SHERIFFDOM OF SHERIFF COURT

[2021] FAI 28

OBN-B21-20

DETERMINATION

BY

SHERIFF PATRICK HUGHES

UNDER THE INQUIRIES INTO FATAL ACCIDENTS AND SUDDEN DEATHS ETC (SCOTLAND) ACT 2016

into the death of

JAMES DARREN KERR

Oban, 26 April 2021

Determination

The Sheriff, having considered the information presented at the Inquiry, determines:

(1) in terms of section 26(2)(a) of the Inquiries into Fatal Accidents and Sudden Deaths etc. (Scotland) Act 2016 ("the Act"), that James Darren ("Jamie") Kerr died aboard the workboat "Carol Anne" then moored in Loch Spelve, Mull at approximately 1300 hours on 30 April 2015;

(2) in terms of Section 26(2)(b) of the Act, that the accident which caused the death took place on that date on the deck of the said vessel, when the workboat's Atlas VCS 170.2 A12 crane collapsed and struck Mr Kerr;

(3) in terms of Section 26(2)(c) of the Act, that the cause of death was chest and pelvic injuries sustained by Mr Kerr in the said accident;

(4) in terms of Section 26(2)(d) of the Act, that the said accident was caused by the failure of the bolted connections which fastened the crane in place; a failure arising from the fact that the 'M24' fitting kit erroneously ordered and supplied for the crane was the wrong size and contained inappropriately matched parts, some of which were of substandard quality;

(5) in terms of Section 26(2)(e) of the Act, that precautions which (i) could reasonably have been taken; and (ii) had they been taken, might realistically have resulted in the accident resulting in the death, and therefore the death, being avoided would have been:

1. For the larger 'M30' fitting kit specified in the Atlas Installation Manual - containing either the components included at that time by the crane's manufacturer Atlas Germany, or alternatively the components included at that time by the manufacturer's subsidiary company, Atlas UK - to have been used to install the crane;
2. For the person ordering the fitting kit, James Donaghue, to have checked what fitting kit this model of crane required, rather than making an assumption based on his experience of other models of cranes;
3. For the crane's supplier, Atlas UK, to have issued an 'M30' fitting kit notwithstanding having received the said erroneous request for an incorrect fitting kit from Mr Donaghue;

(6) in terms of section 26(2)(f) of the Act, the following defects in systems of working contributed to the accident and the resultant death in that:

(i) Atlas UK did not have a system of working in place to ensure that the correct fitting kit was issued even if an incorrect kit had been requested;

(ii) Atlas UK did not provide crane purchasers with information on the appropriate fitting kit to be used in installing cranes;

(iii) Atlas UK lacked a robust system to verify the quality of the fasteners supplied to it;

(7) in terms of section 26(2)(g) of the Act the following facts are relevant to the circumstances of the death:

(i) Prior to the accident, Atlas UK was unaware that its parent company Atlas Germany used different and more numerous components in its M30 fitting kit;

(ii) The engineer who conducted the thorough examination of the crane, Walter Galbraith, did not have any information regarding the appropriate fitting kit that it required.

RECOMMENDATIONS

The Sheriff, having considered the information presented at the inquiry, makes the following recommendation in terms of 26(1)(b) of the Act:

1. That the Health and Safety Executive opens an investigation into how grade 6 locknuts incorrectly designated as being of the higher grade |8| strength came to enter the supply chain; and whether any ongoing risk to safety arises from their having done so.

NOTE

Introduction

[1] This was an inquiry held under the Fatal Accidents and Sudden Deaths etc. (Scotland) Act 2016 ("the Act") into the death of James Darren Kerr, known to family and friends as Jamie. His death was first reported to the Crown Office & Procurator Fiscal Service on 6 May 2015. A notice of an inquiry was given by the procurator fiscal under section 15(1) of the Act on 16 July 2020.

[2] I pronounced a first order on the same date assigning a preliminary hearing for 28 August 2020. Having heard from parties on that latter date I continued proceedings to a further preliminary hearing on 29 October 2020; I also ordained the Crown to lodge a draft joint minute, ordained certain other participants to lodge revised Rule 3.7 notices and allowed all parties a set period to lodge notices to admit information in terms of Rule 4.12. Further preliminary hearings took place on 9 October 2020 and 29 October 2020. The hearing of evidence began on 8 February 2021, with evidence continuing on 9 and 10 February 2021 before concluding on the latter date. Due to the ongoing Covid-19 pandemic all proceedings took place remotely using WebEx.

[3] The majority of evidence in this inquiry was agreed in the form of three joint minutes. It was also agreed that a number of witness statements, police interviews and documentary productions could be treated as evidence in place of oral testimony. The court heard oral evidence from six witnesses;

- Adrian Lambert, an inspector with the Marine Accident Investigation Branch (MAIB), who had prepared Accident Report No. 11/2016 on the investigation of the crane's collapse;
- Keith Nigel Birkett BSc (Hons) MSc CEng MWeldI MIMMM, principal materials engineer for the Health & Safety Executive (HSE) Science Division (formerly the Health & Safety Laboratory (HSL)), who was the co-author of a report prepared by HSL on the failure of the crane;
- Dr James William Hobbs MEng PhD CEng MIMechE, a senior engineer and colleague of Mr Birkett's who co-authored the HSL report with him and who gave evidence concurrently with him in terms of Rule 4.19 of the FAI Rules;
- Ian Malcolm Simpson BEng CEng MIMechE, now self-employed with Langside Consulting Ltd but formerly an HSE Specialist Principal Inspector (Mechanical Engineering) who had prepared two reports into the crane's collapse for the Maritime and Coastguard Agency (MCA) and a supplementary report for the Crown;
- Walter Galbraith, a retired Atlas engineer who had carried out the mandatory "thorough examination" of the crane following its installation;
- John Anthony Holland BE(Hons) CEng MIMechE, a Consultant Engineer with Hawkins & Associates Ltd who had prepared a report on an investigation into the cause of the incident focusing on engineering matters relating to how the crane was secured to the deck of the boat.

