to be less than the top speed of the boat, a warning label was required to be posted on the boat in a location visible to the operator.

The warning label was required to contain a warning sign and the following message:

> *"SUDDEN TURNS ABOVE YY KNOTS MAY CAUSE LOSS OF BOAT CONTROL WHICH COULD RESULT IN SERIOUS INJURY OR DEATH. REDUCE SPEED BEFORE ATTEMPTING A SUDDEN SHARP TURN. READ OWNER'S MANUAL FOR ADDITIONAL INFORMATION."*

1.14 GROUNDING INVESTIGATION

The MAIB investigated the possibility that *Milly* had grounded during the turn to starboard that triggered the accident. A combination of evidence obtained from witness statements, photographs and closed circuit television made it possible to plot the position of the accident with a good degree of reliability **(Figure 14)**.

A hydrographic survey of the area, conducted by the Padstow harbourmaster, confirmed that the depth in the vicinity of the accident was more than 8m at the time of the accident. *Milly*'s draught was 0.6m and in view of the depth of water no further grounding assessment was undertaken.

1.15 ALCOHOL

Part 4 of the Railways and Transport Safety Act 2003 set the blood alcohol limit for professional mariners in the UK at 80 milligrams of alcohol per 100 millilitres of blood, which was the same as the limit for driving on roads in the UK. No alcohol limit was set for non-professionals.

A postmortem examination found that Mr Milligan had 56 milligrams of alcohol per 100 millilitres of blood at the time of his death.

Marine Guidance Note (MGN) 489

In June 2013 the Maritime and Coastguard Agency (MCA) issued MGN 489 **(Annex M)** which gave an overview of the Merchant Shipping legislation applicable to pleasure vessels. Best practice guidelines were made, which skippers of pleasure vessels were "*strongly recommended*" to follow. One of these was:

> *"Avoid alcohol – If you have been drinking alcohol, your judgement will be impaired and you will be more likely to make mistakes, which at sea could be life threatening"*.

1.16 LOCAL RESILIENCE FORUM, DEVON & CORNWALL

The Civil Contingencies Act 2004, Part 1 set out a range of possible incidents for which local emergency responders had to be prepared. To facilitate co-operation at the local level, multi-agency resilience fora were established to review the community risk register and the responses required.

The local resilience forum for Devon and Cornwall was established in 2004 as a multi-agency partnership made up of representatives from the emergency services, local authorities and other partners who were Category 1 responders. The forum was supported by Category 2 responders who included harbour authorities and public utility companies.

1.17 PREVIOUS SIMILAR ACCIDENTS

From 2005 up to and including this accident the MAIB has been made aware of 21 accidents involving small high speed craft which have circled or continued out of control because a kill cord was either not used or was not properly connected. These have resulted in 7 fatalities and 12 injuries.

Image courtesy of Google Earth

Figure 14: Triangulation of accident site based on photographic/CCTV evidence

The MAIB has investigated the following cases:

Abersoch RIB (MAIB Report 12/2006)

The console of a 4.5m RIB failed, resulting in the driver and a passenger falling overboard. The driver was not wearing a kill cord and the RIB continued to circle and the propeller struck the passenger, resulting in a serious chest injury.

Loch Lomond RIB (MAIB Report 24/2005)

A father was driving his 6.4m RIB with his two daughters on board when a fault in the steering system caused the boat to turn unexpectedly. The father and one daughter were ejected overboard and drowned. The father had not been wearing a kill cord and the boat continued under power until his other daughter, who had been thrown to the deck, was able to regain control and return to the scene. However, she was unable to rescue her father or sister, neither of whom had been wearing lifejackets.

The MAIB issued Safety Bulletin 1/2005 which strongly urged powerboat users to ensure that:

- Kill cords, where fitted, are used correctly.
- Crew and passengers wear suitable clothing and lifejackets.
- They have the means to summon assistance: ideally a Very High Frequency (VHF) radio or, in the very least, distress flares.

RIB *Atlantis* 2006 (Preliminary Examination)

The two occupants of a RIB were thrown into the water when the RIB was turned to port. The boat continued on out of control and eventually grounded. The passenger was wearing a buoyancy aid and the driver had donned a manually inflatable lifejacket, which was not inflated. They had been in the water for 30 minutes when they were recovered by the crew of a passing ferry. The passenger was unharmed but the driver could not be revived.

