

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 such 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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Death of a recreational diver after a fall on board **MV JEAN ELAINE** 15nm NW of Cape Wrath 14 August 2012

SUMMARY

At 1607 (UTC+1) on 14 August 2012, Mr Lex Warner, an experienced recreational diver, fell onto the deck of the dive workboat *Jean Elaine* (**Figure 1**). When he fell, Lex was fully dressed and prepared for diving to a depth of 95m; he was wearing heavy equipment on his back and had additional diving gear attached to his front and sides. Although it was not immediately apparent, it was likely that the diving gear impacted into Lex's abdomen during the fall and caused significant internal injuries. Having been helped back to his feet by the boat's crew, Lex made a positive indication that he wished to continue with the dive and he entered the water unaided. At a depth of 88m, Lex started an unplanned return to the surface. He lost control of his breathing and buoyancy shortly afterwards. Three of his fellow divers attempted to increase his buoyancy and administer breathing gases; however, Lex did not start breathing again. He was attached to a lifting bag and ascended to the surface from a depth of 65m. Despite further medical treatment on board *Jean Elaine* and by the emergency services, he could not be revived and was pronounced dead later that evening.



Figure 1: Jean Elaine

The MAIB investigation found that:

- There was a significant risk to divers of tripping and falling when attempting to walk on the deck of a workboat in open sea while fully dressed and equipped for deep 'technical' diving.
- The effects of wearing a large amount of heavy diving equipment can significantly exacerbate the results of what might otherwise be considered a relatively minor fall.
- While other incidents underwater have not been considered, it is plausible that Lex Warner started his unplanned ascent, which led to his death, because he felt unwell as a result of internal injuries suffered during a pre-dive fall.
- Although the skipper was aware of the demands of his working environment, there was no evidence of a formal assessment of the risks to a fully-dressed diver moving from his seated preparation area, to the point of entry into the water.

As a result of this investigation, two safety recommendations have been made to improve the arrangements for recreational divers when operating from workboats.

FACTUAL INFORMATION

Background

Lex Warner made his first expedition with the group of experienced recreational divers (who sometimes referred to themselves informally as the 'Dark Star') in the summer of 2011. The group specialised in diving on previously unexplored wrecks and used advanced 'rebreather' equipment to enable them to reach depths in the order of 80 to 100m. Other members of the group had made similar expeditions over many years; the majority of these had been on board the Stromness-based dive workboat *Jean Elaine*. At the end of the 2011 expedition the divers agreed to return the following year.

Preparation

The divers travelled by ferry from Scrabster to Stromness on Saturday 11 August 2012 and met with the owner and skipper of *Jean Elaine* who was already well known to many of them from previous trips. Having loaded their diving kit onto the boat, they spent the evening ashore before returning on board for the night.

During the morning of Sunday 12 August 2012, *Jean Elaine* departed from Stromness and headed to Scapa Flow, where the divers conducted two uneventful 'shake-down' dives on German battleship wrecks; Lex only participated in the first of these dives, to a depth of 45m. Overnight *Jean Elaine* headed west towards Cape Wrath, and during the following morning the group conducted their third dive of the trip on the wreck of MV *Majorca*, which sank near the Cape in a depth of 54m. Lex did not participate in this dive; it was reported that he was not prepared in time and the other divers continued without him.

The weather started to deteriorate during the afternoon so, in consultation with the divers, the skipper decided to head for Kinlochbervie for shelter overnight. Early the following day, Tuesday 14 August 2012, the skipper reviewed the weather forecast and decided to cancel the dive that had been planned for that morning and remain alongside.

However, in the course of the morning the weather started to improve, so a revised plan was agreed between the skipper and the divers to find and then dive on an unnamed wreck which was thought to be approximately 15 miles north-west of Cape Wrath (**Figure 2**). At 1130, *Jean Elaine* departed Kinlochbervie and headed towards the wreck. During the passage, the weather conditions continued to improve and other divers described Lex as being excited, but also nervous, in anticipation of the first deep dive of the trip on a previously unexplored wreck.

At approximately 1500, *Jean Elaine* arrived in the vicinity of the wreck and the skipper started searching for wreckage using the vessel's echo sounder. The wreck was soon identified at a depth of 95m and the divers each started their personal preparations for the dive.

Although there was no formal briefing, the group did discuss the depth of the wreck, its orientation and the order in which they would enter the water. The skipper and the group had developed a system for managing the dive and subsequent decompression over many years and this was well understood by all those involved. An important requirement, to maximise use of the slack tidal stream and align decompression requirements, was for all the divers to enter the water in fairly quick succession.