[4] All of these witnesses were called on behalf of the Crown, with the exception of Mr Holland who was called on behalf of PMG Services Ltd, the company which had installed the crane.

[5] On 23 March 2021 a hearing was held on the parties' written submissions, following which the court made avizandum. There was little dispute at the inquiry regarding the evidence; the real issues were how the facts were to be interpreted.

[6] In these proceedings the Crown was represented by Ms Selena Brown, Procurator Fiscal Depute. Jamie Kerr's employer, Inverlussa Shellfish Company Ltd., trading as Inverlussa Marine Services ("Inverlussa"), was represented by Mr Barry Smith QC. HI-AT (Scotland) Ltd and its director Mr James Donaghue, who were involved in the purchase of the crane, were represented by Mrs Susan Duff, advocate. PMG Services, the company which Inverlussa hired to install the crane, was represented by Mr Peter Gray QC. Atlas Germany and Atlas UK, respectively the manufacturer and the supplier of the crane were represented by Mr Gavin Anderson, advocate. Walter Galbraith, who conducted the mandatory "thorough examination" of the crane after its installation, was represented by Mr Anthony Graham QC. Ross Hunter, a naval architect who carried out an inspection of the "Carol Anne" on 8 April 2015 was represented by Mr John Scullion QC. In the preliminary hearings Jamie Kerr's family was represented by Mrs Catherine Crowe of Stuart Balfour & Sutherland, solicitors. At the final such hearing the family decided that their ongoing involvement in the inquiry would be as attendees rather than formal participants and Mrs Crowe withdrew from acting at that point, although she continued to act as a point

of contact when necessary. I am grateful to her for doing so and to all of the above representatives for their assistance throughout proceedings.

The Legal Framework

[7] The law governing this inquiry is set out in section 1 of the Act and in the Act of Sederunt (Fatal Accident Inquiry Rules) 2017. The purpose of this inquiry is to establish the circumstances of Jamie Kerr's death, and to consider what steps, if any, might be taken to prevent other deaths in similar circumstances. A fatal accident inquiry is not an exercise in establishing criminal or civil liability, apportioning blame or finding fault. It is an inquisitorial process, the purpose of which is to establish facts. The public interest is represented by the Crown. In terms of section 26(1)(a) and section 26(2) of the Act, the sheriff's determination must set out findings made on:

(a) when and where the death occurred,

(b) when and where any accident resulting in the death occurred,

(c) the cause or causes of the death,

(d) the cause or causes of any accident resulting in the death,

(e) any precautions which—

(i) could reasonably have been taken, and

(ii) had they been taken, might realistically have resulted in the death, or any accident resulting in the death, being avoided,

(f) any defects in any system of working which contributed to the death or any accident resulting in the death,

(g) any other facts which are relevant to the circumstances of the death.

[8] In terms of section 26(1)(b) and section 26(4) of the Act the sheriff must make such recommendations, if any, as are considered appropriate regarding any of the following matters which might realistically prevent other deaths in similar circumstances;

(a) the taking of reasonable precautions,

(b) the making of improvements to any system of working,

(c) the introduction of a system of working, and

(d) the taking of any other steps.

[9] As a result of section 2(3) of the Act, the holding of this inquiry was mandatory, because Jamie Kerr's death resulted from an accident which took place in Scotland and which occurred while he was acting in the course of his occupation as skipper of the workboat "Carol Anne".

Summary

Jamie Kerr

[10] Jamie Kerr was born on 17 March 1990 to John and Morag Kerr, the middle brother of his siblings John, Amanda, Jordan and Ashleigh. At the time of his death he lived in Oban and had been in a relationship with his partner Toni McIntyre for four years; they had purchased a flat together six months prior to his death. He was an enthusiastic sportsman who excelled at shinty and motocross. From an early age he had a love of fishing boats, working on a creel boat during weekends and school holidays

from the age of 10; by the age of 14 he was the only person trusted to take the boat out alone when the employer was on holiday. On leaving school he began travelling around the United Kingdom working on fishing boats. In October 2013 he began working with Inverlussa as a crewman, working on barges carrying out different types of work including working with fish farms. In addition to this paid employment he also worked on his own fishing boat, *Sandpiper*. It was a matter of formal agreement amongst all parties that he was a very experienced and reliable employee. The statement of one of his fellow skippers, Sam Lloyd, describes him as:

> "great at his job, experienced in that area and taught me a lot in two months. He also lifted morale on the boat as well".

[11] In April 2013 he attended and successfully completed a two-day training course including a theory and practical test on sea cranes. In February 2015 he attended and successfully completed the Royal Yachting Association RYA/MCA Day Skipper for Sail and Power Craft course, as well as the RYA/MCA Coastal Skipper & Yachtmaster Offshore course. In March 2015 he obtained the RYA/MCA Yachtmaster Offshore Certificate of Competence. In 2014 Inverlussa promoted him to skipper. In January 2015 he transferred from Shetland to his new post based at the Marine Resource Centre in Barcaldine, where he became the skipper of another Inverlussa vessel, the "Carol Anne".

