ACCIDENT REPORT

Report on the investigation of the falling of

a lifeboat into the sea during

a launching exercise on board the

polar research vessel

RRS *Sir David Attenborough*

on Loch Buie, Isle of Mull, Scotland

on 4 March 2021

MAIB

MARINE ACCIDENT INVESTIGATION BRANCH

MARINE INCIDENT REPORT NO 6/2023 NOVEMBER 2023

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.

Front cover image courtesy of Reuters (Phil Nobel)

All MAIB publications can be found on our website: www.gov.uk/maib

For all enquiries:

Marine Accident Investigation Branch
First Floor, Spring Place
105 Commercial Road
Southampton
SO15 1GH
United Kingdom

Email: maib@dft.gov.uk
Telephone: +44 (0)23 8039 5500

Press enquiries during office hours: +44 (0)1932 440015
Press enquiries out of hours: +44 (0)300 7777878

CONTENTS

FIGURES

TABLES

ANNEXES

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

3/O	-	third officer
BAS	-	British Antarctic Survey
C/E	-	chief engineer
C/O	-	chief officer
Cammell Laird	-	Cammell Laird Shiprepairers and Shipbuilders Limited
DPA	-	Designated Person Ashore
ETO	-	electro-technical officer
FRC	-	fast rescue craft
HPU	-	hydraulic power unit
ISM Code	-	International Safety Management Code
knots	-	kts
LR	-	Lloyd's Register
LSA	-	lifesaving appliances
LSA Code	-	International Life-Saving Appliance Code
m	-	metre
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MOU	-	memorandum of understanding
NERC	-	Natural Environment Research Council
Norsafe	-	Norsafe AS (the original equipment manufacturers)
PMS	-	planned maintenance system
RRS	-	Royal Research Ship
SEC	-	Cargo Ship Safety Equipment Certificate
SG1	-	seaman grade 1 (a deckhand with an able seaman certificate)
SMS	-	safety management system
SOLAS	-	International Convention for the Safety of Life at Sea, 1974
t	-	tonne
UKRI	-	United Kingdom Research and Innovation
UMS	-	Unattended machinery space
UTC	-	universal time coordinated
VLSE	-	Viking Life-Saving Equipment A/S

TIMES: all times used in this report are UTC unless otherwise stated.

SYNOPSIS

At about 1145 on 4 March 2021, while Royal Research Ship *Sir David Attenborough* was at anchor on Loch Buie, Isle of Mull, Scotland, three of its crew members sustained minor injuries when a lifeboat fell into the sea during a familiarisation launch. The three crewmen were inside the port lifeboat and had used its remote control system to start the launch. The lifeboat fell from the davit onto the ship's deck and was dragged over the side by the moving davit arms before it detached from its hooks. The crew on the deck of RRS *Sir David Attenborough* were unable to halt the launch sequence and prevent the lifeboat falling into the water.

The accident occurred because a safety interlock had not automatically reset after a previous test of the lifeboat launch system. When the remote control system was activated the winch brake released out of sequence and caused the lifeboat to prematurely lower from the davits during the launch.

Sir David Attenborough had recently been handed over from the shipbuilder, Cammell Laird Limited, to the Natural Environment Research Council and British Antarctic Survey. The launching of the lifeboat was the first opportunity for the crew to practice the procedure at sea.

The investigation found that the required checks and planned maintenance on the davit had not been completed since it had been installed on the ship. The installation of the davit had not been fully completed in accordance with the manufacture's specifications, but had been accepted by the approving authorities.

Following the accident, *Sir David Attenborough* returned to the builder's yard and completed a period of defect rectification that included completion of the davit installation. British Antarctic Survey has: modified its system of launching lifeboats for the purpose of training and drills so that launch and recovery is undertaken without embarked crew; rewritten the operating instructions for lifeboats in the Safety of Life at Sea manual, taking advice from Norsafe AS as the original equipment manufacturer; and written additional checklists for both the launching and recovery of the lifeboat. Viking Life-Saving Equipment Ltd has: fitted a new tension weight and wire clamp and installed a training mode remote control system that meets the SOLAS requirement.

Recommendations have been made to the Maritime and Coastguard Agency to review its process for delegating Safety Equipment Surveys to Recognised Organisations to provide assurance that surveys have been carried out effectively and in compliance with SOLAS regulations. Also, to review its delegation policy to consider whether it is appropriate to delegate initial surveys.

Image courtesy of Reuters (Phil Nobel)

RRS *Sir David Attenborough*

SECTION 1 – FACTUAL INFORMATION

1.1 PARTICULARS OF RRS *SIR DAVID ATTENBOROUGH* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Sir David Attenborough*
Flag	Falkland Islands
Classification society	Lloyd's Register
IMO number	9798222
Type	Research vessel
Registered owner	United Kingdom Research and Innovation
Manager(s)	British Antarctic Survey
Construction	Steel
Year of build	2016
Length overall	128.82m
Registered length	123.23m
Gross tonnage	15,609
Minimum safe manning	16
Authorised cargo	Not applicable

VOYAGE PARTICULARS	
Port of departure	Holyhead, Anglesey, Wales
Port of arrival	Loch Buie, Isle of Mull, Scotland
Type of voyage	Coastal
Cargo information	Not applicable
Manning	33

MARINE CASUALTY INFORMATION	
Date and time	4 March 2021 at 1145
Type of marine casualty or incident	Marine Incident
Location of incident	Loch Buie, Isle of Mull, Scotland
Place on board	Port boat deck
Injuries/fatalities	None
Damage/environmental impact	Port lifeboat. No environmental damage
Ship operation	At anchor
Voyage segment	At anchor
External & internal environment	Daylight; very good visibility; weather condition clear; wind force 3
Persons on board	38

1.2 NARRATIVE

At 0910 on 4 March 2021, Royal Research Ship (RRS) *Sir David Attenborough* anchored on Loch Buie, Isle of Mull, Scotland **(Figure 1)** to conduct deck crew training on fast rescue craft (FRC) operations followed by lifeboat launching familiarisation. The weather conditions were good, with a smooth sea state and a gentle breeze.

At 1100, the chief officer (C/O) conducted a toolbox talk with eight crew and assigned individual tasks to each for launching the lifeboat. The C/O decided to launch and recover the unmanned lifeboat three times from the port boat deck to the waterline, to familiarise the crew in the operation of the davit **(Figure 2)**.

The crew took up their assigned positions around the lifeboat davit on the boat deck. The bosun's mate, located on the deck above the boat deck, used the electric push button controller to start the hydraulic power unit (HPU) and then pushed the davit out button. The port davit arms started moving and stopped once they had reached their fully deployed position. The deck engineer, positioned by the electric winch, lifted the winch brake release arm and lowered the lifeboat to just above the waterline. The bosun's mate attempted to hoist the lifeboat back up to the davit arms using the electric remote control but the electric winch did not start. The C/O called for technical assistance and the chief engineer (C/E) and two electro-technical officers (ETO) arrived and traced the fault to a seized limit switch on the davit arm. This was rectified and the lifeboat was recovered to its stowed position in the davit. The electric push button controller was then used to lower and recover the lifeboat twice more without incident.

The C/O decided to test the remote control launching system from within the lifeboat and so three crew entered the lifeboat from the embarkation platform on the davit and sat in their assigned positions: the third officer (3/O) was in charge of the lifeboat, at the helm; the seaman grade one (SG1) was next to the 3/O; and the science bosun was in the bow. The 3/O instructed the crew to fasten their seatbelts and prepare for launching. Realising that the remote control wire was not fed through the gland into the lifeboat, he released his seatbelt, stood up, opened the hatch and fed the remote control wire into the lifeboat. He then closed the hatch and sat back down on the seat, but did not fasten his seatbelt again. He then attempted to start the lifeboat launch by pulling the lifeboat remote control wire, which was adjacent to his seat. However, the lifeboat did not launch so the SG1 unfastened his seatbelt, stood up and pulled the remote control wire again, which activated the launch system. At the same time as the davit arms started to move, the winch system released the lifeboat falls.

The lifeboat dropped from the davit head, landed on the base of the davit arms and rolled 90° onto its side on the deck. The SG1 let go of the remote control wire and was thrown towards the helmsman's seat. On the boat deck, the bosun's mate activated the hydraulic system pump's emergency stop but the davit arms continued to move outwards. The lifeboat was dragged across the deck and momentarily balanced on the deck edge before being pulled over the side **(Figure 3)**. The forward hook released the falls suspension ring followed by the suspension ring being released from the aft hook. The lifeboat, with its bow pointing downwards, fell towards the sea. The aft falls suspension ring ripped the aft hatch off as the lifeboat dropped bow first into the water. The 3/O and the bosun inside the lifeboat remained in their seats but the SG1 fell to the bow. The lifeboat became completely submerged and water started to flood through the aft hatch opening before the lifeboat righted itself and came to rest, floating on an even keel.

Reproduced from Admiralty Chart 0002-0 by permission of HMSO and the UK Hydrographic Office