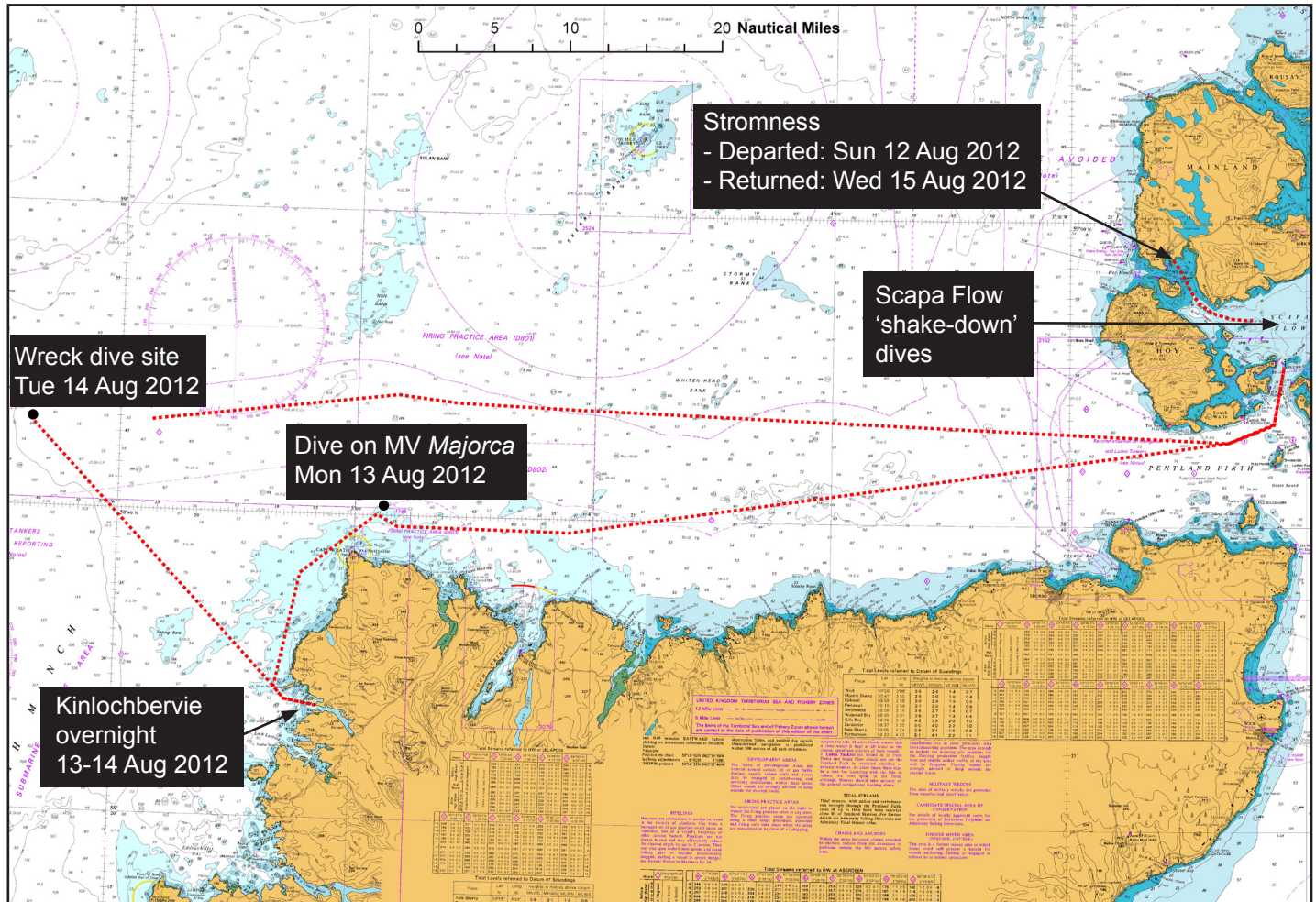


Figure 2: Voyage of MV Jean Elaine

The weather conditions had further improved and were now considered to be very satisfactory for diving; it was warm and sunny with a slight swell. Lex sat on the central bench on *Jean Elaine's* foredeck, facing to starboard (**Figure 3**) to prepare for the dive; this included a successful pre-dive check of his rebreather equipment. All the divers prepared their equipment in isolation; they did not check or assess each other's kit.

The skipper and deckhand placed the shot guideline¹ into the sea as close to the wreck as possible. As the divers continued to dress and prepare, the skipper manoeuvred the vessel in close proximity to the buoy marking the shot line, and assessed the strength of the tidal stream².

At 1558, in suitable tidal conditions and with all personal preparations complete, the skipper gave a signal for divers A and B to enter the water. They did so and then swam down the shot line to connect its lower end to the wreck. They were soon followed into the water by divers C and D who set up the 'lazy' shot line³ and trapeze decompression station at a depth of 6m (**Figure 4**).

At 1607, diver E entered the water and, at the same time, Lex stood up from the bench and started to walk towards the exit gate on *Jean Elaine's* starboard side (**Figure 5**). Lex was fully prepared for the dive carrying his rebreather equipment on his back, three bail-out bottles⁴ on his sides and additional personal diving kit including a torch, surface marker buoys and dive computers. Lex was breathing through his rebreather and wearing his facemask, gloves and fins.

¹ A rope line running from the surface to the wreck used by the divers as a guide. It also has three small buoys attached at the surface end that functioned as an approximate gauge of the strength of tidal stream.