The "Carol Anne"

[12] This vessel is a landing-craft style workboat that was built in 1999 by Alexander Noble and Sons Ltd, Girvan specifically for fish farm operations. It is

approximately 16.5m in length and 6.5m in width. In 2010 it was purchased by Inverlussa which remains its registered owner. Its operating criteria and limitations are listed in its stability information booklet which was approved by the Maritime and Coastguard Agency (MCA) in 2000.

[13] The vessel was primarily used to distribute fish food. Other tasks included fish farm development, maintenance and the treatment of fish stocks against parasites. It was operated by a "pool" of two skippers and one deckhand working a cycle of two weeks on duty followed by one week off duty. The workboat was routinely manned by either a skipper plus the deckhand or by the two skippers. Its weekly work schedule was arranged by its crew based on the fish farms' requirements. The skipper would e-mail the vessel's schedule to Inverlussa one week in advance.

[14] When the vessel was acquired by Inverlussa it already had an Atlas 102.A3 crane attached to it. In 2011 this crane was replaced by a larger Atlas 165.2 crane. By September 2014 that second crane had developed recurring problems which suggested that it was coming to the end of its serviceable life. Inverlussa's managing director Benjamin Wilson contacted HI-AT (Scotland) Ltd ("HI-AT") to discuss options and prices for a new crane.

The commissioning of the replacement crane

[15] HI-AT is a company which handles crane sales in Scotland on behalf of Atlas Cranes UK Limited ("Atlas UK"). Atlas UK is the wholly-owned subsidiary of a

German manufacturing company, Atlas Maschinen GmbH which later became Atlas GmbH ("Atlas Germany"). Atlas Germany's products include static and mobile[1] cranes for vehicles and marine vessels operating both within and outwith the European Union. Atlas UK is the dealer for sales of Atlas Germany's cranes into the United Kingdom and Republic of Ireland markets.

[16] HI-AT was set up by James Donaghue, a time-served mechanical engineer who worked for Atlas UK from 1970 until 1992 and maintained a business relationship with that company since then. The company was paid a small monthly retainer by Atlas UK. In addition, it would purchase marine cranes from Atlas UK and sell them on to its customer, making a profit on each sale.

[17] Benjamin Wilson, managing director of Inverlussa, advised HI-AT on Inverlussa's requirements for a replacement crane. In October 2014 Inverlussa placed an order with HI-AT for an Atlas 170 VCS A12 model at a net cost of £24,900. This price included a fitting kit for mounting the said crane to the "Carol Anne"'s deck as well as a Scanreco remote control.

[18] The Atlas 170 VCS A12 model crane (hereafter "the crane" or "the Atlas 170 crane") weighed 2,610kg. It had two extensions, a long boom and could lift 1.5 tonnes at a maximum radius of 10.8 metres. Its base consisted of a slew ring mounted on two sub-frames. One sub-frame had a pivot incorporated into it and the other was rigid.

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[1] A static crane is one fixed to a single spot, which in the present case was the deck of the "Carol Anne", whereas a mobile crane is usually mounted on the chassis of a lorry. An important difference between static and mobile cranes is that the latter have stabilisers or outriggers which provide the main load path for resisting load moments, whereas with static cranes it is the studs in the crane's mounting which must absorb the full load moment.

[19] Atlas UK and HI-AT were aware that the crane was for fitment and use on a sea-going vessel, in a marine environment. The crane was suitable for such fitment and use.

[20] On 22 December 2014 James Donaghue sent an email to Robert Higson, parts manager at Atlas Cranes UK Ltd. The text of the email was as follows:

> "Robert can you send out to MRC, Barcaldine, Benderloch, Nr Oban FAO me Ben Wilson Inverlussa Shellfish Co, 4 x 24 x 400 tie bolts[2], 4 x 24 x 350 tie bolts, 8 nyloc[3] nuts, 16 plain nuts, 8 tab washers. This is for Atlas 170 CS[4] a 12 crane. Thanks Robert".

[21] The sort of items requested in this email were known as a "fitting kit" and were intended to fit the said Atlas 170 crane onto the "Carol Anne". Mr Donaghue would ask for a fitting kit for every crane he sold. Normally he would not specify the fitting kit, and instead simply state the crane's model. However on this occasion he thought that by also specifying the kit he would be helping Mr Higson, whom he knew to be recovering from brain surgery at the time.

[22] The fitting kit that Mr Donaghue ordered on 22 December 2014 is known as an "M24" fitting kit (i.e. one in which the bolts have a nominal diameter of 24mm). The Atlas 170 model of crane required an M30 fitting kit, in which the bolts would have a have a nominal diameter of 30mm. At that time, Atlas UK used the calculations of its operations director, Bryan Flintham, to specify the diameter, number and grade of fasteners to be included in the kit. In 2015 an Atlas UK M30 kit would comprise

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[2] "Bolts" here should be taken to mean "studs".

[3] These were lock nuts which were fitted with a blue polymer insert at one end to prevent seepage of liquids.

[4] The omission of the V from the crane's designation occasionally recurs in correspondence regarding the crane but that has no significance for the purposes of this inquiry. No evidence suggests that there was ever any misapprehension as to the crane's model.

four 30 x 500 grade 10.9 studs[5]; four 30 x 650 grade 10.9 studs; eight grade 8 nyloc nuts; sixteen grade 8 plain nuts; and eight tab washers.

[23] Atlas UK had a computer programme which calculated stability for vehicle mounted cranes but there was no equivalent programme for marine cranes. The programme could be accessed through a "dealer portal" on the Atlas UK website which contained technical information not available on sales brochures, but Mr Donaghue did not have access to that portal or to any Atlas UK computer programmes. He did not know that the Atlas 170 VCS A12 model required a M30 fitting kit. He knew that both the smaller Atlas 165 model and the larger Atlas 172 models of crane required a M24 fitting kit and concluded erroneously that the Atlas 170 crane did too.