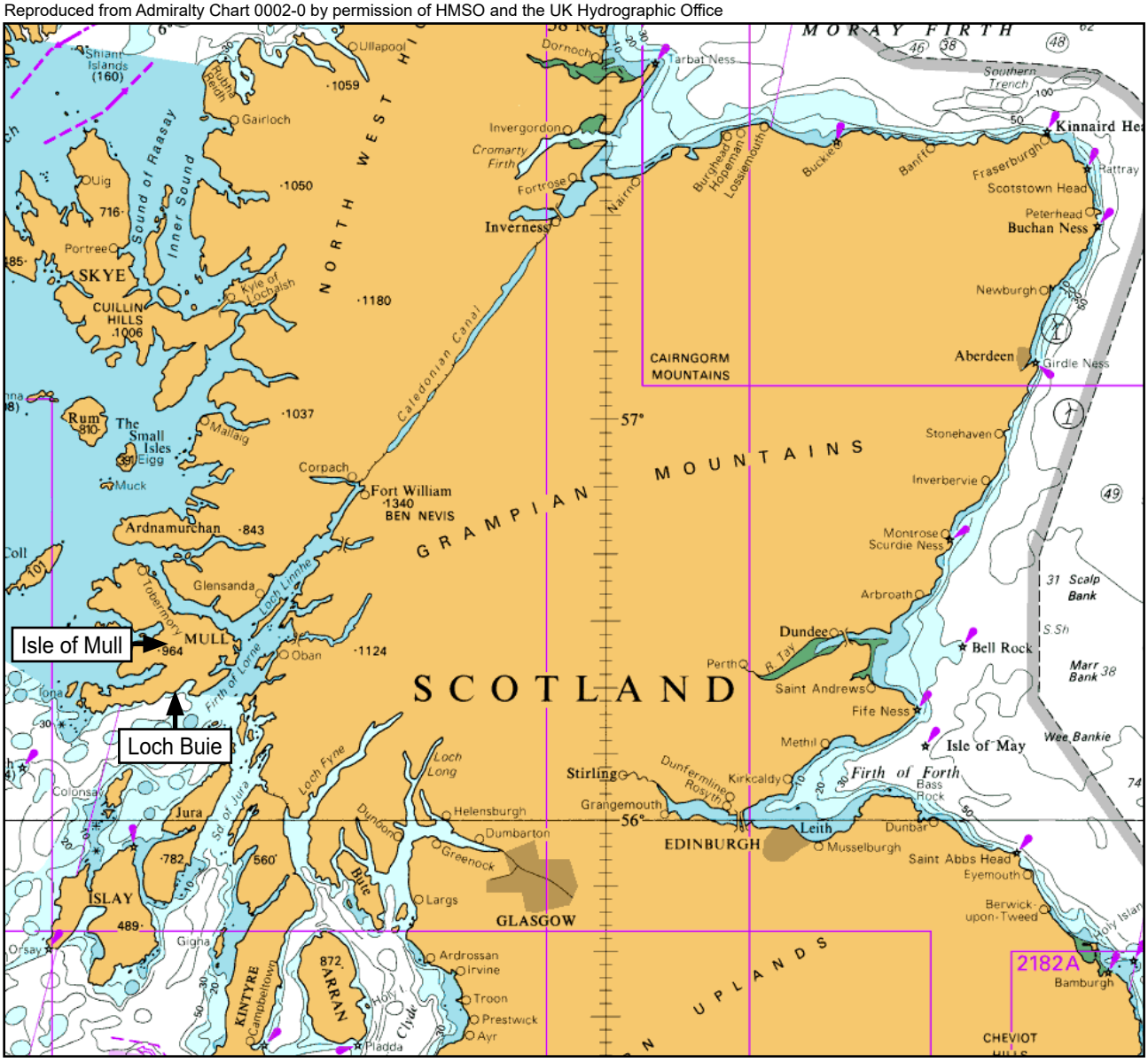


Figure 1: Location of accident

For illustrative purposes only: model shows a starboard launching system

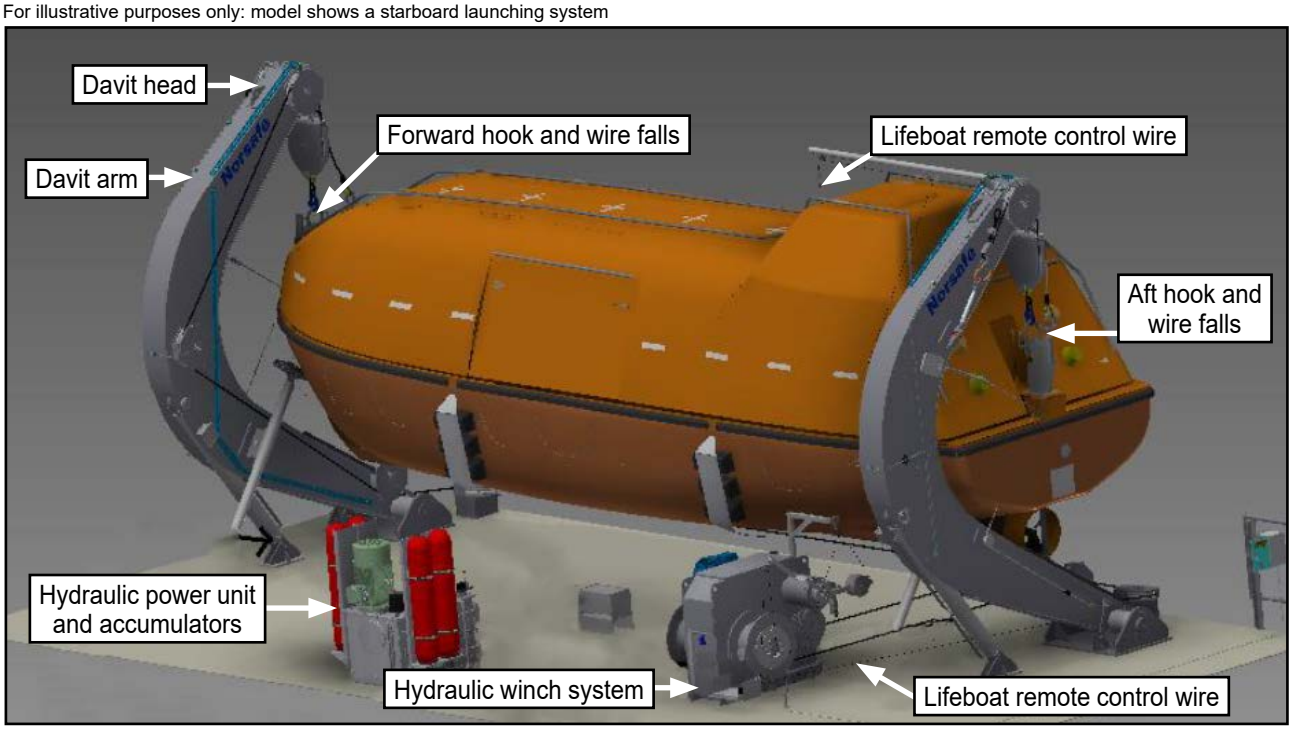
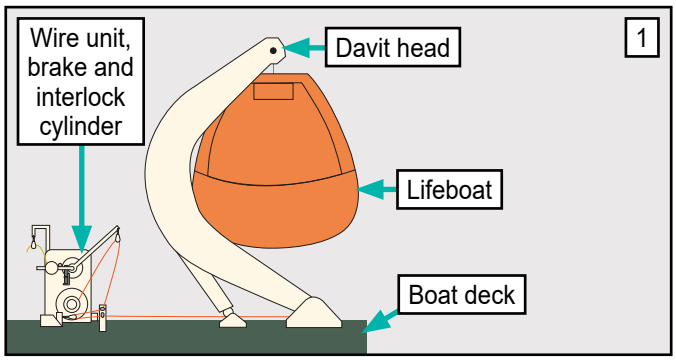
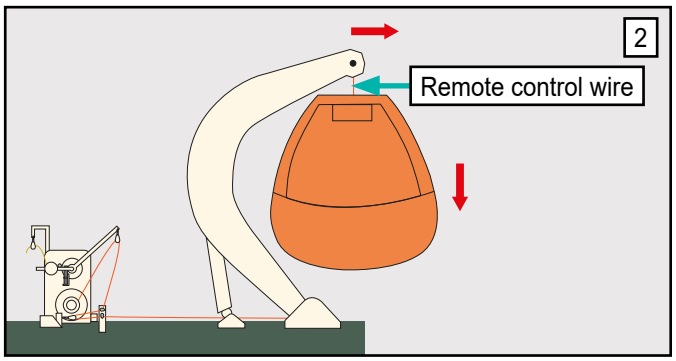


Figure 2: Davit system general arrangement

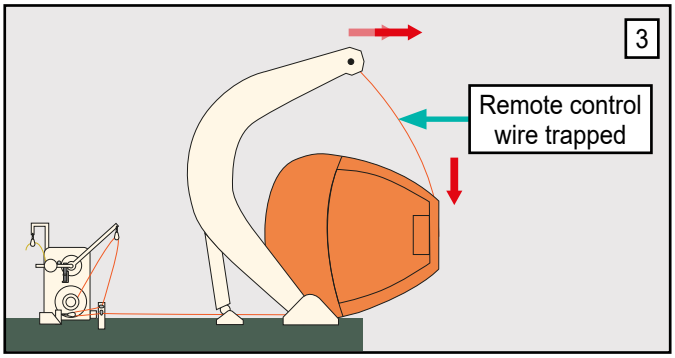
For illustrative purposes only: not to scale



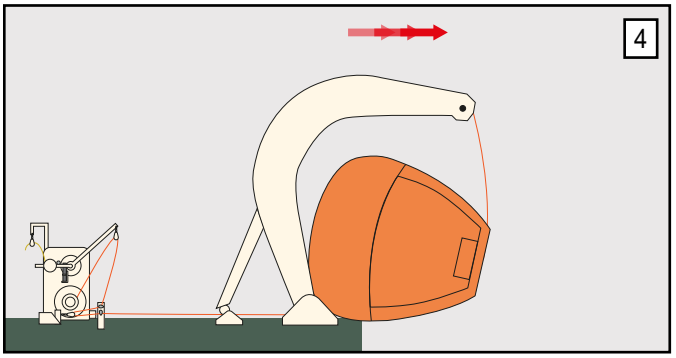
Lifeboat suspended from davit head



Activated emergency remote control wire engages hydraulic winch system. Hydraulic pressure moves davit arm and lowers lifeboat



Lifeboat drops onto base of davit arm and rolls 90° onto its side



Davit arm continues to move outwards and drags lifeboat across boat deck and over the side

Figure 3: Sequence of lifeboat being dragged overside

The boat deck crew on board RRS *Sir David Attenborough* raised the alarm by calling the bridge. At 1158, the vessel's master sounded the emergency stations alarm and the crew prepared to launch the FRC to go to the aid of the lifeboat, which had drifted away from the ship. As the FRC approached the lifeboat, the 3/O indicated that no one on board was seriously injured. The FRC then towed the lifeboat back to RRS *Sir David Attenborough* where it was craned onto the vessel's main deck. The lifeboat's crew were examined by the ship's doctor who confirmed that they had not suffered any serious injuries.

1.3 RRS *SIR DAVID ATTENBOROUGH* PROJECT

1.3.1 General

In 2014, the UK Government announced funding for a new polar research vessel that would be operated by British Antarctic Survey (BAS). The vessel was commissioned by the Natural Environment Research Council (NERC) for ownership by United Kingdom Research and Innovation (UKRI). It would replace two existing vessels, RRS *James Clark Ross* and RRS *Ernest Shackleton*, and serve as a multidisciplinary research platform and provide logistical support for BAS polar research teams in inshore locations.

1.3.2 Project award and construction

UKRI awarded a contract to Houlder Ltd to undertake the basic design development of the new vessel and manage the project.

In 2015, Cammell Laird Shiprepairers and Shipbuilders Limited (Cammell Laird) was awarded the contract to build the new polar research vessel RRS *Sir David Attenborough*. The ship was built to a Rolls-Royce Marine AS design, which also supplied the machinery and equipment. Construction of the vessel was undertaken by Cammell Laird at its Birkenhead facility.

Houlder Ltd also acted on behalf of NERC to oversee the vessel's construction. Houlder Ltd's responsibilities encompassed witnessing equipment installation, systems testing and acceptance, and providing progress reports, which included quality and technical matters.

Steel cutting for RRS *Sir David Attenborough* began in July 2016, and its keel laying ceremony to mark the start of the vessel's construction took place a few months later. In the same year, Cammell Laird managed a competitive bid process for equipment contracts that resulted in the supply of davits and lifeboats being awarded to Norsafe AS (Norsafe).

On 2 December 2020, following a 49-month construction phase and sea trials, RRS *Sir David Attenborough* was handed over to NERC and BAS.

1.3.3 RRS *Sir David Attenborough*

RRS *Sir David Attenborough* was designed and built to operate in the Arctic and Antarctic oceans. The 15,600t vessel measured 129m in length and its hull was ice-strengthened to Polar Class 4, giving the ship an ice-breaking capability of 1m ice thickness at a speed of 3 knots (kts). RRS *Sir David Attenborough* had a range of 19,000 nautical miles at 13kts cruising speed and was designed to be operated with unattended machinery spaces (UMS)[1]. The vessel could accommodate 30 crew and 60 scientists.

The lifesaving appliances included two fully enclosed Polar Class 90-person lifeboats, one on either side of the ship.

[1] UMS mode enables a ship to operate without engineers working in the machinery spaces for several hours, generally accepted as a maximum of 16 hours.

RRS *Sir David Attenborough* was registered on the British register of ships in the Falkland Islands, which was a British Category 2 shipping register[2]. As RRS *Sir David Attenborough* exceeded the gross tonnage limit for the Falkland Islands shipping register, a memorandum of understanding (MOU) existed between the Falkland Islands Government and the UK Department for Transport. The MOU allowed for RRS *Sir David Attenborough* to be included on the Falkland Islands register but required that the flag state duties and administrative functions were carried out by the Maritime and Coastguard Agency (MCA).

1.3.4 Project oversight

Some of the BAS crew who would operate RRS *Sir David Attenborough* stood by the build at Cammell Laird during the construction phase. Their role was to assist in project oversight, develop vessel operating procedures, transcribe maintenance routines into the vessel's planned maintenance system (PMS) and undertake training for the vessel's equipment and systems.

1.3.5 Operational programme and ship handover

The proposed operational programme **(Table 1)** for RRS *Sir David Attenborough* was designed to meet two BAS milestones: the removal from service of RRS *James Clark Ross* and RRS *Ernest Shackleton* and the need to achieve its November 2021 deployment in time for summer in the southern hemisphere. Also, the UK Government expected that RRS *Sir David Attenborough* would be showcased during the 2021 Cop26 climate conference hosted by BAS and Royal Museums Greenwich in London.

The original plan, in which *James Clark Ross* supported *Sir David Attenborough* in the first deployment to the South Atlantic to properly evaluate *Sir David Attenborough*'s capabilities, was cancelled due to the extensive overrun of the build project. This decision to dispose of *James Clark Ross* was taken by NERC.

Delays in project delivery and the effects of the coronavirus pandemic meant that BAS did not take delivery of the ship from Cammell Laird until 2 December 2020 and so the planned November/December crew training period was not achieved. Approximately 2400 system and equipment defects existed at the point of handover and rectification of these was undertaken by the crew of RRS *Sir David Attenborough*, assisted where necessary by Cammell Laird workers, while the ship was alongside in Holyhead, Wales. Further, it was not possible to operate the vessel in UMS mode as the machinery monitoring and alarm system was continually alarming so the engine room had to be manned 24 hours a day by two engineers in a watchkeeping routine. The knock-on effect of this unforeseen additional workload diverted the crew away from routine maintenance work, extended the period the vessel was alongside in Holyhead until March 2021 and further delayed crew training. On 15 March 2021, Lloyd's Register (LR) issued a Cargo Ship Safety Equipment Certificate[3] (SEC) for RRS *Sir David Attenborough*.

[2] Category two register – limited to merchant vessels up to 150t, fishing vessels and pleasure vessels.

[3] Issued to signify that a vessel had been surveyed in accordance with the International Convention for the Safety of Life at Sea, 1974 (SOLAS), as amended, and was found to comply with the requirements for the provision of life-saving equipment.

Month/Year	Activity
November 2020	Handover of the completed RRS *Sir David Attenborough* from Cammell Laird to NERC
November to December 2020	BAS crew to assume operational responsibility for the ship and carry out 50 days of crew training, including safety drills alongside in Holyhead, Wales
January to February 2021	30 days of operational sea trials
March to May 2021	Operational sea trials and test of scientific equipment in Arctic ice conditions
November 2021	Deployment to the South Atlantic

Table 1: Proposed operational programme for RRS *Sir David Attenborough*

1.4 RRS *SIR DAVID ATTENBOROUGH* ORGANISATION

1.4.1 Manning

Two crews of 30 people operated RRS *Sir David Attenborough* and worked to a 4-months on, 4-months off rotation. The crew were structured into four departments: deck, engineering, hotel services and medical.

The deck department consisted of a master, C/O, second officer, two 3/Os, and eight deck crew, consisting of a bosun, science bosun, bosun's mate and five able-bodied seamen. The routine care and maintenance of the lifeboats was a 3/O responsibility.

The engineering department consisted of a C/E, second engineer, two third engineers, a fourth engineer, a deck engineer, two ETOs, a chief petty officer motorman and a petty officer motorman.

Science operation support was provided by the deck engineer and the science bosun. The deck engineer had been recruited by BAS to assist with the commissioning of the deck machinery. The deck engineer had previously been a project manager for Cammell Laird, overseeing the installation of the deck equipment and systems.

1.4.2 British Antarctic Survey

BAS managed Antarctic and Arctic research and operations from its headquarters in Cambridge, UK; the ship programme and operations manager and senior marine engineer were responsible for the management of RRS *Sir David Attenborough*. The ship programme and operations manager was also the company's Designated Person Ashore (DPA)[4].