² Ideally, a dive would take place at slack water, either side of a high or low water time.

³ A second line which runs from the surface and connects to the main shot line at approximately 40m depth. This line has the main decompression station attached at 6m under the surface.

⁴ Bail-out bottles are reserve bottles; typically a gas mix for use at depth and compressed air for decompression stops, and divers often loosely strap 2 or 3 of these to the abdominal area.



Figure 3: Lex's dressing position

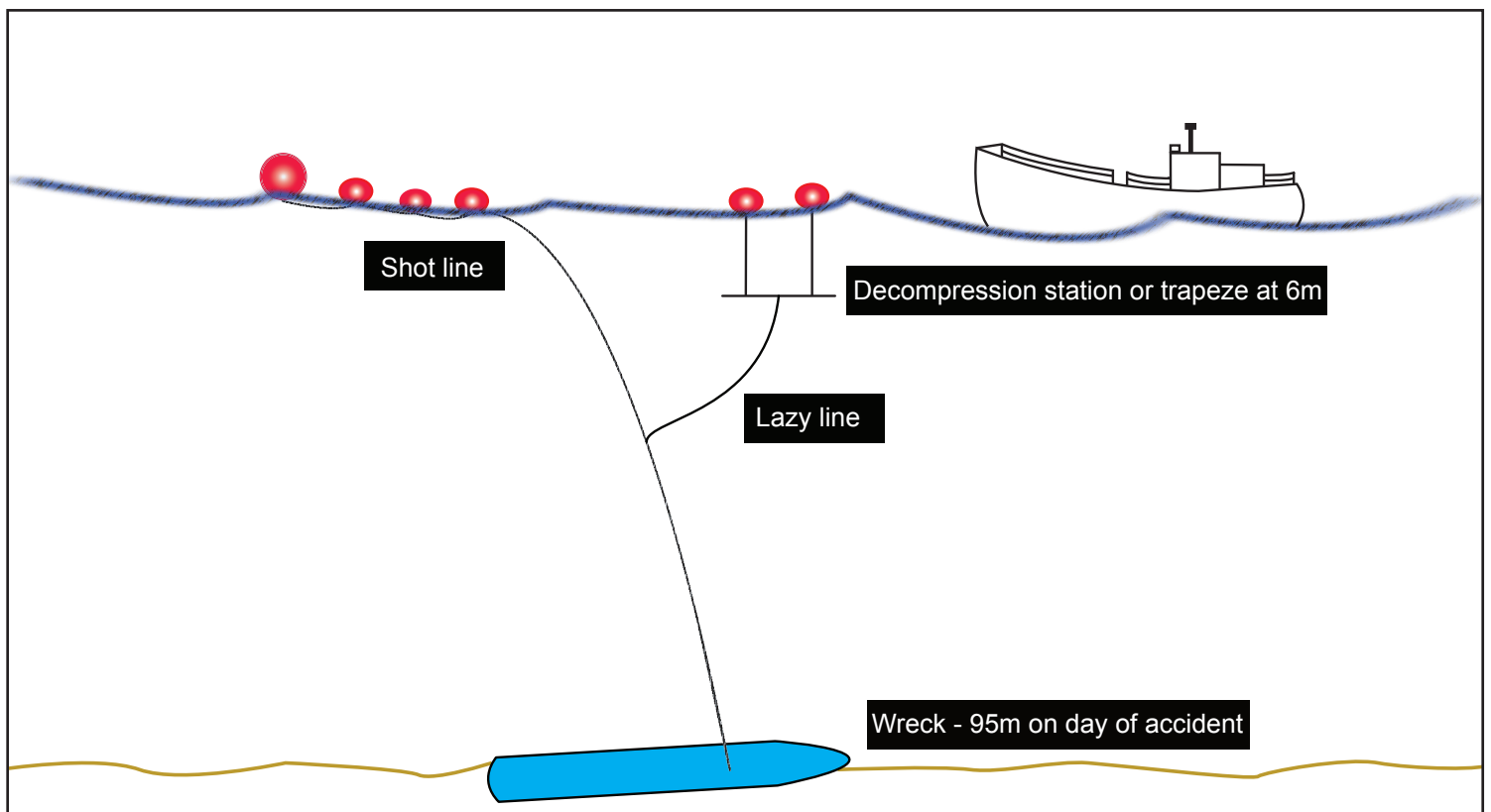


Figure 4: Diving rig

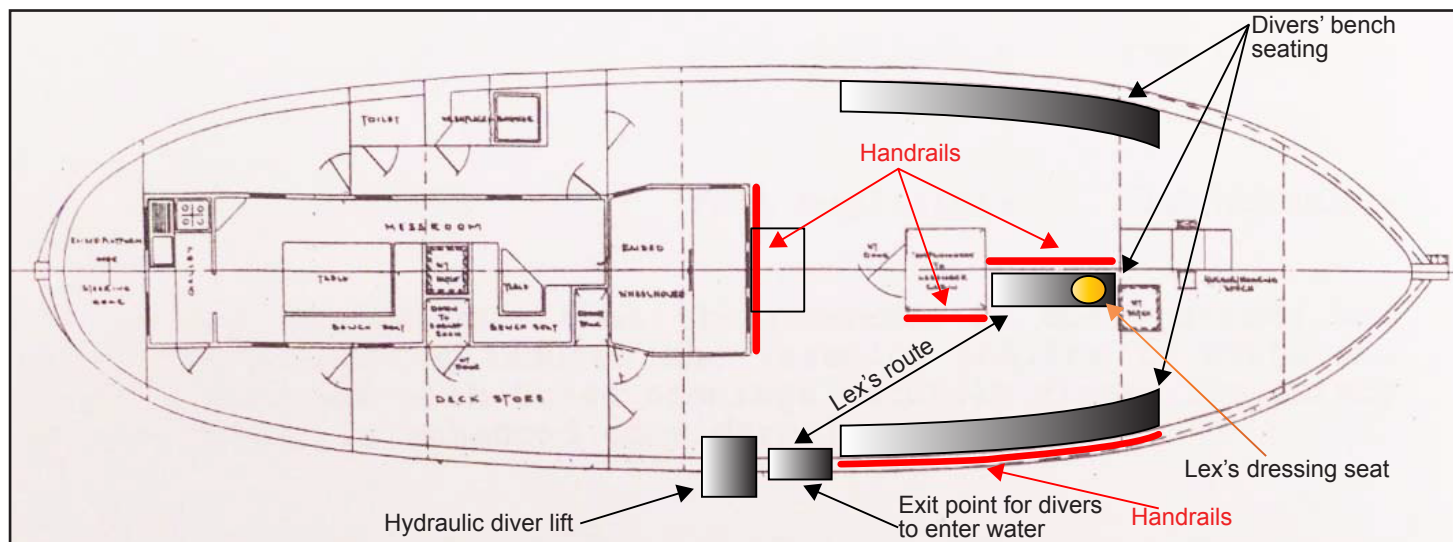


Figure 5: Deck layout

The fall

As he approached the exit gate, Lex fell forwards, landing very heavily onto the deck. The initial impact was to his knees, immediately then onto his hands. His fins became trapped towards his shins, which caused him to roll onto his side and finally over onto his back; a position from which he could not recover himself. There were no obstructions in Lex's path which could have tripped him and he was reported to have expressed frustration and annoyance at himself for falling.

The deckhand was standing immediately behind Lex at the time of the fall and was not able to offer much support as Lex fell away from him. The skipper was in the wheelhouse, and on hearing Lex fall he left the boat in gear and moving slowly ahead⁵ and went down to the foredeck to assist. With much physical effort, the skipper and the deckhand managed to get Lex back onto his feet. The skipper asked Lex if he wanted to sit down and recover while the other divers entered the water. They both then asked Lex how he felt and if he still wanted to dive. Lex's response was reported to be positive and enthusiastic; he nodded and answered that he intended to continue the dive as planned. Two of the other divers who were waiting to enter the water witnessed the fall but did not intervene and, by this time, diver E had commenced his descent down to the wreck alone.