[24] Atlas UK did not identify HI-AT's error and issued an M24 fitting kit.

[25] The crane was then assembled in Germany. Once manufactured it became the property of Atlas UK. In December 2014 it was delivered to R. Allison Limited who had been contracted to fit a Scanreco wireless crane control. The M24 fitting kit was initially delivered to the Scottish Sea Farms workshop at the Marine Resource Centre in Barcaldine.

[26] On 11 February 2015 the crane and the M24 fitting kit were taken to Barcaldine, where work to install the crane onto the "Carol Anne" was taking place. Prior to the crane being delivered to Barcaldine for installation, R. Allison Limited were asked by

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[5] Atlas UK's use of grade 10.9 studs in M30 kits is attested by the witness statement of its managing director James Smith at paragraphs 95 and 127. I accept that evidence although I note that the 2010 Atlas (UK) Installation Manual at page 13 seems to recommend grade 8.8 studs for M30 kits (as opposed to grade 10.9 studs for M24 kits). Mr Flintham left Atlas UK for health reasons on 31 December 2015 and has since passed away; consequently Atlas UK cannot provide further detail as to the basis of his calculations.

Atlas UK to carry out modifications to its valve block. The purpose of these modifications was to connect an overload protection system to the relevant functions on the valve block. This modification prevented the crane from being extended beyond a certain point if the crane were overloaded.

[27] The operating instructions for this crane were dispatched along with the crane. In line with Atlas Germany's practice regarding marine cranes, no installation instructions[6] were provided.

The installation of the crane

[28] Inverlussa contracted PMG Services Limited ("PMG") to remove the Atlas 165.2 crane from the "Carol Anne" and install the Atlas 170 crane in its place. PMG is a plant services company owned by Peter MacGregor, a plant mechanic and technician who at the time of this incident had 19 years' experience.

[29] In the communications between Inverlussa, HI-AT and Atlas UK which preceded the ordering of the said crane, it had been noted that the crane's base would be different from that of the Atlas 165 crane which it was to replace. On 6 October 2014 a base drawing for a 170.2 crane (hereafter "the new drawing") - was sent by Atlas UK's managing director James Smith to Mr Donaghue at HI-AT, who forwarded it to Mr Wilson at Inverlussa.

[6] These should not be confused with the operating instructions, a copy of which was provided to Inverlussa.

[30] On 18 November 2014 Mr Wilson at Inverlussa e-mailed PMG Services attaching the new drawing as well as a base drawing for an Atlas 165.2 crane ("the old drawing"). In his email he identified that there was apparently a difference of 103 millimetres between the bases of the two models and asked if thought could be given to a "*sort of adaptor plate*".

[31] Both the 165 and 170 models of cranes have "channels" in their subframes through which bolts fasten the crane to its base plate or mounting plinth. The old drawing noted a channel width of 26 millimetres, which would indicate that a stud of 24 millimetres' diameter should be used for installation. The new drawing did not note any channel width nor did it indicate a size of stud for installation. In reality, the channel width on the Atlas 170 crane was 31.5mm. Both drawings indicated that eight fasteners should be used, four on either side of the crane base.

[32] Although Mr MacGregor and some of his employees could weld, the nature of this structural welding was such that he felt it needed a fully qualified welder to modify the plate on which the crane was to be mounted, so he hired Robert MacKenzie of MacKenzie Welding Ltd to do this.

[33] Prior to commencing work, Mr MacGregor and Mr MacKenzie inspected the "Carol Anne" to consider whether its base structure would be robust enough to support the crane to be installed. Both men considered the structure to be strong enough to support the new crane.

[34] MacKenzie Welding Ltd used the new drawing when manufacturing the adaptor plate to mount the Atlas 170 crane. This adaptor plate was 30 millimetres thick. The

holes drilled into the adaptor plate to accommodate the studs were based on the 24 millimetre studs delivered by Atlas UK.

[35] Mr MacGregor was surprised that no installation instructions had been provided other than the new and old drawings. He has been working on cranes for 19 years from various manufacturers including Jonsered, Palfinger Epsilon, PM Cranes and Penny Hydraulics, and all of their products would come with more detailed installation instructions, including bolt sizes and bolt torques. However, given that the crane had a certificate attached to it saying that it had to be inspected by the manufacturer, and knowing that they were fitting parts supplied by the manufacturer, Mr MacGregor was satisfied that he could proceed with the installation, which then took place between 12 March 2015 and 16 March 2015.

[36] PMG Services had not previously installed a crane on a boat so Scott Turnbull, trading as Scott Turnbull Engineering, was contracted to dismantle and remove the Atlas 165.2E A19 crane from the "Carol Anne" and to install the said Atlas 170 crane in its place. Mr Turnbull worked with cranes on a daily basis and had installed three brand-new cranes, one of which was an Atlas crane. A good deal of his work involved the bases of cranes with the associated studs, bolts and fittings.

[37] When the welders had finished fabricating the new adaptor plate Mr Turnbull checked over the fitting kit which he understood to be supplied by the manufacturer. There were eight studs in total, four for either side, and the plate to which the crane was to be mounted was predrilled for these studs. The new crane was lifted into place on the

vessel's starboard side and mounted longitudinally along the vessel's axis using the M24 fitting kit that had been provided.