It was later found that the driver had a blood alcohol level in excess of the UK road limit.

1.18 SAFETY BULLETIN 1/2013

The MAIB issued Safety Bulletin 1 of 2013 **(Annex N)** in May 2013. The safety lesson in the bulletin related to the importance of a kill cord being securely attached to the driver, ideally before an engine is started.

The bulletin also covered the importance of regular tests of the kill cord, checks of its condition, and stopping the engine before transferring the kill cord to another driver.

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 PERFORMANCE

The speed with which *Milly* accelerated into the pre-accident turn, and the resultant hook, not only caught all six occupants by surprise, but it also came as a shock to Mrs Milligan that the boat was capable of such performance.

Mr and Mrs Milligan were given a familiarisation handover when they took delivery of *Milly* and had both attended RYA level 2 powerboat handling courses. However, this training and experience did not provide them with a good understanding of how their boat would perform in a high powered turn.

The RYA Level 2 Powerboat Handling syllabus is seen as providing an appropriate entry level qualification by a wide range of planing craft users. At the lower end of the spectrum, courses are conducted on small boats equipped with 20-40hp outboard engines. While some RYA Recognised Training Centres do use powerful engines on larger RIBS, engines of 300hp and above are usually only found on craft privately owned by students undergoing 'own-boat' tuition.

Notwithstanding that the syllabus already compresses a great deal into a short course, it would be appropriate, when students are known to be going on to use powerful craft, for the possible need for advanced training in the characteristics of such boats to be emphasised during the tuition. Manufacturers and brokers similarly should ensure that purchasers of their craft are fully briefed on the craft's limitations, as well as its capabilities.

2.3 KILL CORD USE

When Mr Milligan stopped the boat, he removed the kill cord from his leg and left the helm. Mrs Milligan moved to stand in front of the helm, initially to ensure that the children could not access the controls as the engine was still running. However, Mrs Milligan then took control of the helm and began driving back towards the boat's mooring at Rock without having first attached the kill cord.

The kill cord was probably not attached because the day's activities were almost at an end and her intention had been to return, at a moderate speed, to the boat's mooring a few hundred metres away. However, the decision subsequently was made to take the boat back out for another run along the estuary, during which the accident occurred.

The use of a kill cord is fundamental to the safe operation of small planing craft. The evidence of this and previous accidents **(Section 1.17)** would indicate that kill cord use is still sporadic, and that much more needs to be done to make fitting a kill cord second-nature when taking over the helm of a powerboat. While technological advances, such as the use of proximity devices/sensors, may prove an effective

device on newer craft, the legacy of traditional manual kill cords fitted to older vessels should be the focus for any safety campaign. The MAIB has issued a Safety Bulletin to this effect **(Annex N)**, but more needs to be done.

2.4 THE MANOEUVRE

The turn to starboard which led to the ejection was initiated by Mrs Milligan, but Mr Milligan almost immediately reached across his wife and took control of the helm with his right hand and grasped the throttle with his left. It is likely that he did this because he thought that a tighter turn to starboard was required to keep *Milly* clear of the beach on the Padstow side of the estuary.

The manner in which Mr Milligan took the helm appears to have been out of character as he was known to be a safety conscious and prudent individual.

It cannot be established whether the wine he had consumed about 1½ hours earlier adversely affected his judgment or fine motor skills when he reached across and took the controls, but his alcohol levels were well below the drink-drive limit for UK roads.

Additionally, this was Mr Milligan's first trip of the year in the boat, and as he had not driven *Milly* for 8 months his familiarity with the boat's handling characteristics would have been reduced.

However, the electronic, fly by wire, throttle lever would have offered no resistance to the coarse hand motor movement he would have made as he operated the throttle by reaching across from the co-driver's position. This type of throttle is renowned for its smooth operation but does require fine motor skills for effective control.

The historic engine data obtained after the accident shows that the throttle was increased to full power which, with the helm to starboard and the engine slightly trimmed in, caused the boat to accelerate and turn quickly before hooking. It was this hooking action that resulted in the ejection of all the boat's occupants.