At 1609, Lex (diver F) entered the water unaided with divers G and H immediately following him – the three of them effectively entering the water as a group. After the skipper repositioned the boat, diver I was the last to enter the water.

The dive

Having stepped off the boat, Lex swam on the surface to the buoy marking the lazy shot line and started his descent alone. Divers G, H and I made their way to the buoy marking the main shot line to start their descents.

On his way down, Lex was seen at 40m by diver D and at 70m by divers A and B; on each occasion he was observed to be on his own and swimming well. However, after just over 9 minutes in the water and at a depth of 88m, Lex started an unplanned ascent. Records from his diving equipment showed that his breathing remained normal at this point. Divers A and B, who were conducting a decompression stop at about 70m, became aware of Lex beneath them; they observed that he was struggling with his breathing and control of his buoyancy. Divers A and B tried to calm Lex down, but he did not respond and continued to haul himself up the shot line.

Diver A pursued Lex up the shot line; he caught up with him at a depth of about 60m and saw that Lex did not have either the breathing loop from his 'rebreather' or a demand valve⁶ from his bail-out cylinders in his mouth. He attempted to fit a demand valve into Lex's mouth without success. Diver A also tried to assist Lex with his buoyancy by adding air to his suit, this was also not successful. Divers B and H joined

⁵ The boat was left in gear, ahead, so it would not foul the buoys marking the lazy shot line.

⁶ Demand valve – also referred to as a second stage regulator reducing the interstage gas pressure so that it can be breathed safely.

diver A in trying to assist Lex, who was still not breathing and had become very heavy due to his lack of buoyancy control; this caused him to start descending again. The three divers assisting Lex were unable to get him to restart breathing. Given this situation, they decided to attach a lifting bag to Lex, which was then inflated. The inflated lifting bag carried Lex rapidly to the surface from a depth of about 65m.