[38] Acting on instructions from Peter MacGregor, Mr Turnbull used a calibrated wrench to torque[7] the nuts on all bolts up to 600 nanometres. Mr MacGregor gave this instruction based on his knowledge of what M24 studs should be torqued to. His own company's Epsilon crane was fixed with exactly the same studs and was torqued to 800 nanometres, but he knew that Atlas recommended much lower torque figures. In his opinion their recommendation was far too low, about two-thirds of any other manufacturer's recommendation. Mr MacGregor considered that 600nm was a "good intermediate torque", and if there were any problems with it he expected this to be corrected as part of the thorough examination that he knew was later to be conducted by an engineer.

[39] After installation the crane was used on a number of occasions in March 2015 without incident.

[40] Benjamin Wilson of Inverlussa did not engage a naval architect to carry out stability calculations before fitting the replacement crane because he considered this to be unnecessary, as he was "exchanging like for like". Following the accident a new

[7] The application of torque to a fastener creates preload in the joint. This allows the applied loads to be shared between the fasteners and the clamped plates, and limits the loads to which the fasteners are exposed. If done correctly, the fasteners will be exposed to a relatively constant load throughout their service life, instead of being exposed to the stresses of cyclic loading. In other words, the fasteners of a crane base should experience the same load at all times irrespective of whether the crane is being used to lift anything.

crane was fitted and a stability calculation was carried out which demonstrated that it did not affect the stability of the vessel.

The "Thorough Examination"

[41] Subject to certain exceptions, employers must ensure that before lifting equipment is put into service for the first time it is thoroughly examined for any defect[8]. Atlas UK first asked Raymond Allison to carry out this examination. He was unable to do so and asked Walter Galbraith to carry out the examination in his place.
Mr Galbraith was employed as a service engineer by Atlas UK. He had received training from ALLMI, the Association of Lorry Loader Manufactures and Importers[9].

[42] On 23 March 2015 Mr Galbraith on behalf of Atlas UK examined the crane as installed on board the "Carol Anne". During the inspection he followed the Atlas Loader Crane Service Inspection/Thorough Examination Report matrix. This included checking that what are described in that matrix as the "hold down bolts" (i.e. the assembled fasteners comprising studs, nuts and washers) appeared adequate for the crane and were all in place.

[43] As part of the thorough examination the crane was load tested by Mr Galbraith. During the load test the crane was not fully extended through its entire slewing range.

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[8] Regulation 9 of the Lifting Operations and Lifting Equipment Regulations 1998 ("LOLER"); Regulation 12 of The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006
[9] The ALLMI is a trade association devoted exclusively to the lorry loader industry which aims to promote the safe use of lorry loaders, help to formulate legislation affecting the industry's interests and promote compliance with training requirements.

[44] Part of the examination involved the crane being deliberately overloaded to test stability. The overload factor ought to have been 1.25 (125%) but the load used, recorded in the test certificate, was 2000kg representing an overload factor of 1.33 (133)%.

[45] Mr Galbraith confirmed that there were as expected eight bolts fitted with tab washers on top and a nyloc nut with two plain nuts. He did not measure any of the fasteners but in his experience the studs would normally be 24mm with matching fixings and nuts. He was not aware of the recommended size of fasteners for this model of crane; it was not something that he would check. He considered that the fittings "looked tight and big enough"[10]. He did not see any sign of deformation or bending; had he done so he would have commented on it.

[46] Following the examination Mr Galbraith (on behalf of Atlas UK) issued a certificate of report to Inverlussa which did not identify any defects[11].

The annual safety inspection

[47] The "Carol Anne" was classed as a "small workboat" and was therefore subject to the Merchant Shipping (Small Workboats and Pilot Boats) Regulations 1998 (SI 1998 no. 1609). Consequently it required to be subject to an annual safety inspection.

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[10] Statement to police, 24 June 2015.

[11] One thing he noted was that the nyloc and plain nuts had been installed the wrong way round. There is a suggestion in the MAIB report at section 2.4 that this may have played a role in the accident, but both Dr Hobbs and Mr Holland discounted it as a factor, and I accept their evidence.

Inverlussa instructed Ross Hunter, a qualified naval architect and ship surveyor to conduct this inspection, and he did so on 8 April 2015.

[48] At that time Mr Hunter was unaware that the Atlas 165 crane had been replaced with the Atlas 170 crane. Had he been informed that the crane had been replaced he would have instructed Inverlussa to inform the certifying authority[12] of the change of crane. Also, he would have required to check that the appropriate stability calculations had been carried out and that the stability book had been updated and amended as required. Subsequent calculations carried out by McDuff Ship Design Limited confirmed that the replacement crane did not adversely affect the stability of the vessel and was suitable for use on the workboat "Carol Anne".

[49] During the inspection Mr Hunter inspected the deck connection of the foundation on which the crane was secured but did not inspect the crane because it did not form part of the inspection in terms of the Code of Practice. He did not see anything which caused him concern in relation to the crane during the inspection of the vessel. He noted that the load radius chart was missing; that the crane inclinometer could not be seen by the operator as required; and that the thorough examination certificate for the crane was not on board the vessel. He reported these deficiencies to Inverlussa.

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[12] The Maritime and Coastguard Agency (MCA) is an Executive Agency of the Department for Transport and has responsibility and accountability for the UK Merchant Shipping Regulations and the enforcement thereof. It has devised codes of practice for various types of vessels, and has authorised ten "certifying authorities" to examine and certify the vessels to which these codes apply. The relevant code for the "Carol Anne" was "The Safety of Small Workboats & Pilot Boats - A Code of Practice (*The Brown Code*)" and the certifying authority was the Society of Consulting Marine Engineers and Slip Surveyors (SCMS).

[50] Inverlussa accepted the deficiencies noted and corrected them. It is a matter of agreement that none of the deficiencies noted had any material bearing upon, or any causal connection to, the accident which caused the death of Jamie Kerr. The replacement of the crane was permitted by the Code of Practice; the structure of the vessel and base plate for the crane were suitable; and the stability of the vessel was unchanged.