2.5 BOAT TRIALS

2.5.1 Seating

The trials conducted on *Milly* provided a reliable reconstruction of the performance of the boat immediately prior to the accident and indicated the forces acting on the occupants during high powered turns. The boat was observed to hook on several occasions, and transverse acceleration forces up to 1.3g were recorded at the forward seating area.

It should be noted that the trials data was obtained from instrumentation mounted on the deck while the boat was performing controlled turns with a very experienced test driver. The forces acting on the occupants of the boat at the time of the accident were probably higher and were totally unexpected.

The highest transverse forces were experienced when the boat 'hooked' and then returned violently to the upright from heel angles of 40°. It was found on one turn that the boat had rolled 30° in less than half a second. The nature of the seating in the forward part of the RIB did not provide adequate security against sudden, violent motion. Further, the conservation of momentum experienced by the occupants

during such a manoeuvre would have meant that the children would have been unlikely to have been able to keep hold of the grab ropes on top of the tubes in the forward seating area, even if a warning had been given that the boat was about to be turned.

The naval architect's analysis stated that "*it is considered poor practice to drive a craft at speed with passengers loose at the forward end of the craft. Not only are the motions in that area more violent than those at the helm position but the centre of gravity of the craft is moved forward which can be detrimental to directional stability*".

The RYA's guidance to the operators of small commercial high speed craft **(Annex F)** referred to the need for passengers to use correct handholds and adopt a good posture. It also advised that the magnitude of impact and movement is greatest at the bow and reduces towards the stern **(Annex F, paragraph 7.7)**.

An understanding of the importance of adequate seating to minimise the possibility of back injury was included in the level 2 *Powerboat Handling* syllabus, but no reference was made to the forces being greater at the bow than the stern. Following a succession of accidents, mainly resulting in compression fractures of the spinal vertebrae, guidance has been provided to commercial operators about the importance of adequate seating and handholds **(Annex F)** and this guidance was incorporated into the RYA powerboat scheme syllabus from 2011. However, Mr and Mrs Milligan were unaware of the hazards associated with allowing their children to sit and stand in the front of their RIB while it was travelling and turning, at high speed. Given their safety conscious nature, they would likely have ensured the children were safely seated before conducting high speed manoeuvres had they been aware of the risks.

2.5.2 Analysis of the hook

During the trial, in some of the turns the entire length of the RIB's keel was lifted clear of the water and the craft was observed to be planing sideways on one side of its lower hull. This situation could not be sustained for long as the craft's momentum was lost through the short wide surface skipping across the surface of the water.

The naval architect analysed this performance and concluded that when the boat had heeled right over into the turn it was "*effectively, planing sideways on a very short, wide surface. This, like a high aspect ratio aircraft wing (i.e. glider with long slender wings) gives a lot of lift, so the craft rises and the wetted surface shortens towards the chine on the inside of the turn. Once – say, in a Starboard turn where the stern is sliding to Port – the centre of this planing lift moves past the Centre of Gravity (CG) position (i.e. to Starboard of it – towards the chine on the inside of the turn), then what is effectively a sideways 'porpoise' occurs. The craft CG being to Port of the centre of pressure of the remaining wetted surface, causes a moment that rolls the craft back to Port and, at the same time, the hull has risen virtually clear of the water. So, the hull 'skips' sideways and rolls upright at the same time, whereupon, on landing, the keel bites into the water and abruptly stops the sideways slide. This happens with varying degrees of violence!*"

This action corresponds with the evidence that the boat appeared to stop suddenly just before the occupants were ejected.

On the day of the accident another boat had previously passed through the area of the accident and some residual wash waves might have been encountered as the boat rolled back to the upright. If this was the case, and the hull had been sliding when waves were encountered on the port bow, then the violence and amplitude of the roll upright at the end of the hook would have been increased.