Recovery

At 1628, just under 19 minutes after entering the water, Lex surfaced. At that time, *Jean Elaine's* crew were recovering divers C and D, who had returned to the surface early after diver C had experienced a problem with his equipment. The skipper spotted a diver (not yet identified as Lex) near the buoy marking the shot line. It was apparent from the diver's position in the water that something was wrong, so the skipper manoeuvred *Jean Elaine* closer to the shot line to assess the situation. The deckhand then managed to catch hold of the diver with a boat hook and divers C and D re-entered the water to assist; they identified the diver at the buoy as Lex. Diver D managed to tie a line to Lex's rebreather casing and the crew were able to lift him into the boat using a davit. Diver D could not detect a pulse so Lex's dry suit was cut loose and cardiopulmonary resuscitation (CPR) was commenced immediately.

At 1643, the skipper returned to the wheelhouse and called the Coastguard on VHF Channel 16 reporting that he had an unconscious diver on board and requesting assistance. The Coastguard attempted to connect the VHF call to the on-call doctor ashore. However, appreciating the seriousness of the situation, the skipper requested an immediate helicopter casualty evacuation. The Air Rescue Co-ordination Centre (ARCC) at Kinloss directed the Coastguard rescue helicopter based at Stornoway to proceed to the scene. The helicopter arrived at 1709 and Lex was winched up and flown directly to the Western Isles Hospital in Stornoway; CPR was sustained during the flight. Despite further attempts by the accident and emergency staff, Lex could not be resuscitated and was declared deceased at the hospital.

Diving equipment examination

The diving equipment used by Lex Warner was examined by an independent diving company shortly after the accident and later by the equipment's manufacturer. No defects were found.

The deceased

Lex Warner was a 50 year old businessman who was a highly qualified and experienced recreational diver. He achieved an Advanced Instructor qualification with the British Sub-Aqua Club (BSAC) in 2004 and was a member of BSAC from 2000 to 2011. He initially qualified in the use of closed circuit rebreather diving equipment in 2004 and further qualified in its use to a depth of 100m in 2009. He obtained these qualifications through training with the International Association of Nitrox and Technical Divers (IANTD). Often referred to as 'technical' diving, the use of mixed gas rebreather diving equipment is a specialised form of the recreational sport and only a small (but increasing) number of divers graduate to this level. Lex had a reputation as being a meticulous maintainer and operator of his equipment. Notwithstanding his extensive qualifications, Lex was the least experienced member of the group on the expedition; he had only been on one previous expedition with them (the year before) and his deepest dive then had been to a depth of 78m.

Medical evidence

An autopsy of Lex Warner's body was conducted on 17 August 2012. This examination identified internal injuries which were assessed to be inconsistent with a diving related accident. The report of the examination recorded the cause of death as drowning, following a traumatic injury *'resulting from a fall on a dive boat'*. It concluded that the internal injuries were *'almost certainly caused when he [Lex] fell to his knees and the tops of the cylinders strapped to his thighs impacted with his abdomen'*.

The MAIB commissioned a second opinion on this autopsy report from a consultant pathologist with a specialist interest in diving. His conclusion was contrary to the original autopsy and was that death was caused by a gas embolism resulting from the rapid ascent. However, the second opinion agreed that the internal injuries were the result of a *'diffuse crushing injury'* to the abdomen by a *'blunt object leaving no external mark'*. This report further concluded that, given the minimal bleeding in the abdominal cavity, the

injury would not have caused a problem such as shock, but would have been a medical emergency in its own right. The second opinion also judged that this trauma would have *'caused some degree of pain and this has to be considered as a possible factor resulting in the rapid ascent'*.

Dark Star

The Dark Star group was not a formally organised diving club or association and did not use an expedition leader or diving supervisor. However, each member of this group was experienced in their own right and they all had a thorough understanding of diving safety. The build-up to each dive was focused on individual mental preparation and equipment checks. Discussions were often held regarding the planning and execution of each dive; formal briefs did not routinely take place and no-one was nominated as being 'in-charge' of a dive or having responsibility for safety. While the divers typically entered the water in pairs, their system was to dive as a group, which allowed individuals the freedom to explore the wreck and make adjustments to their plans to take account of different gas mixes and decompression stops. The divers were normally close enough to one another for any of them to be able to assist a colleague in an emergency. It was also expected that each individual diver would have sufficient equipment and skill to be able to support themselves in all but the most serious emergencies.

Jean Elaine

Built in 1956 as a trawler, since 1994 *Jean Elaine* had operated from Stromness as a commercially operated diving workboat supporting recreational and research diving. At the time of the accident, the vessel was coded as a workboat under the Maritime and Coastguard Agency's (MCA) Marine Guidance Notice 280 *'Code of Practice for Small Vessels in Commercial use for Sport or Pleasure, Workboats or Pilot Boats'* (MGN 280). *Jean Elaine* was certified to carry up to 12 passengers with a total loading not to exceed 2050kg (including a maximum of 1000kg of equipment). The vessel's permitted area of operation was Category 2 (up to 60nm from a safe haven). The vessel was fitted with handrails behind the central bench seating, along the sides of the foredeck accommodation access housing and across the front of the wheelhouse (**Figure 5**). The wooden deck was covered with a non-slip coating.