The accident

[51] Shortly after 05:00 hours on 30 April 2015, the "Carol Anne" sailed from its base at Barcaldine, Loch Creran. It was carrying a palletised cargo of plastic pipes and fittings that were to be delivered to the Scottish Sea Farms fish farm at Kinlochspelve, Loch Spelve. The crew consisted of Jamie Kerr as skipper and Jack Young as deckhand.

[52] The vessel arrived at the sea farm site at 08:00 hours. The cargo was discharged using the crane. On completion of this task, Mr Kerr was asked by the fish farm manager Geoffrey Kidd to recover five fishing nets from the seabed near to the loch's south shore. Mr Kerr agreed to do this and confirmed the arrangement with Benjamin Wilson.

[53] Mr Kidd boarded the vessel to assist with directions to the fishing nets. At 08:30 hours the "Carol Anne" arrived at their location, recovered the first net from the seabed and returned to the slipway of the sea farm where that net was offloaded using the crane. Mr Kidd remained at the fish farm and the vessel returned to retrieve the remaining four nets.

[54] At approximately 11:00 hours the "Carol Anne" arrived at the fish farm with the remaining four nets on board. The vessel's bow ramp was lowered onto the slipway at the fish farm. Mr Kerr used the remote control unit to operate the crane to land the first net ashore. This net was lifted from the deck. The crane was slewed in an anticlockwise direction and its boom extended in order to carry the net over the vessel's starboard side and position it over the slipway ahead of the bow ramp. The net was lowered to the ground, unhooked, and removed from the slipway using the telehandler.

[55] The remaining nets were off-loaded from the "Carol Anne" by Jack Young operating the crane under the supervision of Jamie Kerr. Both men stood on the port side of the working deck opposite to the on-board crane. At approximately 11:40 hours the last net was lifted and manoeuvred over the starboard side of the workboat in the same manner as the previous nets had been moved, still with Mr Young and Mr Kerr standing together at the port side of the vessel. As the net was being lowered towards the ground Jack Young heard a "loud high-pitched bang" and observed the crane collapsing in their direction. Jack Young ran aft toward the wheelhouse and Jamie Kerr ran in the opposite direction towards the bow. Mr Kerr was struck by the crane boom and pinned to the bow ramp, causing injuries to his head and body.

[56] Justin Liddle, a Husbandry Man at the fish farm, dialled 999 and asked for an ambulance and the fire service to attend. He asked the emergency operator if the crane could be lifted from Jamie Kerr; after consulting the ambulance service, the emergency operator confirmed that it could.

[57] A forklift was operated by Geoffrey Kidd and with the assistance of Justin Liddle the on-board crane boom was lifted from Jamie Kerr, who was then moved onto pallets to assist with CPR. Justin Liddle commenced CPR on Mr Kerr with assistance from Donald MacDonald, Senior Husbandry Man, Geoffrey Kidd and Jack Young.

[58] Peter Greenway, Paramedic and Martin Rowley, Scottish Ambulance Service Urgent Tier, arrived at the fish farm at approximately 1203 hours. Mr Greenway and Mr Rowley took over CPR on Jamie Kerr until the Scottish Ambulance Service 'Air Ambulance' attended at approximately 1225 hours with Doctor Nicola Littlewood in attendance.

[59] Doctor Littlewood was advised by Mr Greenway and Mr Rowley that CPR had been carried out for 30 minutes prior to her arrival. Jamie Kerr was intubated and intra-osseous needles were inserted into both of his upper arms to facilitate the administration of two units of blood and one of normal saline. Two bi-lateral thoracostomies were carried out to both sides of his chest and a pelvic splint was applied. Doctor Littlewood confirmed that he was in cardiac arrest. CPR was carried out for a further 30 minutes. Jamie Kerr remained asystolic and was pronounced dead by Doctor Littlewood at 1300 hours on 30 April 2015.

[60] Jamie Kerr's body was subsequently conveyed to Craignure Mortuary, and on 13 May 2015 was examined at the Southern General Hospital, Glasgow by Doctors Marjorie Turner MB ChB FRCPath DipFM and Gemma Kemp MBBS, FRCPath, both forensic pathologists. Their post mortem report recorded the cause of death as:

1a: Chest and pelvic injury

due to

1b: Accident at work

Investigations

[61] The MAIB commenced an investigation into the accident led by Adrian Lambert. In parallel with the MAIB investigation, a joint investigation into the circumstances of the crane's collapse was conducted by Police Scotland and the Maritime and Coastguard Agency (MCA). On 6 May 2015 Captain Allan Marsh of the MCA contacted Keith Birkitt and Dr James Hobbs, a metallurgist and mechanical engineer respectively, both with the HSL to assist with the investigation into the crane's collapse.

[62] A separate investigation began on 6 May 2015 when Hawkins and Associates Limited was instructed by loss adjusters to investigate the cause of the accident on behalf of AXA Insurance, who provided liability insurance to PMG Services. This investigation formed the basis for the report that Mr Holland prepared in October 2020 for the purposes of this Inquiry.

[63] On 11 May 2015 Mr Birkitt and Dr Hobbs accompanied by police visited the "Carol Anne" which was still moored in Loch Spelve, and examined the failed crane in situ. Thereafter they carried out and instructed extensive further work including detailed visual examination of the studs, nuts and tab washers, tensile testing, chemical analyses and metallography and hardness tests. Following this they produced a detailed 60-page report which was lodged with the Inquiry as Crown Production no. 66.