BAS operated RRS *Sir David Attenborough* under the International Safety Management (ISM) Code[5] and had developed a safety management system (SMS), for which a Safety Management Certificate and a Document of Compliance

[4] The DPA provided the link between a company and its crew to ensure the safe operation of the ship and was a direct line of communication to upper management.

[5] SOLAS Chapter IX, Regulation 2 – Application permitted government operated ships used for non-commercial purposes to not comply with the ISM Code.

(DOC)[6] had been issued. The SMS detailed the roles and responsibilities of both ship and shore staff in the safe operation of RRS *Sir David Attenborough* and the management of the vessel's environmental policy. The SMS also identified critical shipboard equipment required to be maintained for safe operation of the ship.

The senior marine engineer was responsible for monitoring the material state of the ship from the BAS headquarters. The master of RRS *Sir David Attenborough* was responsible for ensuring that critical system assessments and planned maintenance, including regular testing, were completed. The heads of department were responsible for the fulfilment of PMS generated maintenance routines that fell within their areas of responsibility.

1.5 LH-140 MKIII LIFEBOAT DAVITS

1.5.1 LH-140 MKIII lifeboat davit system

The LH-140 MKIII davit was designed and manufactured by Norsafe AS. In September 2018, Norsafe was acquired by Viking Life-Saving Equipment AS (VLSE) and Norsafe UK staff, including its service engineers, continued working under the VLSE brand.

The davit system consisted of two davit arms, an electric winch and an HPU. Each davit arm was powered by a hydraulic operating ram controlled by a hydraulic circuit. The circuit was energised via an electrically-driven pump, which also charged hydraulic accumulators that powered the circuit in the event of total electrical failure.

The electric winch controlled two wire falls that connected to the lifeboat via the forward and aft hooks. The winch allowed a fully laden 90-person lifeboat to lower under gravity, controlled by a centrifugal brake **(Figure 4)**, and could lift the lifeboat with a maximum of three crew on board when operating in electrically-powered mode. A hand crank could also be used to haul the lifeboat.

A winch drum brake held the loaded lifeboat suspended on the falls until the winch drum brake arm was lifted to release the brake. The brake arm could either be lifted by hand or by pulling on one of two wires attached to the brake arm; one of the attached wires led to an adjacent lifeboat launching station and the other to the inside of the lifeboat **(Figure 4.2)**. The wire leading to the lifeboat was also attached to a hydraulic directional control valve, which controlled the movement of the davit arms by releasing the hydraulic pressure stored in the accumulators **(Figure 4.3)**.

The winch drum brake arm was held locked in the *brake on* position by a hydraulically-operated locking pin that, when retracted, released the brake arm only when both davit arms were in the fully turned out position **(Figure 4.5)**.

An electric push button controller was used to start or stop the hydraulic pump and to turn out the davit arms or recover them to the stowed position. The electric controller also operated the winch electric motor to haul the falls when recovering the lifeboat.

[6] A DOC is issued to a company when the shoreside aspects of the SMS are fully compliant with the requirements of the ISM Code.

For illustrative purposes only: not to scale

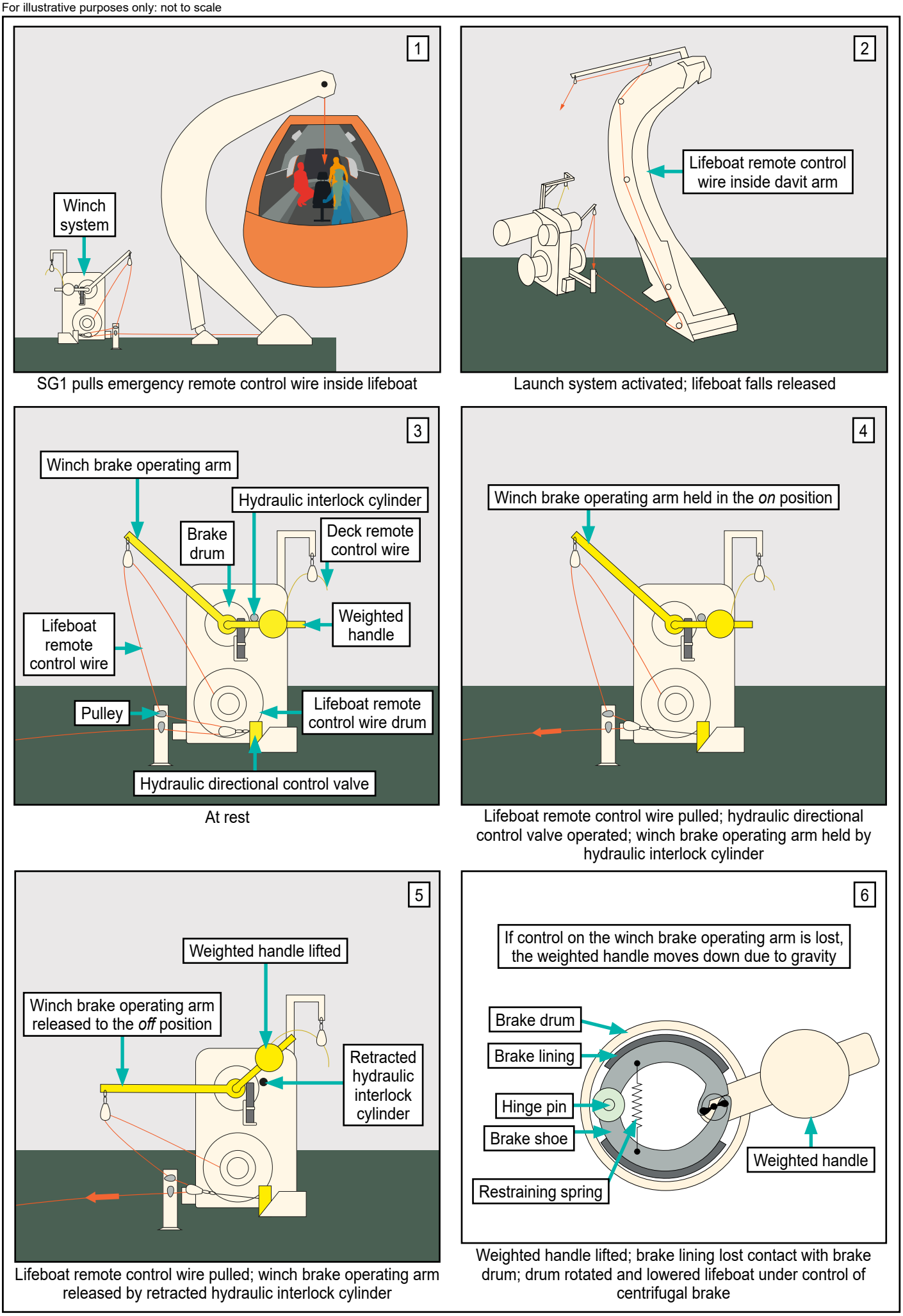


Figure 4: Davit system launch remote control method

The electric push button controller was fitted with an emergency stop button that cut all electric power to the davit system when pressed. This did not affect the launching of the lifeboat in either dead ship launch mode or training mode when the hydraulic directional control valve was operated by the attached wires.

The lifeboat could be launched from either the adjacent deck station or by pulling on the wire that led to the inside of the lifeboat, which was known as the remote control wire.

Neither BAS staff nor the crew of RRS *Sir David Attenborough* had any previous working knowledge of Norsafe LH-140 MK III davit systems.

1.5.2 The winch brake arm hydraulic interlock cylinder and locking pin

The winch brake arm locking pin was attached to the end of the hydraulic interlock cylinder piston rod by a screwed connection. The free end of the locking pin had been machined to form a tapered cone shape **(Figure 5)**.

The interlock cylinder piston rod was retracted by applying hydraulic pressure through the hydraulic oil inlet port that acted against a piston, the other side of which was vented to atmosphere via a sintered bronze filter. When hydraulic pressure was removed the piston rod and its locking pin were extended outwards by means of a return spring **(Figure 6)**.

The piston rod was manufactured from hardened chrome alloy steel designed to resist wear but not, specifically, to resist corrosion in a marine environment.