The crew

Jean Elaine's crew consisted of the skipper and a deckhand. The skipper was a 54 year old former commercial diver who had owned the vessel since 1994. He had 25 years' experience of commercial and recreational diving, as well as operating workboats. He held a Health and Safety Executive (HSE) Part 4 qualification for commercial diving and diving supervision, although his medical certification had lapsed so only the supervising element was still valid. He held a Royal Yachting Association (RYA) Yachtmaster Offshore qualification, commercially endorsed for power-driven craft, and was also a member of the Professional Boatmans' Association.

The deckhand was 42 and had been working at sea for 26 years on fishing boats, container ships and the local ferries. Most of his experience related to cooking and general deck work, however, he had undertaken basic courses in first-aid, sea survival and fire-fighting. He was employed by the skipper to undertake general seamanship duties, cooking and assisting the divers.

Risk assessment

MGN 280 requires that risk assessments are conducted and Annex 3 states that *'Risk assessments should identify the hazards and personnel at risk'*. However, the regulations do not require that risk assessments are written down. MGN 280 also directs skippers to take *'appropriate measures to remove the risks in so far as possible'*. While *Jean Elaine*'s skipper had considered the safety of parts of the operation (such as his method for assessing the strength of tidal streams) he had not conducted or documented a formal risk assessment of his diving support operations.

Other guidance

Section 22.2.5 of MGN 280 states that: *'Handrails should be provided for access stairways, ladderways, passageways and for decks without bulwarks or guardrails'*. Section 22.7.1 states that: *'The surface of a working deck should be non-slip'* and section 22.7.2 explains that *'acceptable surfaces are: chequered plate, unpainted wood; a non-skid pattern moulded into FRP; non-slip deck paint; or an efficient non-slip covering'*.

BSAC is the UK's National Governing body for scuba diving and snorkelling, and it publishes extensive guidance on the conduct of diving expeditions, including: *'Expedition Leader Guidelines'*, *'Dive Planning and Management'* and *'Guidelines for the Safe Operation of Member Club Dive Boats'*. This guidance is commonly used for diving expeditions undertaken by affiliated clubs and associations.

Chapter 3 of the Professional Association of Diving Instructors' (PADI) Open Water Diving Manual offers guidance for recreational divers when in boats, in particular: *'be careful when walking with equipment on. Equipment changes your centre of gravity and makes your balance awkward. If necessary, hang on to railings and handrails as you move, and don't try to walk with your fins on. Put your fins on immediately before entering the water'*.

Commercial diving regulation

Although it does not apply in this case, the Merchant Shipping (Diving Safety) Regulations 2002 and the 1997 *'Diving at Work Regulations'* set the requirements for commercial diving. The MCA offers further guidance on the implementation of these regulations in MGN 424(M), *'Safety Responsibilities on board Dive Boats'*. This guidance notice advises that the master of the vessel is responsible for all activities on board which *'may include aspects of the diving project'*. This guidance also emphasises the importance of risk assessments, dive planning and the role of a diving supervisor.

Responsibility

The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997⁷ require that employers take appropriate measures to ensure the health and safety of workers and other persons, so far as is reasonably practicable. The MCA's interpretation⁸ of this regulation is that the term *'other person'* includes passengers travelling on board a vessel.

MGN 280 Article 3.4 states that for sport diving: *'Vessel owners, agents, managers and charterers are recommended to discuss and agree their respective responsibilities for safety before the vessel goes to sea'*.

Orkney Islands Council Harbour Authority issues permits for diving operations, including recreational activity, being conducted within the Orkney Harbour Areas. This would have applied to the 'shake-down' dives conducted on the first day of the expedition but not thereafter. The Orkney Islands Council's permit to dive requires all leisure divers to *'confirm to the dive boat skipper that they are suitably experienced/qualified to carry out each dive'*. It also requires the dive boat skipper or diving supervisor to state that *'safety arrangements will be maintained for the duration of the diving operation'*.

RYA training

The skipper's qualification to operate the vessel was his commercially endorsed RYA Yachtmaster Offshore certificate. Widely recognised and utilised in the maritime industry, this is a qualification that covers a significant and diverse range of applications in the small commercial vessel environment. The RYA Yachtmaster syllabus is broad and does not cover specific requirements for specialist areas such as diving support. The RYA's relatively new, and mandatory, Professional Practices and Responsibilities (PPR) course is intended to improve the broader knowledge of skippers who use RYA qualifications commercially. The PPR course includes training in understanding the commercial environment, the importance of correct manning, maintenance of safety equipment, risk assessments and operating procedures.