2.5.3 Boat's performance

The naval architect observed the performance of the boat when turning at the end of the straight line runs, and noted that "*the boat did take up a high angle of inward heel – towards the more extreme end of the scale for planing deep vee craft - and also, that this could happen in two stages – a certain angle of heel at the start of turning and then an increase to a more extreme angle part way through the turn. This is not unknown and some other craft have exhibited this tendency, but it is preferable to engineer it out".*

In his report, he concluded that "*the craft did not seem to show any bad handling characteristics, although banking, tail sliding, side-skip when the craft reaches its limit… was noted. It is felt it would be nice to develop out the above characteristic from the craft or reduce it. It is undesirable and it should be possible to reduce the effect or the suddenness of it. Reducing the degree of heel angle would help."*

In determining the reasons for the high angle of heel, the naval architect considered why the dynamic righting moment of the hull did not overcome the heeling moment in a turn. He suggested that *"either the round tube or the unusual outer panel of the hull (just inboard of the chine) are picking up water by 'coander effect'*[6] *(the force exerted by water sticking to and being drawn round a curved surface) which is actually sucking the hull over beyond its natural banking angle. If this is the case then it should be possible that hull modifications/additions could be fitted which would separate the flow and break the suction*". [sic]

It is evident that the boat was put into a high powered tight turn, which was an exceptionally unusual manoeuvre for a recreational boat. However, the boat's tendency to adopt a high angle of inward heel when turning, which was also noted in the RIB International article, was described by the naval architect as "*undesirable"*.

2.6 RECREATIONAL CRAFT DIRECTIVE COMPLIANCE

Milly was manufactured to meet the essential requirements of the Recreational Craft Directive.

The manufacturer had produced a DoC which listed the relevant essential requirements and the applicable ISO standards. ISO 6185-3 was the standard used to ensure the boat's handling characteristics complied with the RCD. This required the boat to pass the manoeuvring test specified by ISO 11592. Although the test had been successfully carried out, the results of the test were not readily available.

The technical file, which had been prepared for the previous manufacturer of Cobra RIBs in 2007, was noted to be inconsistent with the DoC issued for *Milly* in that ISO 6185-4 was the standard referenced for the boat's construction. The DoC in the technical file stated, in relation to handling characteristics, that no standard was

[6] 'Coander' effect – more commonly spelt 'coanda'.

applicable, which is incorrect as ISO 11592 applied. Further, the section of the form requiring insertion of the notified body undertaking the stability assessment, had not been completed.

In *Milly*'s owner's manual it was noted that the maximum engine power given for the boat was 336kW (450hp), as opposed to 264kW (350hp) on the DoC. The maximum power was listed on the builder's plate as 261kW but was barely legible due to the poor standard of marking used on the plate. Use of the formula listed in ISO 6185-4, which was the reference used in the technical file, gave a maximum power figure of 226kW (303hp).

Although unlikely to have contributed directly to the accident, as the naval architect stated *Milly* '*did not seem to show any untoward bad handling characteristics*', the inconsistencies in maximum engine power identified above, the incomplete technical file, and poorly documented results of the manoeuvring test are all areas of concern. Such inconsistencies and omissions should be rectified as soon as possible, particularly as they impact on the maximum power of engine that is permissible on a vessel of this size.

2.7 EMERGENCY SERVICES RESPONSE

This accident occurred during a bank holiday weekend. The emergency services received multiple telephone calls from members of the public who had witnessed the accident or its aftermath. The response to the accident was prompt and, in general, well co-ordinated.

The emergency services arrived to find a difficult scene, which was handled with a high level of professionalism. There was some initial confusion relating to the out of control boat, which took the focus away from the casualties for a short time but, given the number of reports received from the public, this was not surprising and did not affect the outcome.

The deployment of the fast response ambulance to the coastal path above the beach, instead of the harbour, led to a short delay in the ambulance service attending the casualties. The Padstow harbour authority was not included in the initial phase of the emergency response, which potentially deprived the emergency services of a valuable, well-informed, local asset.

Had the harbour authority received earlier notification, and had a list of landing sites been readily available, the slight delay in the ambulance service attending the casualties might have been avoided.

2.8 COMMENDABLE ACTIONS BY MEMBERS OF THE PUBLIC

When the accident occurred the closest craft to the casualties were two canoes. The three people in the canoes did not hesitate when proceeding to the assistance of the casualties.

As the first on scene they were faced with an extremely difficult and distressing scenario. The fact that they were able to triage and provide first-aid to the casualties, while also phoning the emergency services and summoning help from other craft in the area, was highly commendable. Without their highly professional intervention it is possible that the consequences of this accident would have been worse.