[64] The visual inspection found the crane lying on its side at approximately a 90 degrees angle to the position in which it would have been orientated at installation. The base plate was undamaged.

[65] On the outboard side, the four studs (numbered in the report as 1 to 4, with 1 being the rearmost) were still in position and were undamaged, but the tab washers and the nyloc nuts that had been attached to each of them on top of the base plate were no longer present. Examination showed that the four outboard nyloc nuts had been "stripped" from the studs.

[66] On the inboard side, two of the studs (numbered 1 and 3) had fractured at around the point where they protruded through the base plate. The other two studs had not fractured and had remained in position, but had bent at an approximately 90 degrees angle in the direction in which the crane had fallen. On one of them, (inboard stud 2) the nyloc nut and a deformed tab washer remained in place at the top end of the stud; but the nut and washer had been pulled into the slot of the sub-frame. On the other, (inboard stud 4) the two standard nuts remained intact but the nyloc nut had again stripped from the stud.

[67] The failure mechanism was the stripping of the internal threads on the nyloc nuts which secured the outboard side of the crane to its base plate. This had allowed the crane to pull away from its base plate and fall on to the deck.

[68] "Thread stripping" of nuts occurs when the stud is made of harder material than the nut with which it is matched. The "peaks" of the nuts' threads are sheared off into the "valleys" of the studs' threads. So instead of two sets of threads clamping each other

together, the surfaces of both nut and stud are smoothened which allows the nuts to be pulled off the studs. Thread stripping of this kind is very rare. To find an explanation for it, Mr Birkitt and Dr Hobbs turned to consider the components of the M24 fitting kit used to install the crane.

[69] One of the outboard studs was examined. At one end it was marked "10.9"[13] which represents the grade[14] of the stud as defined in BS 3692:2014 "ISO metric precision bolts, screw and nuts – Specification"[15]. Metallurgical examination showed the stud's mechanical properties to meet the requirements of BS EN ISO 898 Part 1: 2013[16].

[70] One of the 'stripped' nyloc nuts was also tested. Although the nuts used to install the crane were designated as grade 8, this nut was marked "|8|". Nuts are marked with vertical bars in this way to demonstrate that while they conform to the requirements of BS 3692:2014, they do not conform to the requirements of BS EN ISO 898 part 2: 2012. The foreword to BS 3692:2014 states:

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[13] Section 5 of BS EN ISO 898 provides that in numeric grades the number to the left of the dot consists of one or two digits and indicates 1/100 of the nominal tensile strength in MPa (megapascals); the number to the right of the dot indicates 10 times the ratio between the nominal yield strength and the nominal tensile strength.

[14] Fasteners such as bolts and nuts are graded according to specifications set out in consensus standards. In this country the British Standards Institute (BSI) controls national standards, which are denoted as British Standard or 'BS'. A common standard adopted at European level supersedes national standards and would in this country be prefixed with BS EN. Once an International Standard has been adopted as a European Standard it supersedes the existing European standard. In Britain these standards are then prefixed with BS EN ISO.

[15] British Standard BS 3692 gives a specification for "ISO metric precision hexagon bolts, screws and nuts". It was last updated in 2014. Its foreword notes that it "should be read in conjunction with BS EN ISO 898-1 as it contains tables that reflect up-to-date best practice for mechanical properties of bolts".

[16] British, European and International Standard BS EN ISO 898 is a multi-part standard titled "mechanical properties of fasteners made of carbon steel and alloy steel". Part 1 of the standard, which was last updated in 2013, relates to "bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread (ISO 898-1: 2013)". Part 2 of the standard, which was last updated in 2012, relates to "Nuts with specified property classes – Coarse thread and fine pitch thread (ISO 898-2: 2012)".

> *"The mechanical properties of the nuts in this British Standard do not conform to BS EN ISO 898-2. Higher proof load[17] values have been allocated to the revised property classes in BS EN ISO 898-2 in order to ensure that fracture[18] of the bolt generally occurs in the case of overloading.*
>
> ***"CAUTION.** Nuts in accordance with this standard cannot be fully loaded with sufficient assurance up to the yield point of the appropriate bolt, or beyond this, without the possibility of the nut being stripped, and for this reason it is essential that new designs of nuts for use with BS 3692 bolts and studs conforming to this standard conform to BS EN ISO 898-2.*
>
> *"In order to differentiate nuts that conform to British standard from those that conform to BS EN ISO 898-2 vertical bars have been added to the symbols for strength grade designations e.g. "|8| instead of 8."*

[71] In other words, grade |8| nuts are weaker and softer than grade 8 nuts.

[72] Table 8 in BS 3692:2014 sets out the grades of nut to be used with each grade of bolt or screw. For grade 8.8 bolts it recommends the use of grade 8 or grade 10 nuts. For grade 10.9 bolts it recommends the use of either grade 10 or grade 12 nuts. It is also noted that nuts manufactured in accordance with BS 3692:2014:

> "*are at least 15% lower in height than ISO metric 'Regular' nuts, in BS EN ISO 4032 for example. Therefore they are not capable of withstanding the same tensile loads without the risk of thread stripping […] Nuts of a higher strength grade may be substituted for nuts of a lower strength grade*".

[73] Generally speaking the nut must be of equal or greater strength to the bolt; if not, thread stripping may be caused as the harder material in the bolt's threading shears

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[17] Proof load is defined as the greatest load than can be applied to a fastener that will not strain it beyond its elastic limit (i.e. cause it to deform). Typically the proof load is between 85 to 95% of the yield strength (i.e. the amount of stress at which a predetermined amount of permanent deformation occurs).