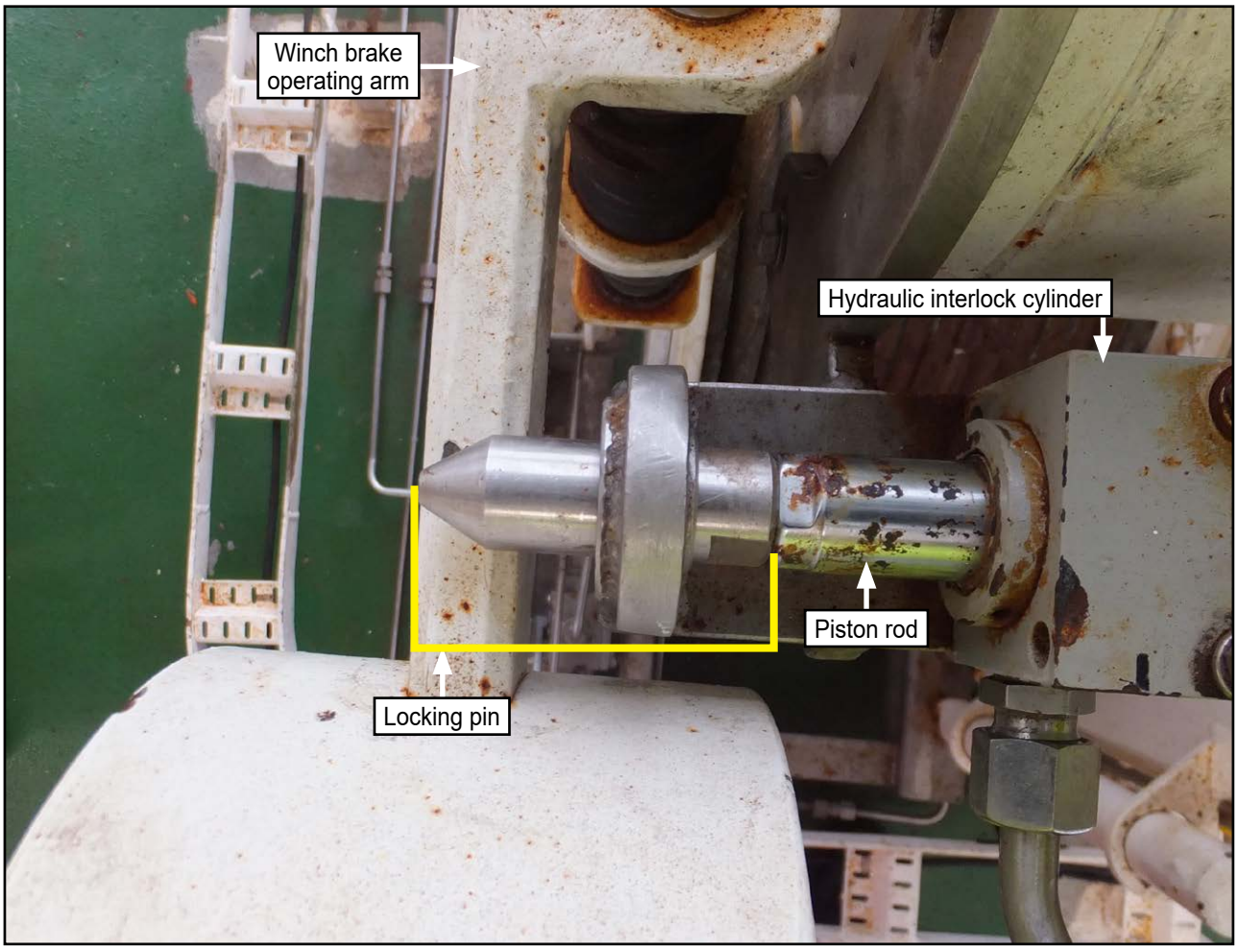


Figure 5: The hydraulic interlock cylinder as fitted to davit

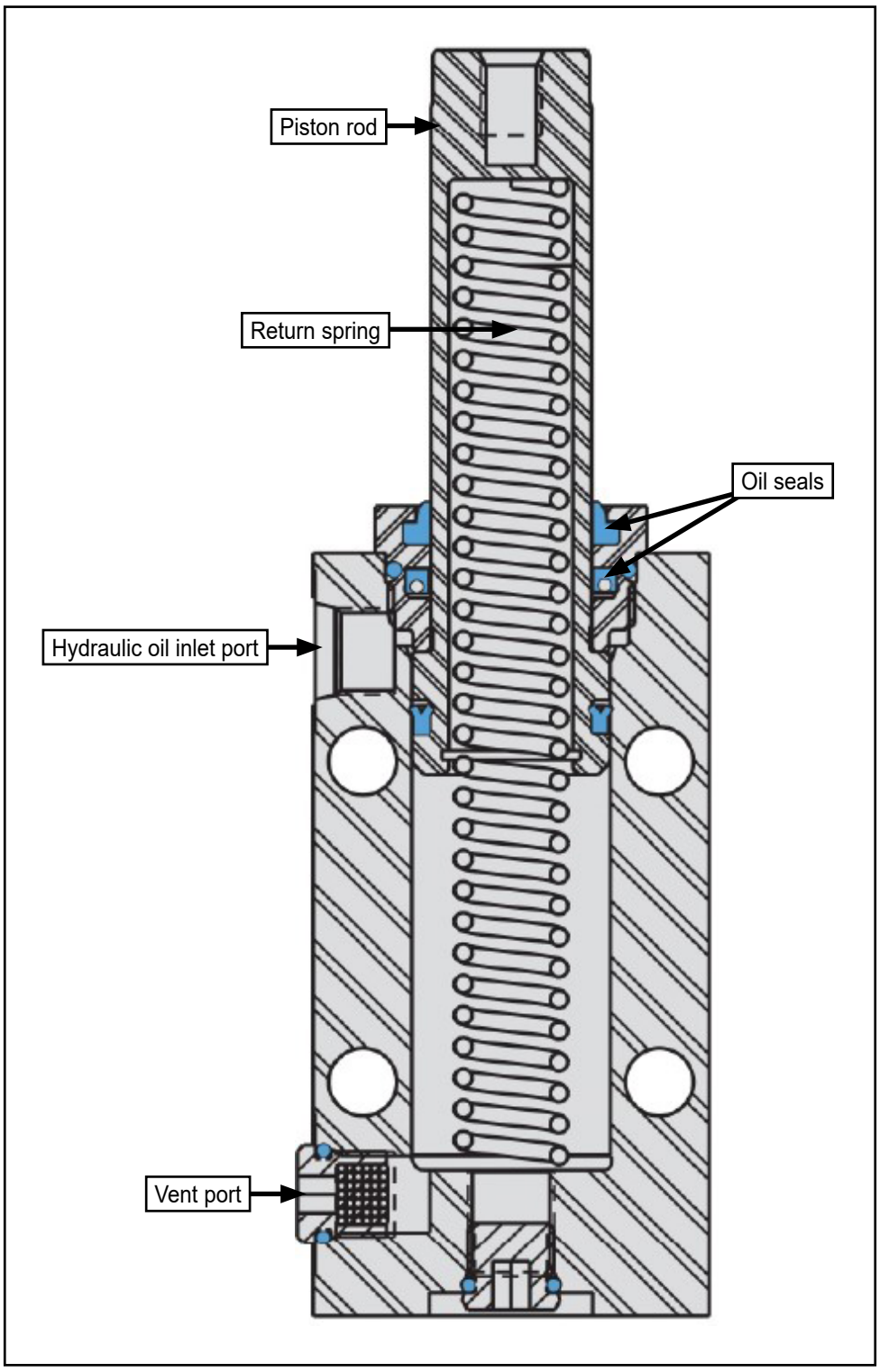


Figure 6: Cross-section of the hydraulic interlock cylinder

1.5.3 Normal launching operation

One person launched the lifeboat from the lifeboat launching station during normal launching operations. The electric hydraulic pump was started from the lifeboat launching station following embarkation and the davit arms were turned out using the electric push button control. When the davit arms were in the correct position two hydraulic proximity switches were activated and the brake arm locking pin was retracted by the hydraulic interlock cylinder. From the launching station, the wire that led to the winch brake arm was pulled and the lifeboat was lowered to the water.

The normal launching operation satisfied the requirements in section 6.1.2.2 of the International Life-Saving Appliance Code (LSA Code), which required the launching mechanism to be:

> *… so arranged that it may be actuated by one person from a position on the ship's deck and, except for secondary launching appliances for free-fall lifeboats, from a position within the survival craft or rescue boat. When launched by a person on the deck, the survival craft or rescue boat shall be visible to that person.* [sic]

1.5.4 Dead ship launch

In the event of total power failure and abandonment of the ship, the lifeboat was launched using the emergency remote control wire from inside the lifeboat following embarkation **(Figure 4)**. The tension on the remote control wire operated the hydraulic directional control valve and stored hydraulic pressure moved the davit arms to the fully turned out position. The winch brake arm was prevented from lifting by the locking pin **(Figure 5)**. When the davit arms were fully turned out the hydraulic proximity switches activated, retracting the winch brake arm locking pin. Tension on the remote control wire lifted the winch brake arm and the lifeboat was lowered to the water.

The launching sequence could be halted at any point by releasing the tension on the remote control wire. The remote control wire was payed out as the lifeboat was lowered.

1.5.5 Training mode launch system

The lifeboat davit system included a training mode remote control that was operated from the lifeboat launching station. A separate wire from the launching station was attached to the hydraulic directional control valve. When this wire was pulled the hydraulic directional control valve operated, using stored hydraulic pressure to turn the davits out. When the davit was fully turned out and the brake arm locking pin had been retracted, the wire attached to the brake arm was pulled and the lifeboat was lowered to the water. This system simulated the operation of the remote control wire from inside the lifeboat.

There was no requirement for crew to be inside the lifeboat when the training mode launch system was in use.

1.6 RRS *SIR DAVID ATTENBOROUGH* DAVIT INSTALLATION

1.6.1 Davit construction, testing and storage

The davits and lifeboats for RRS *Sir David Attenborough* were manufactured in Norsafe's factory in Jiangyin, Jiangsu Province, China. In July 2017, the factory acceptance test of the davits was completed in China and witnessed by Houlder Ltd's staff and a representative from Cammell Laird. On completion of the testing the lifeboat and davit equipment were packed into a shipping container. The equipment was delivered to Cammell Laird on 24 September 2018, where it was repackaged for storage in the shipyard until it was required for installation.

1.6.2 Davit system installation

Cammell Laird staff fitted the davits, winches and HPUs to the boat decks of RRS *Sir David Attenborough* and sub-contractors installed the electric cabling, hydraulic pipework and ancillary components. Lloyd's Register (LR), as the classification society, maintained oversight of the davit design and installation to ensure that there was compliance with both SOLAS and classification society rules[7]. The davit installation was completed in November 2019. In November 2020, following sea trials, the ship's 3/O raised a defect reporting that the *On board launching system does not operate as designed. Norsafe to reconfigure*.

Norsafe had supplied an installation manual and drawings to aid Cammell Laird with the fitting of the davit system on board RRS *Sir David Attenborough*. The completed installation deviated from the drawings provided in that the lifeboat launching station and associated training mode launch system was not fitted. Additionally, the dead ship launch system remote control wire tension weight securing clip supplied by Norsafe had been lost and Cammell Laird had consequently supplied a similar but larger clip **(Figure 7)**.

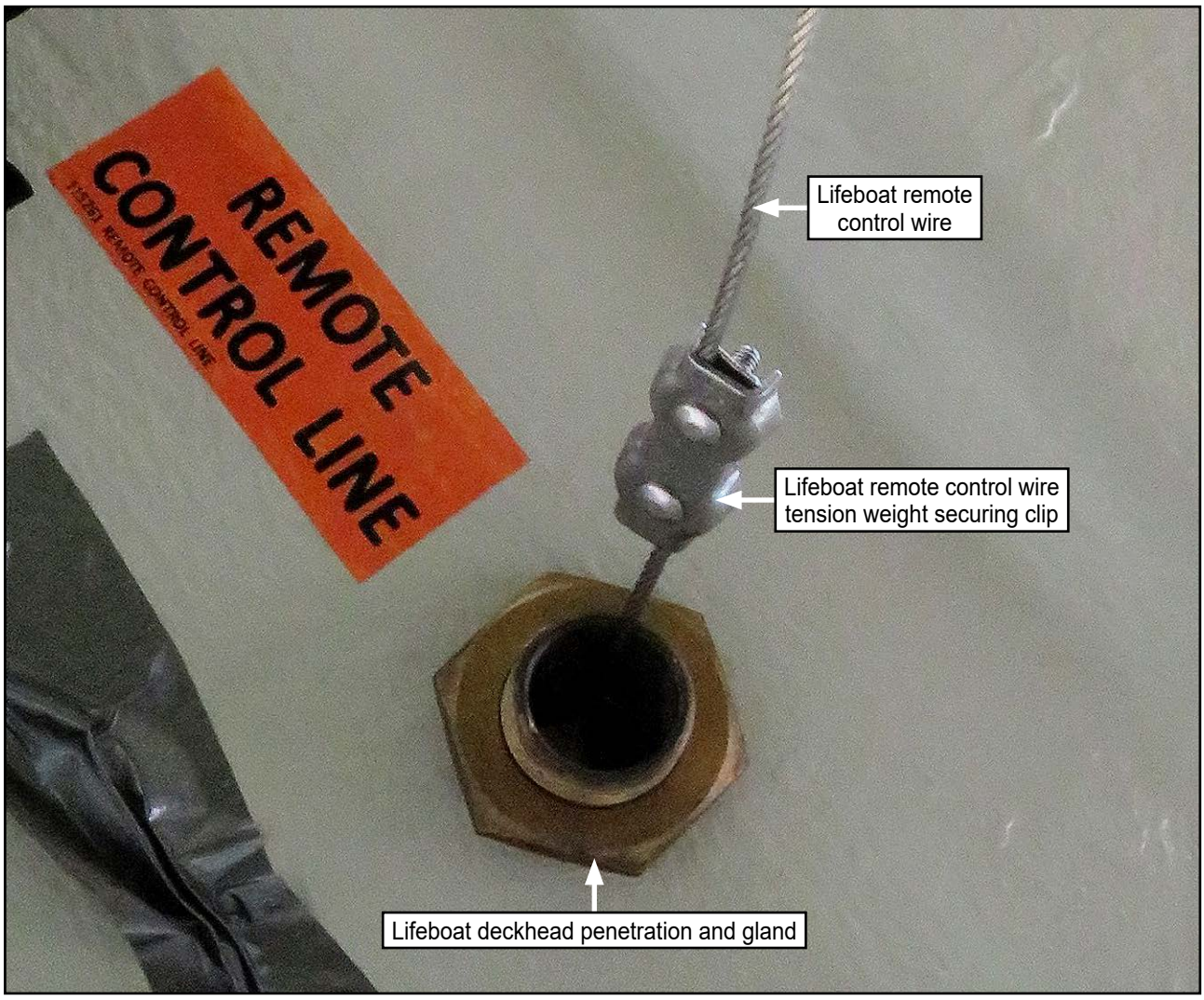


Figure 7: Lifeboat remote control wire tension weight securing clip

[7] Classification society rules are technical standards for the design, construction, and survey of ships.

1.6.3 Davit system commissioning

Cammell Laird's davit system commissioning routine was divided into three parts: pre-commissioning procedure; commissioning procedure for the lifeboat; and load test procedure for the davit. The commissioning documentation included a Norsafe general arrangement drawing. The commissioning process included the statutory load testing of the davit and lifeboat, testing the brake and verifying the speed of the lowering of the lifeboat. Each check involved a number of steps that had to be completed and signed off, none of which included confirming that the installation was completed in accordance with the manufacturer's instructions. VLSE service engineers followed a Norsafe procedure document to commission the davits and lifeboats, but this did not include operating the davit from the lifeboat launching station using either the normal launch procedure or the training mode launch system. The lifeboats were not launched using the dead ship launch system. There was no subsequent record to indicate either that the lifeboat launching station had not been fitted or that the training mode launch system had not been installed.

During the commissioning process for the lifeboat it was found that the remote control wire tension weight securing clip **(Figure 7)** was too big to pass through the deck gland fitted to the lifeboat canopy deckhead. To overcome this the VLSE service engineer enlarged the deckhead aperture and fitted a larger gland. In February 2020, the load testing of the davits and winches was signed off as completed, having been witnessed by an LR surveyor, Cammell Laird staff and VLSE service engineers. In July 2020, following basin trials of the lifeboats, BAS staff signed a document to accept that all lifesaving equipment and lifeboats had been installed and commissioned and were functional.

1.7 DAVIT MAINTENANCE

1.7.1 Manufacturer maintenance and training requirement

Norsafe recommended that a vessel's crew should attend a Norsafe product training course before operating or carrying out maintenance on the davit system. It also required that regular maintenance of the davit system was undertaken **(Table 2)**.

Weekly routine	Monthly routine
Monitor the pressure in the hydraulic accumulators	Grease and lubricate the davit
Check the condition and security of lashing belts (gripes[8])	Hydraulic system and winch gearbox oil level check
Check the interlock cylinder locking pin is fully extended over the winch brake operating arm	Davit limit switch lubrication and function test
Check remote control wires for correct placement	Clean and lubricate the brake arm damping cylinder
Visually inspect for operational readiness	Winch brake arm interlock cylinder inspection, corrosion removal, lubrication and function test

Table 2: Norsafe davit system maintenance routine

[8] Gripes are wires used to secure a lifeboat into its davits.

Norsafe had recognised that the interlock cylinder piston rod was vulnerable to corrosion and stated in its operating and maintenance manual that:

> *A crucial part for the davit operation is the small interlock cylinder mounted on the brake arm. This cylinder is blocking the brake arm for unintended lowering before the davit arms are fully turned out. This cylinder needs visual check and cleaning to ensure good lifetime. If cylinder rod is dirty, clean it with fresh water, spray with a thin layer of lubricant, do a function test of cylinder and wipe off excess spray. If cylinder rod has signs of corrosion, it needs to be replaced – contact Norsafe for spare parts.* [sic]

1.7.2 Statutory inspections

In May 2016, the 96th session of the International Maritime Organization (IMO) Maritime Safety Committee (MSC) adopted amendments to SOLAS Regulations III/3 and III/20 that made annual and 5-yearly inspections mandatory for all ships' lifeboats and davit systems from 1 January 2020. It was mandated that the inspections must be carried out by either the manufacturer or its authorised agent.

On 31 January 2021, a VLSE service engineer completed the statutory lifeboat and davit system inspections on board RRS *Sir David Attenborough*. The service schedule that the service engineer used did not highlight that the interlock cylinder required specific maintenance or that its material condition was critical to the launching sequence of the lifeboat. The service engineer did not record whether ship's staff had undertaken regular routine maintenance of the davit system.