Previous accidents

A search of the MAIB database from 2002 to 2011 revealed eight reported accidents involving falls by divers in or from boats; none were fatal. BSAC's accident database contained records of an additional five significant fall injuries since 2000; also none were fatal. While it is possible that many minor falls go unreported, fatal accidents are, in general, much more likely to be recorded.

⁷ Statutory Instrument 1997: 2962

⁸ MGN 492 (M+F) Health and Safety at Work: Protecting those not employed by the ship owner

ANALYSIS

While some elements of the diving activities undertaken from *Jean Elaine* during this trip have been included in this report for completeness, investigation of diving accidents is outside the MAIB's area of responsibility and expertise. Consequently, the following analysis focuses on the fall sustained by Lex Warner prior to his final dive, and any influence this might have had on his death.

The accident

Lex Warner was an experienced technical diver who, despite missing some of the shake-down dives, should have been capable of completing this dive. Following the accident, Lex's diving equipment was inspected and found to be working correctly. Consequently, while other incidents underwater have not been considered, an entirely plausible reason for him to have become distressed during the dive was considered to be that he was suffering from the effects of internal abdominal injuries sustained during his fall on board *Jean Elaine* prior to the dive.

Drugs, fatigue and alcohol

There was no evidence that any of those involved in the accident were suffering from the effects of drugs, fatigue or alcohol and therefore these are not considered to be contributing factors to the accident.

The fall

Lex Warner fell, either as a result of losing his balance or tripping, as he tried to walk unaided from the central bench seating on *Jean Elaine*'s foredeck to the exit gate on the boat's starboard side. When he fell, Lex was walking forwards, wearing diving fins. This would have created a very significant tripping hazard. He was also carrying his heavy diving equipment, which raised his centre of gravity and reduced his stability. His visual situational awareness, which could have aided his balance, would almost certainly have been degraded as he was also wearing his diving facemask.

There was no evidence to suggest that the deck was unduly slippery or that there were any tripping hazards in his path. Although the weather and sea conditions were considered to be very satisfactory for diving, the boat was experiencing a gentle rolling action in the slight swell of the open sea. This would probably have contributed to any loss of balance.

The internal injury

Both the initial autopsy report and the second medical opinion described the internal injuries as being caused by a blunt force trauma in the abdominal area. There was no evidence of such an event before the fall and it is difficult to conceive it happening underwater. Lex's fall was a heavy impact forward onto a hard deck. Bulky components of his diving apparatus, including his bail-out cylinders, were strapped to his front and sides. It is highly likely that this equipment would have forcefully impacted his abdominal and chest areas as he fell, and his body would have been further compressed by the significant weight on his back. Therefore, it is considered that the most likely cause of the internal injuries was the fall while Lex was in the boat. The second medical opinion concluded that the severity of the internal injury was such that, even if Lex had not dived, his condition would have developed into a surgical emergency.

Preventing the fall

The handrails on *Jean Elaine*'s foredeck provided good support in the areas where divers prepared their kit, on either side of the accommodation hatch area and across the front of the wheelhouse. However, there was no physical support immediately available to divers if they crossed in a straight line from the central dressing bench directly to the exit gate.

Guidance from BSAC and PADI advises against walking forwards while wearing fins as it causes a significant tripping hazard. However, members of the Dark Star group preferred to put their fins on early in the dressing sequence as it was very difficult for them to put their fins on without assistance once they were encumbered with the rest of their diving equipment. However, there was seating on *Jean Elaine* immediately next to the exit gate which could be used as a final stopping point to put fins on, ideally with the aid of another person.

Although the deckhand was close behind Lex at the time of the fall, he was not able to offer support as Lex fell away from him. While the deckhand would hold onto, or guide fully-dressed divers across the deck if requested, he did not routinely do so. Each of the divers was experienced and the sea conditions were considered to be good. Such dedicated support could also quickly become unmanageable when several divers needed to enter the water in quick succession.

The decision to dive

The dive took place on a previously unexplored wreck at a depth of 95m. This would have been one of the deepest dives of Lex's career and probably an important opportunity to him. Having only completed one of the three previous dives on the expedition this far, and compounded by the weight of the equipment, discomfort of wearing warm underclothing and a dry suit on a sunny day, it is likely that Lex would have felt very motivated to begin the dive. With five divers already in the water and the others waiting, he would also have felt (and was reported to have expressed) personal frustration at the fall, further adding to a natural urge to carry on and enter the water.

Risk control

Recreational divers are effectively passengers while embarked in dive workboats. The transition from passenger to diver occurs at the point of entry into the water. The skipper has no direct authority over a recreational diver in the water. The MCA's regulations relating to the safety of passengers in small vessels clearly set out the requirement for handrails and non-slip decks. However, the regulations are general in nature and do not take into account any additional, specific, requirements that might be needed to meet the needs of a fully-dressed diver.