The action of the single canoeist in attempting to intercept the circling boat, in order to prevent further injuries, to the point where contact was made between the two craft, was selfless and worthy of note.

Also praiseworthy were: the actions of the doctor, a passenger on *Thunder*, who entered the water to provide first-aid to the casualties; and the bravery and seamanship of the local boatman who managed to bring *Milly* under control as it circled in the estuary.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. When the accident occurred, the driver of *Milly* was not wearing a kill cord. [2.3]

2. The crew of the boat did not have a good understanding of how it would perform in a high powered turn. [2.2]

3. It is concluded that the accident occurred because the boat hooked suddenly when placed into a high powered turn. [2.5.2, 2.5.3]

4. During trials, it was discovered that the boat had a tendency to take up an extreme angle of inward heel, following which it started to plane sideways. The boat's tendency to adopt a high angle of inward heel was described, by the consultant naval architect, as 'undesirable'. [2.5.2, 2.5.3]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The evidence of this and previous accidents would indicate that kill cord use is still sporadic, and that much more needs to be done to make attaching a kill cord second-nature when taking over the helm of a powerboat. [2.3]

2. Despite the guidance contained in the owners' manual and the RYA's powerboat training scheme syllabus, Mr and Mrs Milligan were unaware of the hazards associated with allowing their children to sit and stand in the front of their RIB while it was travelling and turning at high speed. [2.5.1]

3. The deployment of the fast response ambulance to the coastal path above the beach, instead of the harbour, led to a short delay in the ambulance service attending the casualties. The Padstow harbour authority was not included in the initial phase of the emergency response, which potentially deprived the emergency services of a valuable, well-informed local asset. [2.7]

4. The inconsistencies found in the manufacturer's RCD conformity documentation should be rectified as soon as possible. [2.6]

SECTION 4 - ACTIONS TAKEN

4.1 MAIB ACTIONS

MAIB has issued Safety Bulletin 1/2013 **(Annex N)** in relation to the use of kill cords on powerboats.

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

The **Royal Yachting Association** has taken a number of actions to promulgate advice relating to safety on powerboats. It has:

- Published articles in the RYA members' magazine which have included safety advice.
- Produced film clips, for use on *YouTube*, social media and the RYA website on how to attach kill cords, how to check a kill cord is serviceable and on general safety tips for powerboat operators.
- Held safety talks at the Southampton Boat Show, September 2013, relating to powerboat safety, kill cord use and safety training courses.
- Produced stickers for attaching to powerboat control consoles relating to the need to wear a kill cord.
- Conducted several TV interviews promoting powerboat safety and the wearing of kill cords.
- Launched a Safety Campaign during the London Boat Show, January 2014, that includes further guidance on the importance and correct wearing of kill cords.
- Undertaken to issue guidance to powerboat instructors on the need to advise individuals undertaking 'own-boat' tuition on high powered RIBs and sports boats of the advisability of conducting additional training beyond the Powerboat Level 2 course.

The **British Marine Federation** has taken the following action:

- Briefed the Boat Retailers and Brokers Association on the accident.
- Begun work on preparing a handover checklist for powerboat owners.

The **Devon and Cornwall Local Resilience Forum** has reviewed the emergency response to this accident and agreed that:

- An early notification to harbour authorities will occur in the future.
- Reference to local marine emergency plans, and co-ordination of landing places will be made in future emergency responses.

SECTION 5 - RECOMMENDATIONS

The **Royal Yachting Association** is recommended to:

2014/103 Revise the powerboat scheme content and delivery to ensure that more extensive guidance is made available to powerboat drivers covering the additional hazards presented by high powered craft and operations at high speed, and the measures that should be taken to mitigate these risks for passengers and crew. Specific guidance should be provided on the hazard of hooking, and the importance of appropriate seating and handholds when travelling at speed.

APV Marine Limited is recommended to:

2014/104 Review its RCD conformance documentation to ensure these contain consistent references to the relevant ISO standards, particularly with reference to maximum engine power.

2014/105 Review the design of the hull of its Cobra RIB range and make modifications to reduce the steep angle of heel which the boat adopts in tight turns.

Marine Accident Report