The service engineer reported that the davit and lifeboat were in a satisfactory condition with no defects found. The interlock cylinder piston rod was not inspected, and no comment was made on its condition.

1.8 POST-ACCIDENT INSPECTION

1.8.1 Davit system tests

The MAIB examined the davit hydraulic system and components and found that the hydraulic pump, system pipework, accumulators and davit operating arms were all in a satisfactory condition and had operated in accordance with the manufacturer's specification. The hydraulic directional control valve and hydraulic proximity switches on the davit arms had also operated satisfactorily.

The hydraulic system was powered up and a series of simulated davit lifeboat launch sequences were carried out. It was found that hydraulic pressure was applied to the interlock cylinder at the correct point in the sequence, retracting the interlock cylinder rod and releasing the winch brake operating arm. When the hydraulic pressure was released the interlock cylinder rod did not return to the extended position over the winch brake operating arm **(Figure 8)**. This sequence was repeated several more times with similar results.

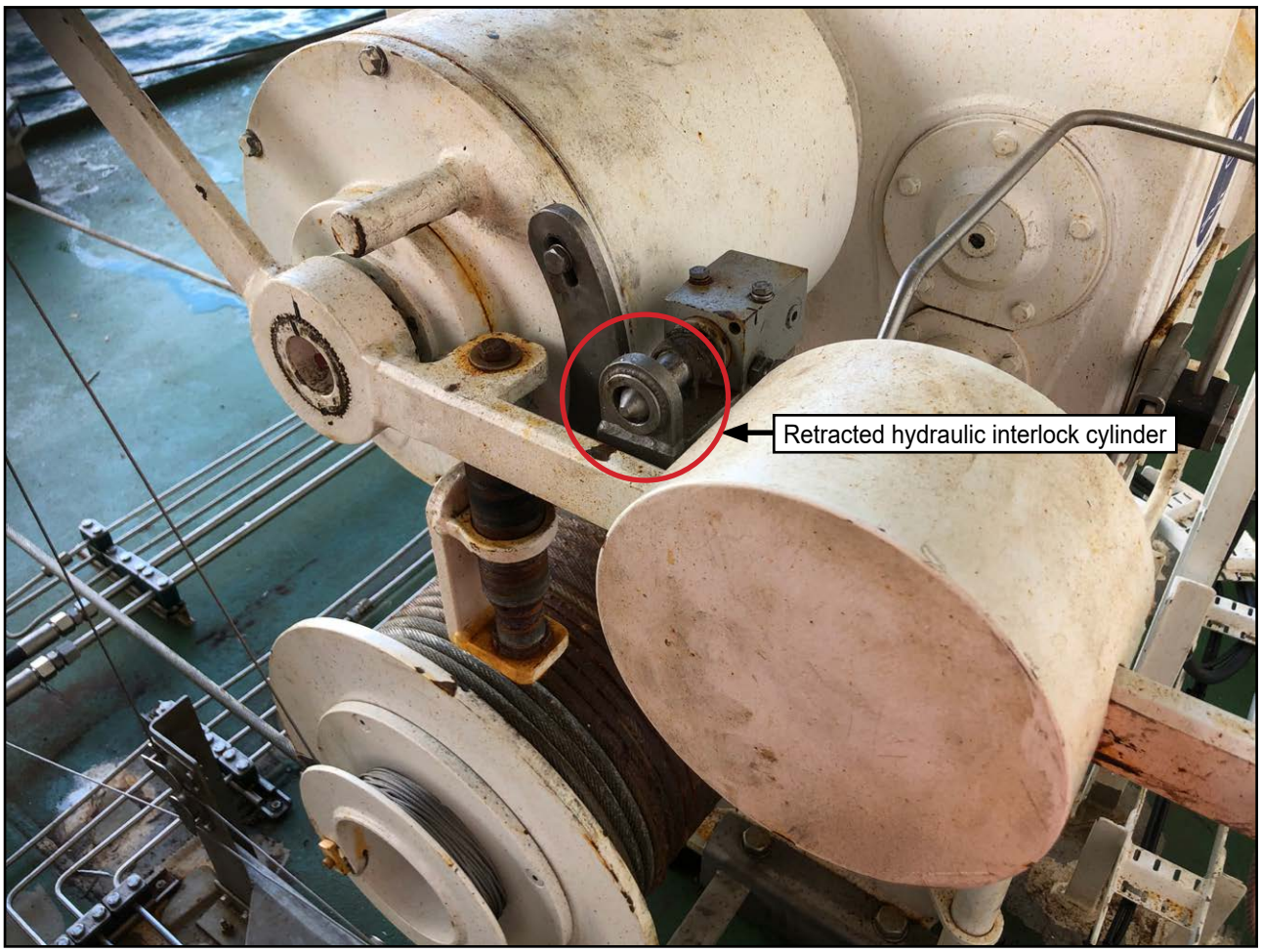


Figure 8: Retracted hydraulic interlock cylinder

The winch brake arm hydraulic interlock cylinder was removed from the davit system and sent to a specialist hydraulic engineering company for examination and testing. The initial test showed that the interlock cylinder piston rod did not return to its extended position when the hydraulic pressure was released. The examination determined that the internal components of the interlock cylinder, including the return spring, were in good working order with no defects. The oil seals exhibited no signs of wear. The interlock cylinder piston rod had corroded around its circumference, leading to pitting and a rough finish to the surface area **(Figure 9)**; it was demonstrated that this degradation prevented the rod from moving linearly over the surface of the hydraulic oil seal and so held the rod in the retracted position. It was also noted that the sintered bronze filter in the vent port for the interlock cylinder rod return spring space had been painted over.

The interlock cylinder piston rod was cleaned to remove the corrosion and to give the surface a more consistent finish before being retested several times. In each test the interlock cylinder rod returned to its fully extended position when the hydraulic pressure was released.

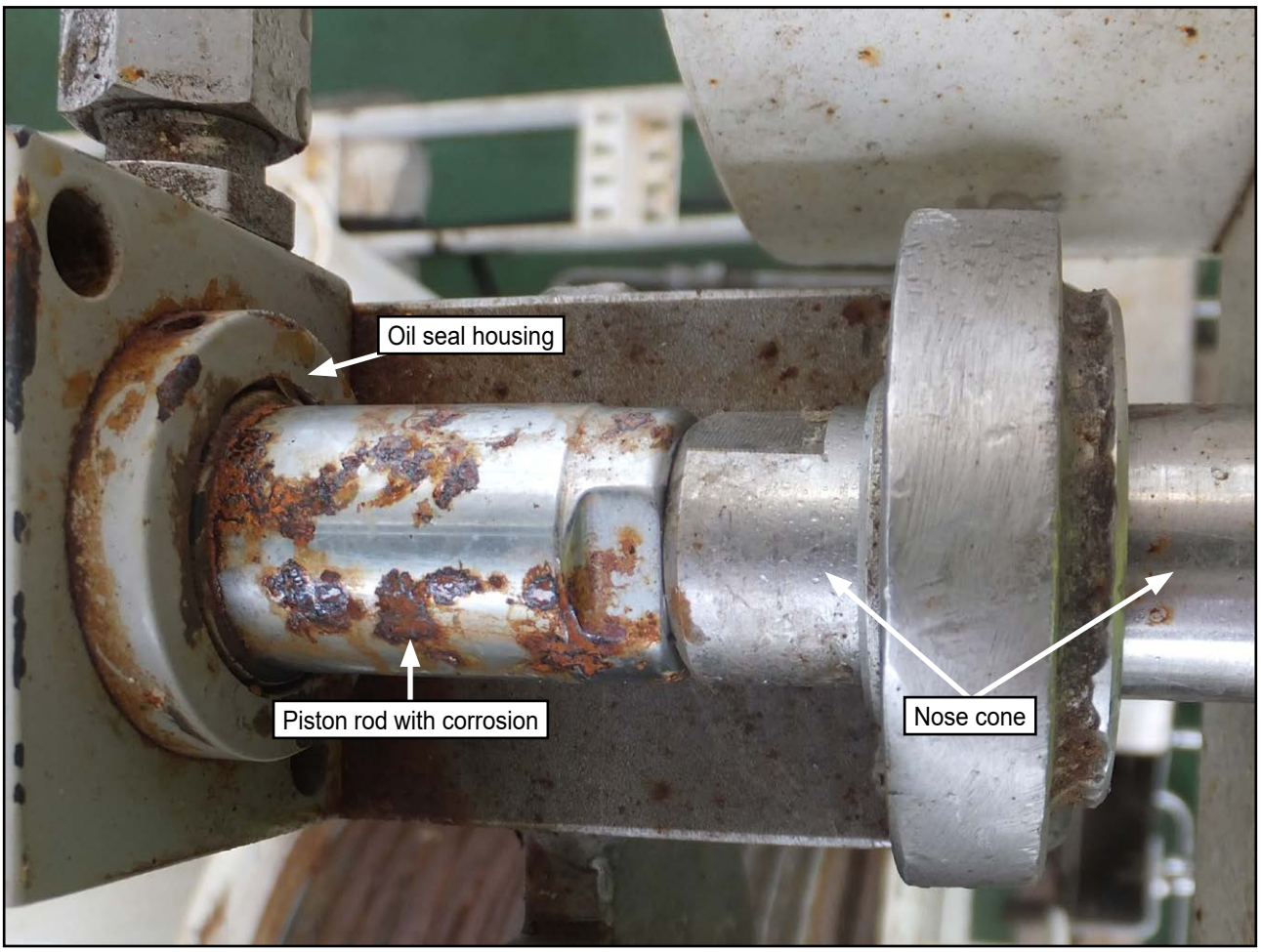


Figure 9: Corrosion on hydraulic interlock cylinder piston rod

1.8.2 Lifeboat inspection and repairs

Following the accident the port lifeboat was delivered to a boat repair company that specialised in the repair of glass reinforced plastic boats. An inspection of the lifeboat revealed external damage to the rear access hatch, which had been torn away; the lifeboat hull, where the keel had made contact with the side of RRS *Sir David Attenborough*; the hull gel coat, where the lifeboat had made contact with the ship's structure; and the engine external cooling pipes and through hull fitting. Some of the seating arrangements inside the lifeboat had sustained damage from the impact of the unrestrained crewman as he fell through the boat.

The lifeboat was repaired and, following and MCA inspection, returned to service.

1.8.3 Lifeboat hooks

The safety latches of both lifeboat hooks sustained damage when the master link suspension rings[9] on the davit falls **(Figure 10)** disengaged from the hooks as the lifeboat rolled onto its side and fell to the water. The damaged safety latches were replaced after the accident and the lifeboat hooks were load tested.

[9] A link used to connect the lifeboat falls block chain to the lifeboat release hook. The link is commonly fitted with handles to aid connection to the lifeboat hook.

Figure 10: Lifeboat hook and master link suspension ring

1.9 RRS *SIR DAVID ATTENBOROUGH* PLANNED MAINTENANCE SYSTEM

1.9.1 Planned maintenance system

To meet the requirement of the ISM Code and classification society rules, RRS *Sir David Attenborough* operated a software-based PMS to monitor, maintain and record equipment maintenance tasks and defects. The PMS automatically scheduled and assigned planned maintenance tasks based on pre-determined intervals and was managed by the C/E and overseen by the BAS senior marine engineer via a data link.

The PMS on board RRS *Sir David Attenborough* had been approved by LR as satisfying SOLAS requirements. The PMS database had been populated with the ship's systems and equipment information, including the associated maintenance schedules, during its build. Each maintenance task was assigned to either the deck or engineering department.

1.9.2 Critical systems

The ISM Code required operators to establish procedures to maintain their ships in accordance the relevant rules and regulations. Section 10.3 of the code stated that:

> *The Company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The SMS should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.*

To comply with the ISM Code, the systems and equipment on board RRS *Sir David Attenborough* were designated as either critical or non-critical in the PMS. Responsibilities for critical equipment had been assigned as follows in the SMS: the master was responsible for its management; the C/E was responsible for its maintenance and testing; and the senior marine engineer at BAS was responsible for the oversight of completed work. The lifeboat davits were deemed to be critical systems.

1.9.3 PMS operation post-handover

The rectification of outstanding defects and the inability to operate the machinery and systems in UMS mode at the time of the ship's handover to BAS from Cammell Laird diverted the focus of RRS *Sir David Attenborough*'s engineering department personnel away from programmed routine maintenance activity. As the number of outstanding tasks increased, the planned maintenance administration team at BAS headquarters consequently paused the maintenance tasks that the PMS generated and the associated lifeboat davit maintenance routines **(Table 2)** were not carried out.

At handover of the ship, the PMS work orders were being rewritten to correct errors and omissions to ensure that the maintenance requirement was applicable to the equipment referred to in the work order. Also, the ability to report emerging defects on equipment and systems via the PMS to BAS headquarters was not functional at handover.

1.10 LIFEBOAT DRILLS REGULATIONS AND GUIDANCE

1.10.1 SOLAS Chapter III

Chapter III regulation 19, *Emergency training and drills*, required that abandon ship drills, including the launching of lifeboats, were conducted monthly for all crew. The regulation also instructed that lifeboats were to be launched by their operating crews and manoeuvred in the water at least once every 3 months.

SOLAS Chapter III regulation 35, *Training manual and on-board training aids*, required all ships to carry a SOLAS training manual that provided information on lifesaving appliances and included a detailed explanation of survival craft launching methods. It instructed that the SOLAS training manual was to be *provided in each crew mess room and recreation room or in each crew cabin*.

SOLAS Chapter III regulation 36, *Instructions for on-board maintenance*, required that vessel operators held maintenance and repair instructions for davits and lifeboats, a schedule for periodic maintenance and a log for records of inspections and maintenance.