The skipper of *Jean Elaine* took an active role in the planning and execution of diving activities and had helped develop the system used by the group on board. His decisions to adjust the programme for the week (due to weather) and the need for his approval to enter the water indicated that he had a significant degree of influence over the diving activities. Despite these positive actions, there was no evidence of a formal assessment of the risks to a fully-dressed diver moving from his seated preparation area, to the point of entry into the water. Such an assessment should have identified the risk of a diver falling over and found methods to reduce the likelihood of this occurring.

Preventing the dive

The nature of internal abdominal injuries can make them extremely difficult to detect, and neither the skipper nor the deckhand on *Jean Elaine* had the medical expertise to detect or treat the injury. Falls of fully-dressed divers were not uncommon, and no others have been identified that have caused fatal injuries. The skipper and deckhand's intervention after the fall were reasonable attempts to establish if Lex was obviously injured and whether he was content to continue with the dive. It was evident immediately following his fall that Lex positively indicated that he wished to carry on with the dive and that he did not appear to be suffering unduly. Lex could have decided not to proceed with the dive at any point, even after he had entered the water.

For commercial diving activity, there are high levels of control and supervision of divers as well as clear explanation of the master's responsibility. Divers enter the water under the control of a diving supervisor who ensures an agreed dive plan is implemented and that appropriate safety control measures are in place. This is a distinctly different operating environment to recreational diving. The Dark Star group's arrangement was that the decision to dive was made by each individual diver; there was no-one in overall charge and no-one with the authority to prevent an individual diver from entering the water if they chose to do so.

The skipper's RYA training was non-specific in nature and did not provide any training targeted to his specialised role. The PPR course will go some way to broaden skippers' skills but will still not cover situations specific to those faced by dive workboat skippers.

Subsequent actions

The second medical opinion stated that Lex's condition would have deteriorated to a serious medical emergency even if he had not dived. Lex was assisted in the water by the other divers and received further medical treatment after he surfaced. Sadly, his internal abdominal injuries, and other injuries relating to inhalation of water and the rapid ascent from a depth of 65m were too severe for him to be saved.

CONCLUSIONS

- When fully prepared for diving, Lex Warner fell heavily onto the deck of the dive workboat, *Jean Elaine*. The fall almost certainly caused him to sustain serious internal injuries.
- The effects of wearing a large amount of heavy diving equipment can significantly exacerbate the results of what might otherwise be considered a relatively minor fall.
- It is entirely plausible that Lex Warner started his unplanned ascent because he felt unwell as a result of internal injuries he suffered during the fall.
- Despite their efforts underwater, Lex Warner's fellow divers were unable to assist him effectively when he was seen to be struggling with his breathing and buoyancy.
- *Jean Elaine* was well suited to its operating environment and compliant with guidance for small, passenger-carrying workboats.
- Although the skipper was aware of the demands of his working environment, there was no evidence of a formal assessment of the risks to a fully-dressed diver moving from his seated preparation area, to the point of entry into the water.
- Due to the widely variable nature of employment of small commercial vessels, regulations for them and training for their crews are necessarily generic and do not focus on the specific issues involved in operating a recreational diving workboat.

ACTIONS TAKEN BY OTHER ORGANISATIONS

The owner/skipper of *Jean Elaine* has made a commitment to undertake the RYA Professional Practices and Responsibilities course at the earliest opportunity.

RECOMMENDATIONS

The **owner/skipper of *Jean Elaine*** is recommended to:

- 2013/245** Conduct a thorough review of the safety arrangements on this and any other vessels he may operate, to ensure that:
- The risks involved in supporting recreational diving operations are formally and methodically assessed.
 - The employment of crew and positioning of physical supports are considered in order to minimise the risks to divers as they prepare to enter the water.

The **British Diving Safety Group** is recommended to:

- 2013/246** Promulgate the lessons identified from this investigation to member organisations and encourage them to ensure that, as policy and guidance for recreational technical diving develops, the effects of specialist equipment on reducing mobility and increasing loads on divers while they are moving about on vessels are taken into account.

Marine Accident Investigation Branch
December 2013

SHIP PARTICULARS

Vessel's name	<i>Jean Elaine</i>
Flag	Not registered (UK registration lapsed in 2010)
Classification society	Not applicable
IMO number/fishing numbers	902675
Type	Dive workboat
Owner	Scapa Flow Charters
Manager(s)	Scapa Flow Charters
Year of build	1956
Construction	Wooden, former fishing vessel
Length overall	21.88m
Gross tonnage	73.18
Minimum safe manning	2
Authorised cargo	Not applicable

VOYAGE PARTICULARS

Port of departure	Kinlochbervie
Port of arrival	Stromness
Type of voyage	Recreational diving expedition
Cargo information	Not applicable
Manning	2 crew, 9 passengers

MARINE CASUALTY INFORMATION

Date and time	14 August 2012, 1607 (UTC+1)
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	15m NW of Cape Wrath
Place on board	Foredeck
Injuries/fatalities	Internal injuries, one fatality
Damage/environmental impact	Not applicable
Ship operation	Recreational diving support
Voyage segment	Mid water
External & internal environment	Daylight, good visibility, sunny with a slight swell.
Persons on board	11