1.10.2 IMO Circulars

On 19 June 2017, the IMO issued MSC.1/Circular.1578 – Guidelines on Safety During Abandon Ship Drills Using Lifeboats – that highlighted the need for seafarers to be familiar with lifesaving appliances and conduct safe, planned and organised abandon ship drills. The circular affirmed that the lifeboat and equipment should be checked for defects and correct maintenance in accordance with the ship's maintenance manuals. The guidelines placed emphasis on drills as a learning experience and instructed that sufficient time should be allocated to support this.

The circular also stated that planning for the drill should include a review of the manufacturer’s instruction manual to ensure correct conduct and that lessons arising from the drill were to be documented and used to plan future drills and shipboard training discussions.

The circular recommended that:

> *…the boat be lowered and recovered without any persons on board first to ascertain that the arrangement functions correctly. In this case, the boat should then be lowered into the water with only the number of persons on board necessary to operate the boat.* [sic]

Reference was made to MSC.1/Circular.1326 – Clarification of SOLAS Regulation III/19 – that clarified the requirement for a lifeboat to be launched and manoeuvred in the water at least every 3 months in that the assigned operating crew did not need to be on board when the lifeboat was launched.

MSC.1/Circular.1206 – Measures to Prevent Accidents with Lifeboats – covered the maintenance of davits and lifeboats and the conduct of drills and training. The circular invited IMO member governments to ensure that vessel crews responsible for the inspection and maintenance of lifeboats, launching appliances and associated equipment were *fully trained and familiar with these duties*.

1.10.3 MCA Marine Guidance Notes

In February 2020, the MCA issued Marine Guidance Note (MGN) 560 Amendment 1 (M), which detailed the operational testing requirements for davits and lifeboats on board UK registered ships. The MGN also referenced IMO MSC.1/Circular 1578.

MGN 560 Amendment 1 (M) also provided guidance on the preparation and execution of lifeboat drills. It stated that, *Abandon ship drills should be planned, organised and performed so that the recognised risks are minimized* [sic]; it placed the emphasis of the drill on learning to ensure that crew were both familiar with and understood their duties and the equipment.

The MCA expected lifeboat drills to include the launching of the lifeboat from its davit in the presence of its launching crew. The MCA recommended that the lifeboat was first launched and recovered with nobody on board to ascertain that the system functioned correctly.

MGN 560 Amendment 1 (M) also referred to the maintenance of davits and lifeboats and stated that:

> *Weekly and monthly inspections and routine maintenance as specified in the equipment maintenance manual(s), shall be conducted by authorized service providers, or by shipboard personnel under the direction of a senior ship's officer in accordance with the maintenance manual(s).* [sic]

1.10.4 Cargo Ship Safety Equipment Certificate

SOLAS Chapter I, Regulation 8 required lifesaving appliances on all cargo ships over 500 gross tonnes to be surveyed to ensure compliance of equipment, installation and operation with SOLAS Chapters II/1, II-2, III and V.

Ship safety equipment was subject to an initial survey at build, annual surveys and a 5-yearly renewal survey. The purpose of the initial survey was to ensure that the installed equipment fully complied with the requirements of the SOLAS regulations and the LSA Code.

For UK registered ships that were based in the UK the MCA conducted the initial survey and at least one annual survey within the 5-yearly renewal cycle of surveys. For ships outside the UK the MCA could authorise a classification society to conduct the survey on its behalf.

LR completed the initial safety equipment survey for *Sir David Attenborough* on 14 January 2021, and the vessel's certificate was issued on 25 June 2021.

1.11 ONBOARD PROCEDURES

1.11.1 Lifeboat launching procedure

The Norsafe operation and maintenance manual described the launching system and operating instructions for the davit, which included an illustration of the operating instruction plate that was to be placed adjacent to each lifeboat **(Annex A)**. The instruction plate fitted for each lifeboat on board RRS *Sir David Attenborough* was for an earlier version of the system and contained incorrect instructions for normal operation, which the C/E had highlighted in a handwritten note dated 9

December 2020 **(Figure 11)**. The Norsafe manual stated that safety checks were to be conducted after the davit operation, which included ensuring that the interlock cylinder piston rod was fully extended over the winch brake operating arm.

The lifeboat launching procedures documented in the SOLAS training manual on board RRS *Sir David Attenborough* were compiled by the two 3/Os. The procedures described the davit operation and the different methods of launching the lifeboat; the *Normal operation – launch* instructions were taken from an illustration of the instruction plate in the Norsafe operation and maintenance manual. The method of launching a lifeboat in *normal operation* by ship's crew was modified from the Norsafe instructions as two crew were required to launch the lifeboat from the boat deck.

The description for the training mode procedure deviated from that stated in the Norsafe operation and maintenance manual and included a note that, T*his process needs to be confirmed once onboard* [sic]. General information about the davit highlighted the function of the interlock cylinder and the winch brake operating arm. There was no reference to the safety checks that were to be conducted after the davit operation.

Figure 11: Instruction plates fitted adjacent to lifeboat davits, showing the handwritten statement

1.11.2 Engineering department information file

The engineering department on board RRS *Sir David Attenborough* was responsible for populating the PMS with davit maintenance routines and for compiling the davit information files. The davit information files described two methods of operating the davit: training mode and emergency mode. The safety checks that were to be completed after davit operation included an inspection of the davit interlock cylinder and a check to ensure that the winch brake operating arm was locked.

1.11.3 Risk assessment

On 7 December 2020, the DPA had issued a risk assessment for the launching and recovery of a lifeboat for drill and exercise purposes **(Annex B)**, which identified *Boat falling from height due to equipment failure* as one of several hazards. The severity of the hazard was deemed *Extremely Harmful* with the likelihood of such an event considered to be *Unlikely* and the inherent risk level recorded as *Very High Risk*. The following preventative control measures had been implemented to reduce the inherent risk level to *High Risk*:

- *Boat lowered and raised a number of times prior to boat crew boarding*
- *Ensure testing, inspections and maintenance has been carried out as per SMS/PMS*
- *Competent person to conduct a good examination of boat, davit and falls and conduct pre launch checks before operation commences*
- *Ensure all certification is up to date* [sic]

1.12 DAVIT TRAINING AND FAMILIARISATION

1.12.1 Manufacturer crew training courses

Norsafe, and subsequently VLSE, ran training courses for operators, maintainers and superintendents to learn about and experience using their davits and lifeboats.

Dependent on the course that was selected the training covered basic procedures from the launch and recovery of lifeboats, maintenance routines and safe drills through to a comprehensive syllabus covering all aspects of design, safe operation, crew competence and operational tests. The training courses were delivered at the VLSE Safety Academy in Lavrio, Greece. VLSE recommended that vessel crew attended its courses; however, BAS did not enrol any of the crew from RRS *Sir David Attenborough*.

1.12.2 Manufacturer on board training

The Norsafe contract to supply the lifeboat and davit equipment included the provision of two on board crew training sessions, which would be carried out by VLSE service engineers.

The training was delivered to the deck department of RRS *Sir David Attenborough* and the C/E; it did not include an agreed programme for the topics that were to be covered in the training; and, those attending did not make any notes on the important points delivered during the sessions.

1.12.3 Planning and conduct of the familiarisation exercise

The day of the accident, 4 March 2021, was the first time that the deck crew had attempted to launch the lifeboat at sea since the handover of RRS *Sir David Attenborough* from Cammell Laird to BAS on 2 December 2020.

There was neither a prior formal plan nor a tabletop discussion with the crew taking part about the lifeboat launching operation. The C/E had not been involved in the decision to operate the davit and so had not planned to be involved in the familiarisation exercise.

The C/O had decided to complete the port lifeboat launch and recovery familiarisation training before lunchtime despite the FRC training taking longer than expected. The documented davit operating procedures and risk assessment were not referred to during the exercise and the post-operation davit system checks were not conducted each time the lifeboat was recovered back into the davit.

1.13 PREVIOUS/SIMILAR ACCIDENTS

1.13.1 *Tombarra* – parting of a fall wire during a rescue boat drill

On 7 February 2011, a crewman from the car carrier *Tombarra* was fatally injured when the rescue boat he was in fell 29m into the sea (MAIB report 19a/2012 and 19b/2012[10]). The fall wire parted as the rescue boat was being recovered back on board during a drill. The fall wire parted because it became overstressed when an electronic proximity switch failed to stop power to the winch motor when the rescue boat had reached the head of the davit.

The investigation found that the installed limit switch was not suitable to be used as a safety limit switch in the control of the winch system and that the limit switch had not been fitted or maintained in accordance with the manufacturer's instructions.

1.13.2 *Saga Sapphire* – two persons overboard during a lifeboat drill

On 29 March 2012, two *Saga Sapphire* crew members fell into the water while taking part in a lifeboat drill (MAIB report 25/2012[11]). The crew members were preparing to release the lifeboat's bowsing tackle when it inadvertently released and the lifeboat swung violently, causing the crew members to fall into the water. The investigation found that one of the crew members had not been trained for the role. It was also found that the quality and management of lifeboat training preparation was below the standard necessary to safely launch the lifeboats.

[10] https://www.gov.uk/maib-reports/parting-of-fall-wire-during-a-rescue-boat-drill-on-car-carrier-tombarra-at-royal-portbury-dock-bristol-with-loss-of-1-life

[11] https://www.gov.uk/maib-reports/persons-overboard-from-passenger-cruise-ship-saga-sapphire-during-a-lifeboat-drill-alongside-at-the-port-of-southampton-england-with-2-people-injured

1.13.3 *Nagato Reefer* – accidental release of a lifeboat

On 9 April 2014, a crewman was injured during an abandon ship drill on the refrigerated cargo ship *Nagato Reefer* (MAIB report 9/2015[12]). As the lifeboat was being recovered back into the davit, the forward lifeboat hook released and the lifeboat fell onto the handrails of the deck below, striking and injuring a crewman and damaging the lifeboat's hull.

The investigation found that the crew had not been adequately trained and were unfamiliar with the operation of safety equipment on board. It also found that no maintenance had been carried out on the lifeboat hook mechanism in the 6 months leading up to the accident.

1.13.4 *Solent Fisher* – inadvertent launching of a lifeboat

On 29 November 2005, a lifeboat on the tanker *Solent Fisher* inadvertently launched itself. A preliminary examination (MAIB PE summary, originally published in August 2006[13]) found that a drill had been carried out using the lifeboat's secondary manual launch system and that, on completion of the drill, the lifeboat had been left in a *ready for use* condition rather than the correct *stand-by* condition. The lifeboat launching system had not been operated in accordance with instructions and the drill had been poorly managed.

[12] https://www.gov.uk/maib-reports/accidental-release-of-lifeboat-on-nagato-reefer-with-1-person-injured

[13] https://www.gov.uk/maib-reports/inadvertent-launching-of-lifeboat-from-coastal-products-tanker-solent-fisher-off-plymouth-england

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 OVERVIEW

The C/O and deck crew had taken the opportunity to practice the launching and recovery of the ship's rescue craft and lifeboats while RRS *Sir David Attenborough* was at anchor on Loch Buie. The deck crew prepared to launch the port side lifeboat from its davit having first launched and recovered the FRC.

The crew carried out three unmanned lifeboat launches to test the equipment. The initial recovery of the lifeboat was delayed due to a seized limit switch on the davit arm. During an attempt to launch the lifeboat by the dead ship launch method with the operating crew embarked, the winch started to pay out and lower the lifeboat before the davit arms were fully extended. The lifeboat was dragged across the deck and pulled over the side, where it then detached from the wire falls and fell bow first into the sea.

The three lifeboat crew incurred minor injuries during the accident. The lifeboat sustained significant damage and required major repairs.

Similar previous accidents have highlighted the risks and consequences of lifeboat equipment defects and training issues. This section of the report will analyse the factors that caused the RRS *Sir David Attenborough* port side lifeboat to fall into the sea and the on board working practices leading up to the accident.

2.3 LIFEBOAT LAUNCH PROCEDURE

The intent of the C/O was to familiarise only the deck crew on the launching and recovery of the port lifeboat; however, no preparations were made by either the C/O or the deck crew before launching the lifeboat. The deck crew relied on the deck engineer's knowledge of the davit system to operate the davit because he had previously been employed by Cammell Laird to oversee the fitting of the deck equipment to *Sir David Attenborough*.

No reference was made to the local operating plate, Norsafe operating manual, SOLAS training manual or risk assessment to aid the deck crew's understanding of the launch procedure to be followed.

The deck crew started the familiarisation process by carrying out unmanned launches and recoveries of the port side lifeboat. The method they used deviated from the manufacturer's guidance for normal launch or simulating dead ship launch because the deck station and the associated remote control wires had not been fitted to lift the winch brake operating arm nor operate the directional control valve. Further, the electric push button controller was not located on the boat deck.

After the completion of three launches from the deck of RRS *Sir David Attenborough* it is probable that the C/O and the deck crew were satisfied that the lifeboat launching system was operating correctly and so assumed that it was safe to test the dead ship launching system with crew inside the lifeboat. However, the post recovery and prelaunch checks were not completed, and the crew did not notice that the interlock cylinder piston rod was still retracted.

When the remote control wire was pulled from inside the lifeboat, the hydraulic directional control valve activated and the davit arms moved outwards. The tension on the remote control wire simultaneously caused the winch brake operating arm, which evidence indicates was not restrained by the locking pin, to lift before the davit arms had moved into their fully deployed position. The lifeboat dropped onto the deck and was rolled onto its starboard side by the moving davit arms. The crew inside the lifeboat let go of the remote control wire but that did not halt the launch. The angle at which the wire was being led out of the gland fitted to the lifeboat combined with the larger replacement wire clip supplied by Cammell Laird is likely to have caused the clip to jam in the gland; the remote control wire therefore remained under tension, and so continued to hold the hydraulic directional control valve open and pull the winch brake operating arm upwards.

Neither the C/O nor the crew on the boat deck had any means available to stop the hydraulic directional control valve from operating and so prevent the stored hydraulic power from continuing to drive the davit arms. The crew did not notice that the remote control wire was under tension, but nor did they have any means to release the tension on it. Consequently, they were powerless to stop the davit arms from continuing to move.

The weight was removed from the suspension rings on each of the falls as the davit arms moved towards their full extension when the lifeboat was balanced on the edge of the ship's deck. The suspension rings were no longer aligned vertically with the apex of the lifeboat hooks and, as the lifeboat toppled from the edge of the deck towards the water, the suspension rings were pulled in succession through the hook safety latches, releasing the lifeboat from its falls.

The remote control wire was released from its trapped position as the lifeboat fell, which in turn stopped the movement of the davit arms.

2.4 INTERLOCK CYLINDER PISTON ROD FAILURE

It is likely that corrosion caused the interlock cylinder piston rod to seize in the retracted position after the initial unmanned lifeboat launches. The interlock cylinder piston rod was vulnerable to the effects of the marine environment because it had not been designed to operate in a salt-laden atmosphere. The piston rod was manufactured from chrome steel to produce a uniform hardened finish that would resist wear and maintain unrestricted movement of the rod through its cylinder. RRS *Sir David Attenborough* was built and outfitted outside and the davit equipment had been installed during the vessel's build, 16 months before the accident, and the interlock cylinder had not been maintained in accordance with VLSE instructions since its installation. The interlock cylinder's piston rod had corroded due to its prolonged exposure to the elements and the surface finish had degraded sufficiently over time to cause it to seize in its housing. As a result, the interlock cylinder's spring could not overcome the resistance of the corrosion and return the piston rod to its extended position once the hydraulic pressure had been released.

The absence of a post-installation planned maintenance system for the davits during this 16-month period and omitted inspection of the interlock cylinder at the time of the davit's statutory inspection both contributed to the failure of the interlock cylinder piston rod to operate correctly.

2.5 DAVIT SYSTEM INSTALLATION AND COMMISSIONING

The Norsafe installation manual provided specific guidance on the installation of the davit system that included the fitting of the deck control station and its associated training remote control wire system. Both were required in order to satisfy the regulatory conditions for the lifeboat to be launched from the ship's deck by a single person with a clear view of the lifeboat and ship's side; and, to meet the recommendation that the system for launching the lifeboat could be operated from the deck to verify its correct operation. The absence of the training remote control wire system and deck control station on board RRS *Sir David Attenborough* required two crew to launch the lifeboat from the deck, one to operate the electric remote control to deploy the davit arms and the other to lift the winch brake operating arm to lower the lifeboat. The lack of any means by which to operate the hydraulic directional control valve meant that it was not possible to simulate an emergency launch using stored hydraulic power to deploy the davit from the deck. BAS did not query the lack of a training remote control wire and deck control station when it accepted the installation of the davits and lifeboats.

The davit commissioning process focused on achieving the statutory load testing of the davit and lifeboat, testing the brake and verifying the speed of the lowering of the lifeboat. There were no checks to ascertain that the final installation complied with either the installation plan or the regulatory requirements, despite that a general arrangement drawing was included in the commissioning documentation. This drawing showed the fitting of the lifeboat launching station on the boat deck.

2.6 DAVIT SYSTEM MAINTENANCE

Cammell Laird did not carry out any routine maintenance to the RRS *Sir David Attenborough* davit system after its installation in November 2019. Consequently, the exposed surface of the interlock cylinder piston rod would have started to corrode during the time leading up to the accident.

The PMS was active and scheduling maintenance routines when RRS *Sir David Attenborough* was handed over to BAS; however, PMS tasks assigned to all departments were suspended by BAS headquarters due to the overwhelming task of post-build defect rectification. The ensuing workload required the full capacity of the engineering department. As a result, the monthly davit system inspection, cleaning and testing routine, which included the interlock cylinder, was not completed.

The statutory davit inspection undertaken by the VLSE engineer in January 2021 did not include a check of the interlock cylinder and the engineer was unaware of the consequences should this fail to operate correctly.

The lack of maintenance and inspection of the interlock cylinder meant that the corrosion went unnoticed and so the interlock cylinder was not replaced in accordance with the instructions in the manufacturer's manual.

2.7 CRITICAL SYSTEM MAINTENANCE

The lifeboats and davits were designated as a critical system in the PMS for RRS *Sir David Attenborough* and the vessel's SMS stated that planned maintenance on a critical system was to be completed so as not to become overdue under normal circumstances. The master was responsible for the on board management of critical system maintenance.

The PMS system was networked to the BAS headquarters; however, the suspension of all PMS tasks by BAS headquarters, including maintenance of the davit systems, was not considered critical by the BAS senior marine engineer who was responsible for the oversight of completed work. The suspension of the PMS tasks was not reported to the master. Consequently, BAS was unaware of the condition of the ship, specifically that critical systems such as the lifeboat davits were not being maintained in accordance with the SMS. As a result, the mandated inspection and maintenance of the interlock cylinder was not undertaken and the lack of maintenance went unquestioned by both the master and BAS headquarters.

2.8 TRAINING

The Norsafe operating and maintenance manual cautioned that drills and maintenance involving the davit system should only be undertaken by adequately trained crew and VLSE offered specific training courses to support this requirement. However, as BAS were unaware of the training that Norsafe offered in Greece, they did not take advantage of this and instead used the onsite VLSE service engineers to deliver training to selected members of the RRS *Sir David Attenborough* crew. The cost of the VLSE training was built into its work specification, but the training did not adequately cover the on board maintenance requirement for the davit system or highlight the importance of the interlock cylinder in the operation of the davit. Thus, the crew did not understand either the modes of operation for the davit system or, critically, the correct operating sequence for the interlock cylinder.

2.9 ONBOARD PROCEDURES

The crew of RRS *Sir David Attenborough* prepared operational safety documentation for the ship while it was being built, which included the SMS and SOLAS training manual. During this process the crew noticed that the training mode remote control system for launching the lifeboat, which was referenced in the Norsafe installation manual, was not fitted to RRS *Sir David Attenborough*'s davits. A note to check the operation of the training mode remote control system was added to the SOLAS training manual and a defect was subsequently raised with Cammell Laird; however, no action was taken and the item was cancelled at the handover of the ship to BAS.

Although the instructions in the SOLAS training manual identified the critical role of the interlock cylinder, the operating instructions did not include checking that the interlock cylinder piston rod locking pin was in the correct position before launching the lifeboat. The three lifeboat launches that were completed before the accident did not follow the method described for launching it remotely from the deck and so did not provide assurance that the next remote launch, from inside the lifeboat, would follow the correct sequence.

The engineering department information file contained a description of the training mode and the davit safety checks to be conducted following recovery of the lifeboat, which included a check to ensure that the interlock cylinder piston rod locking pin was fully extended over the winch brake operating arm.

The SOLAS training manual and engineering department information file had been compiled by deck and engineering crew, respectively, and the two sets of procedures were not cross-checked for accuracy. This meant that the opportunity to challenge both the lack of the training mode remote control system and the disparities in the procedures was missed.

2.10 LIFEBOAT DRILLS

The plan to conduct lifeboat launching familiarisation drills on board RRS *Sir David Attenborough* complied with national and international legislation, which recognised that frequent shipboard drills built on the crew's initial training and helped them to develop confidence with the safety equipment.

The SOLAS guidance emphasised that drills needed to be planned, organised and performed to minimise the risk of injury or equipment failure. Given that the ship's crew were unfamiliar with the Norsafe davit equipment, the lack of prior planning and confirmation of how the lifeboat drill was to be executed almost certainly contributed to the accident. This situation was further exacerbated by the lack of consultation with the C/E on the operation of the davit. Also, by not including members of the engineering department in the drill, possible vital knowledge about the correct operation and checks to be carried out was lost.

Further, the crew did not reference the risk assessment for the lifeboat drill and so the control measures identified to reduce the inherent risk were not actioned and the likelihood of the *Boat falling from height due to equipment failure* increased.

The delay in completing the FRC launch on the morning of the accident and the decision to finish the lifeboat familiarisation before lunch possibly compromised the time available to safely carry out the launch. There were no opportunities during the familiarisation explain the launch procedure to the crew, demonstrate the expected outcome, or check their understanding. It is likely that those crew taking part in the drill mutually assumed they had sufficient knowledge to launch the lifeboat safely. The operation of critical components such as the interlock cylinder were neither identified nor reasons given as to why they were essential for the safe operation of the davit.

2.11 INITIAL CARGO SHIP SAFETY EQUIPMENT CERTIFICATE SURVEY

The survey leading to the issue of the SEC as mandated by SOLAS Chapter I, Regulation 8 was flawed. The regulation required that:

> *the initial survey shall include a complete inspection of the fire safety systems and appliances, life-saving appliances…to which chapters II-1, II-2, III and V apply to ensure that they comply with the requirements of the present regulations, are in satisfactory condition and are fit for the service for which the ship is intended.* [sic]

The SEC initial survey was arguably the most critical of all statutory surveys as it should have confirmed that the design, build and installation of the lifesaving appliances conformed with relevant regulations. Had a comprehensive inspection of the *Sir David Attenborough* lifeboat davits been undertaken, it would have been immediately apparent that the installation was incomplete and did not meet the LSA Code requirements. Thus, the SEC as issued was invalid.

The MCA did not follow its declaration that it would conduct initial safety equipment surveys for ships in the UK, instead delegating the survey for and issue of *Sir David Attenborough*'s SEC to LR. This effectively removed the opportunity for an independent assessment of the lifeboat davit installation.

Although the launching system defect raised by the 3/O was recorded it was not actioned and was subsequently closed out when the davits were commissioned and finally accepted by BAS.

None of the organisations involved in the survey, certification, acceptance and quality assurance of the davit system had raised any concerns during the process and so it is possible that both BAS and the crew of RRS *Sir David Attenborough* believed that the installation complied with the manufacturer's and regulatory requirements. This led to the davit system being accepted in an incomplete state.

Further, it is likely that BAS relied on the certification and VLSE statements of serviceability issued to RRS *Sir David Attenborough* to provide assurance that the vessel was safe to operate after the handover.

2.12 RRS *SIR DAVID ATTENBOROUGH* OPERATIONAL PROGRAMME

The pressure on BAS to meet the declared operational program was palpable and it is unsurprising that on board RSS *Sir David Attenborough* routine tasks became low priority in their efforts to meet the operational programme. In this instance, lifeboat drills had not been undertaken for 3 months preceding the accident.

In Cambridge, BAS did not appreciate the impact that defect rectification was having on the workload of the ship's staff, in particular the lack of familiarisation of equipment and systems as well as the lack of training being undertaken by ship's crew. The consequences of the decision to suspend the generation of scheduled PMS tasks by BAS headquarters was not understood by the senior engineers at BAS headquarters.

The cumulative effect of defect rectification, preparation for deployment and attempting to complete a commissioning and trials programme forced the ship's staff to prioritise active defects over routine maintenance. This also impacted on the time available to undertake system familiarisation and training.

SECTION 3 – CONCLUSIONS

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

1. The port side lifeboat of RRS *Sir David Attenborough* fell into the sea because the remote control system did not operate in the correct sequence and control of the davit was lost during the launching process. This happened because the winch brake operating arm hydraulic interlock cylinder piston rod was corroded and had not reset after the previous lowering of the lifeboat. [2.3]

2. Without the winch brake operating arm being held in the *on* position by the interlock cylinder piston rod locking pin, the winch brake released the falls and the lifeboat lowered from the davit head too early in the launching sequence. [2.3]

3. When the lifeboat fell to the deck, the remote control wire tension weight clip supplied by Cammell Laird became jammed in the enlarged gland arrangement. The weight of the lifeboat, when it was on its side, kept the remote control wire under tension and prevented the interruption of the launch sequence. [2.3]

4. The crew inside the lifeboat and on the deck of RRS *Sir David Attenborough* were unable to stop the lifeboat launch because the remote control wire remained under tension. [2.3]

5. The chrome steel surface finish of the davit's interlock cylinder piston rod was vulnerable to corrosion and susceptible to seizure when exposed to the marine environment. [2.4]

6. It is likely that the corrosion and degradation of the surface finish on the interlock cylinder piston rod prevented it from automatically resetting after the previous lifeboat launch. Lifeboat post-recovery safety checks were not carried out, and so the seized piston rod went unnoticed. [2.3, 2.4, 2.5]

7. Deterioration of the interlock cylinder occurred because it had not been maintained by the shipyard or the manufacturer since the installation of the davits. Subsequently, the PMS davit maintenance tasks had not been completed following the handover of RRS *Sir David Attenborough* due to the suspension of PMS tasks and the engineering department's focus on defect rectification. [2.6, 2.7]

8. Senior officers on board RRS *Sir David Attenborough* were responsible for scheduling and completing PMS tasks to ensure that safety critical systems complied with classification society, flag state and equipment manufacturer requirements. BAS oversight of the PMS was essential to understand the material state of the vessel. [2.6, 2.7]

9. The davit installation had not been completed in accordance with the manufacturer's instructions, specifically the training mode remote control system and deck control station had not been installed. This meant that the davit system did not meet the requirement of the LSA Code and that drills involving dead ship launches could not take place without crew on board the lifeboat. The installation shortcoming went undetected throughout the installation approval and acceptance processes. [2.5, 2.11]

10. The safety equipment survey conducted by LR was flawed and was not completed in accordance with the relevant SOLAS legislation. By delegating the safety equipment survey to LR, the MCA had removed the independent inspection of the davit system by themselves. [2.11]

11. The crew of RRS *Sir David Attenborough* were unfamiliar with the davit system operating procedures and the risk assessment was not followed. They had not completed the training recommended by Norsafe, the on board familiarisation training was delivered primarily to members of the deck department with only the C/E present from the engineering department, and time pressure due to the late running of the drills meant that the crew were not briefed on the launch procedure. [2.8, 2.9, 2.10]

3.2 OTHER SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT

1. The expectation by BAS headquarters that ship's staff could have RRS *Sir David Attenborough* operational according to the published timetable led to overburdening of ship's staff due to defect rectification, deployment preparations and system familiarisation. This prevented routine maintenance on safety systems being conducted and training on emergency systems from being completed. [2.6, 2.7, 2.12]

SECTION 4 – ACTION TAKEN

4.1 ACTIONS TAKEN BY OTHER ORGANISATIONS

Viking Life-Saving Equipment Ltd has fitted a new tension weight and wire clamp and installed the training mode remote control system to meet the SOLAS requirement.

British Antarctic Survey has:

- developed checklists for the launch and recovery of the lifeboats.
- revised and republished the SOLAS manual lifeboat operating instructions.
- revised its risk assessment for the launch and recovery of lifeboats.
- modified its training and drills so that the launch and recovery of lifeboats is conducted without crew embarked.

Cammell Laird Shiprepairers and Shipbuilders Limited has amended its standard procurement terms for newbuild projects to require that original equipment manufacturers must provide a separate annex for any critical planned maintenance or preservation requirements specific to the period between receipt of goods and handover, including installation and commissioning phases at the shipyard.

SECTION 5 – RECOMMENDATIONS

The **Maritime and Coastguard Agency** is recommended to:

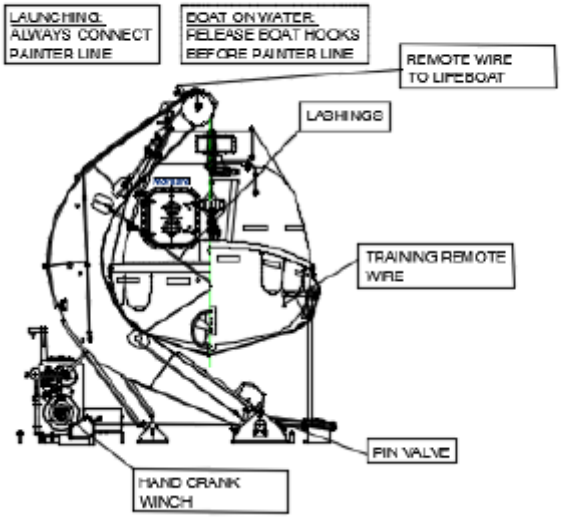
2023/108 Review its processes for delegating Safety Equipment Surveys to Recognised Organisations and ensure that feedback mechanisms are in place to provide the necessary assurance that the surveys have been carried out effectively and in compliance with SOLAS regulations.

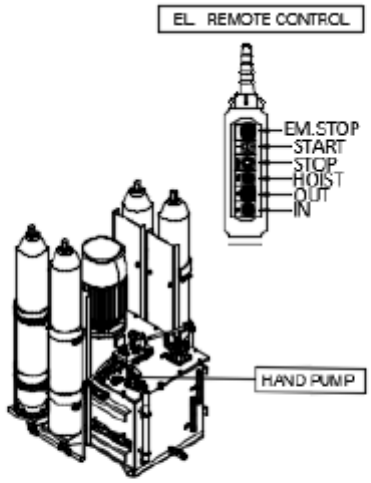
2023/109 Review its policy for delegation to consider whether it is appropriate to delegate initial safety equipment surveys for newbuild vessels or those joining the UK register.

Safety recommendations shall in no case create a presumption of blame or liability

Norsafe operating manual davit instruction plate

OPERATING INSTRUCTION LH-DAVIT





Norsafe as

P.O. Box 115, N-4852 FÆRVIK, NORWAY

NORMAL OPERATION-LAUNCH

1. REMOVE LIFEBOAT EL.POWER
2. CONNECT PAINTER LINE.
3. EMBARKATION.
4. START HPU BY EL. REMOTE CONTROL
5. LAUNCH BOAT BY EL. REMOTE CONTROL TO TURN DAVIT OUT, WHEN BOTH ARMS ARE OUT, PULL TRAINING WIRE FOR LOWERING BOAT.
6. CHECK THAT LASHING RELEASES AUTOMATICALLY.
7. WITH BOAT ON WATER, RELEASE LIFE BOAT HOOKS BEFORE PAINTER LINE.

NORMAL OPERATION-RECOVERY

1. CONNECT PAINTER LINE AND THEN CONNECT LIFTING BLOCKS TO BOAT HOOKS.
2. RAISE BOAT BY PUSHING "HOIST" BUTTON ON EL.REMOTE CONTROL. STOP HOISTING BEFORE THE BOAT REACHES UPPER POSITION, USE HAND CRANK TO BRING THE BOAT TO FINAL CORRECT POSITION.
3. PUSH "IN" BUTTON ON EL.REMOTE CONTROL TO BRING THE DAVIT TO STOWED POSITION.
4. PRESS EMERGENCY STOP BUTTON ON EL. REMOTE CONTROL WHEN BOAT IS STOWED.
5. REWIND THE REMOTE CONTROL WIRE TO THE DRUM
6. INSTALL LASHINGS.
7. CHECK THAT PIN VALVE, PLACED AT MAIN HINGE BRACKETS, HAS RETURNED TO OUTER POSITION.
8. RE CONNECT LIFEBOAT EL.POWER.

DEAD SHIP OPERATION-LAUNCH

1. REMOVE LIFEBOAT EL.POWER
2. EMBARKATION.
3. LAUNCH BOAT BY PULLING THE REMOTE CONTROL WIRE FROM INSIDE THE BOAT. WHEN DAVIT ARMS REACHES OUTER POSITION THE FUNCTION WILL SHIFT AUTOMATICALLY TO LOWER BOAT.
4. WITH BOAT ON WATER, RELEASE LIFE BOAT HOOKS BEFORE PAINTER LINE.

CHARGE ACCUMULATORS

TO CHARGE ACCUMULATORS, EMERGENCY STOP BUTTON ON EL. REMOTE CONTROL MUST BE RELEASED.
PUSH "START" BUTTON ON EL. REMOTE CONTROL TO START HPU.
PUSH "IN" BUTTON ON EL. REMOTE CONTROL TO CHARGE ACCUMULATOR AT STORAGE POSITION.
RELEASE "START" BUTTON WHEN PRESSURE ACHIEVED.
PRESSURE IN ACCUMULATOR MUST BE CHECKED WEEKLY.
THE PRESSURE SHOULD BE AROUND 220 BAR.DO NOT TURN OUT THE DAVIT IF PRESSURE IS BELOW 170BAR.
DO NOT CHARGE ACCUMULATOR ABOVE 220 BAR.

(R-502750-0)

BAS lifeboat drill launch and recovery risk assessment

BRITISH ANTARCTIC SURVEY

MRA / COSHH FORM **SEA-SD-FORM-GEN-23**

Refer to SEA-SD-MSI-GEN-02 for guidance for issue and review of Risk Assessments.

Assessment No.	SEA-SD-MRA-DEK-07	Activity	Launch and Recovery of Lifeboats
Location	Lifeboat and embarkation area	Type of Assessment (Select one)	Risk
Issue Date.	07 December 2020	Ship	Sir David Attenborough
Issue No.	1	Date of next review	07 December 2021
Assessor(s)	[redacted], [redacted]	Reviewed by	

Person(s), Property, Environment at Risk:

All personnel involved with operation, including boat crew and launch/recovery crew on deck
Lifeboat
Potential loss of boat and associated fuel/oil to the marine environment

Brief Description of Activity:

Launching and recovery of a lifeboat for drill/exercise purposes only. Does not include an assessment for launching during an emergency abandon ship scenario

Risk Assessment of Hazards

Hazard No.	Hazards (Personnel, Ship, Environmental)	Hazard Severity (Refer Risk & Actions tab)	Hazard Likelihood (Refer Risk & Actions tab)	Inherent Risk Level
1	All inherent hazards involved with launching and recovery operations	Very Harmful	Likely	Very High Risk
2	Slips trips and falls	Harmful	Likely	High Risk
3	Falling overboard throughout operation	Extremely Harmful	Unlikely	Very High Risk
4	Accidental / Incorrect release of hooks	Extremely Harmful	Unlikely	Very High Risk
5	Boat falling from a height due to equipment failure	Extremely Harmful	Unlikely	Very High Risk
6	Fuel/oil spill	Harmful	Likely	High Risk
7	Lifeboat falls contacting boat crew through open hatches	Harmful	Likely	High Risk
8	Damage to SDA as a result of lifeboat falling	Harmful	Unlikely	Medium Risk
9				
10				
11				
12				
13				
14				
15				

Controls to reduce risk

Hazard No.	Control Type	Control Measures	Date Implemented
1	Preventative	All crew trained, competent, and familiar with correct procedures	28 April 2020
1	Preventative	Responsible officer in charge both on deck and in lifeboat	28 April 2020
1	Preventative	Lifeboat procedures covered in ship familiisation, as well as regular and on going training	28 April 2020
1	Preventative	All personnel involved briefed by officer in charge. Everybody aware of their duties and responsiblities	28 April 2020
1	Preventative	Minimum personnel to be involved. Unneccessary personnel to remain clear of area	28 April 2020
1	Preventative	Weather and sea conditions assessed and deemed suitable	28 April 2020
1	Preventative	Permission granted from bridge for both launch and recovery of lifeboat	28 April 2020
2	Preventative	Boarding area to be well lit and clear of all unneccesary obstructions	28 April 2020
2	Preventative	Personnel to wear appropriate PPE	28 April 2020
3	Preventative	Safety harness to be worn if personnel on deck at risk of falling overboard	28 April 2020
3	Preventative	Safety railings to be utilised where necessary	28 April 2020
3	Recovery	Lifejackets and boat suits to be worn by all boat crew, and deck crew where deemed	28 April 2020
3	Preventative	Seatbelts to be worn in boat except nature of operation permits not wearing it	28 April 2020
4	Preventative	Hooks checked by competent person before entry into boat	28 April 2020
4	Preventative	Hooks and release mechanism checked again by competent person once entered boat	28 April 2020
4	Preventative	Coxswain and boat crew familiar with release mechanism and release procedure	28 April 2020
4	Preventative	Before releasing, if ever in any doubt, seek confirmation boat is waterborne	28 April 2020
4	Preventative	Once hooks are released, ensure they are reset correctly before attempting recovery	28 April 2020
4	Preventative	Responsible officer to check hooks and release mechanism once hooked back on for recovery	28 April 2020
4	Preventative	Boat to be lifted just clear of the water and hooks checked again by responsible officer before attempting full recovery of boat	28 April 2020

5	Preventative	Boat lowered and raised a number of times prior to boat crew boarding	28 April 2020
5	Preventative	Ensure testing, inspections and maintenance has been carried out as per SMS/PMS	28 April 2020
5	Preventative	Ensure all certification is up to date.	28 April 2020
5	Preventative	Ensure lifeboat/davit has been subject to all inspections/tests as required by flag state/class society	28 April 2020
5	Preventative	Competent person to conduct a good examination of boat, davit and falls and conduct pre launch checks before operation commences	28 April 2020
5	Preventative	Ensure boat/davit is not overloaded as per safe working load	28 April 2020
5	Preventative	Hooks checked as per controls for hazard no. 4	28 April 2020
6	Preventative	Engine checks and maintenance completed as per SMS/PMS	28 April 2020
6	Preventative	Measures for boat falling and hook release as per above	28 April 2020
6	Recovery	Oil spill equipment carried on board ship	28 April 2020
7	Preventative	Hatches only to be opened when absolutely necessary	28 April 2020
7	Preventative	Communications between coxswain and boat crew as boat approaches falls	28 April 2020
7	Preventative	Personnel to wear appropriate PPE	28 April 2020
8	Preventative	Control measures as per hazard no. 4 and no.5	28 April 2020

Risk Assessment of Controlled Hazards

Hazard No.		Hazard Consequences (click for details)	Hazard Likelihood (click for details)	Residual Risk level
1	All inherent hazards involved with launching and recovery operations	Harmful	Unlikely	Medium Risk
2	Slips trips and falls	Harmful	Unlikely	Medium Risk
3	Falling overboard throughout operation	Very Harmful	Unlikely	High Risk
4	Accidental / Incorrect release of hooks	Extremely Harmful	Very unlikely	High Risk
5	Boat falling from a height due to equipment failure	Extremely Harmful	Very unlikely	High Risk
6	Fuel/oil spill	Harmful	Unlikely	Medium Risk
7	Lifeboat falls contacting boat crew through open hatches	Slightly Harmful	Unlikely	Low Risk
8	Damage to SDA as a result of lifeboat falling	Harmful	Very unlikely	Low Risk
9				
10				
11				
12				
13				
14				
15				

Marine Accident Report

INVESTORS IN PEOPLE