[18] It may seem counter-intuitive to seek to "ensure fracture" in the case of overloading. However the explanation is well set out by Mr Holland at paragraph 9.2.8 of his report: "One of the reasons joints are designed to fail in this way is because the failure is almost always preceded by visible plastic deformation of the male threaded fastener, which manifests as a loose joint and can be detected before a more catastrophic failure of the joint. However, it is almost impossible to detect an impending thread-stripping type failure in a nut."

through that of the nut. As Mr Birkitt and Dr Hobbs note at paragraph 102 of their report: *"If a grade |8| or a grade 8 nut is used on a grade 10.9 stud, then premature failure of the nut will occur if overloaded or over-torqued."*[19]

[74] A representative sample of the nuts was then sent to Caparo Testing Technologies. Caparo's analysis showed that notwithstanding the grade |8| marking the nuts were in fact weaker grade 6 "thin"[20] nuts. Caparo's report quotes BS EN ISO 898-2:2012 that:

> "Thin nuts (Style O) have a reduced loadability compared to Regular nuts (Style 1) or High nuts (Style 2) and are not designed to provide resistance to thread stripping".

[75] Turning to the tab washers, they were not subject to the same formal grading system as the bolts and nuts. When examined, their tensile strength[21] was found to be as expected. The problem with the washers arose not from any question of grading but rather from the smaller size of washers provided with an M24 kit. A tab washer from an M24 kit was 30% thinner and 53% weaker than its counterpart from an M30 kit. If a load of 187 kN were applied (this being the maximum stud load according to Atlas calculations) the centre of the M24 washer would experience a plastic strain of 10% compared to 0.2% for an M30 washer.

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[19] By way of comparison, paragraph 8.5.4 of Mr Holland's report, citing BS EN ISO 898-2:2012 states "Table 2 shows that Class 8 nuts should be mated with Class 8.8 externally threaded fasteners, and Class 10 nuts should be mated with Class 10.9 externally threaded fasteners".

[20] Section 4.1 of BS EN ISO 898-2:2012 sets outs three categories of nut according to height:
style 2 – high;
style 1 – regular
style 0 - thin

[21] Tensile strength refers to the amount of force required to pull something until it fractures. A fastener's tensile strength is the maximum amount of tensile strength it can handle before failure.

[76] The tab washers were meant to rest underneath the nut on top of the sides of the channels in the subframe. If an M30 washer were placed on top of a channel its larger size would mean that a significant part of its surface area would be in contact with the sides of the channel underneath it, and would be in "compression". However the smaller M24 washers had a much smaller fraction of their surface area in contact with the sides. This meant that a "shear" force was applied to the washers, allowing the sides of the pockets to act as a "guillotine", initially deforming the washers and in some instances shearing them apart.

[77] Mr Birkitt and Dr Hobbs' findings may be summarised as follows. At the point of failure the crane had been used in a near upright position, with its load suspended at a radius of 3.6m. It was not overloaded. It overturned about the longitudinal axis of the four inboard studs, bending two of them and fracturing the other two[22].

[78] The crane's load was applied as a "moment" i.e. force times distance. As the crane swung round there would be a different load on each stud depending on where the arm was. If the crane was facing port or starboard the main turning forces would be acting across the crane, so that if the inboard side was trying to lift up, the outboard side would be in compression, and vice versa. However, if the crane was facing forward or backward then the inboard side, being able to pivot, would not be able to resist any of the load moment; all of the load moment would be resisted only by the outboard studs, especially the rearmost outboard stud because it would be farthest from the pivot point.

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[22] The reason why two studs fractured whilst the other two bent is that with the former two studs, it was their thinner threaded section which protruded through the plinth; while with those that bent, it was the thicker 'plain shank' section.

[79] The crane appeared to have been facing forward at the time of the accident. Therefore the most heavily loaded fastener would have been the rearmost outboard fastener, outboard no. 1. This was the only fastener whose tab washer could not be found after the accident. It was likely that this fastener had been first to fail, and that the "loud high-pitched bang" heard by deckhand Jack Young before the crane began to fall was the sound of that tab washer tearing in half. Once that fastener failed the load carried would transfer to the next rearmost stud, then the next, and so on; a succession of failures like a series of dominoes falling.

[80] There were two main factors causing the failure.

[81] First, the use of the undersize mounting kit resulted in a poor fit of the tab washers and a larger than expected freedom of movement of the studs in the slots before tightening. This in turn resulted in some misalignment of the studs and placed some of the tab washers in shear rather than compression, which gave a significant risk of deformation or failure of the washers. The load at which the M24 washers would deform would have been roughly half that at which M30 washers would have deformed. It was likely that some deformation had taken place during the crane's installation, though it was impossible to say to what extent, or whether this would have been obvious to the naked eye.

[82] Thereafter, even normal operation of the crane would make significant deformation likely, allowing movement within the joint. Movement within the joint would have allowed snatch loading to incur with increasing severity eventually leading to failure. The higher the load, the more likely deformation would be. This deformation

would over time reduce the preload in the studs which in turn would reduce the force needed to strip the nuts' threads.

[83] The second factor was the use of lower-strength nuts on high-strength studs. This again reduced the force required to strip the nuts. However the estimated load for stripping was still relatively high compared to the loads involved; so load alone, absent the first factor described above, could not explain the stripping. Nor could over-torqueing; a torque of 600nm would give a preload of around 160kN, i.e. below the stripping force; so it was unlikely that the torque applied resulted in stripping.

Subsequent developments

[84] Following the accident, Atlas UK was informed that Atlas Germany used grade 8.8 studs with grade 8 nuts for M30 fitting kits. In addition, for marine cranes Atlas Germany recommended that an M30 kit should:

- use 12 studs instead of 8;
- use plain nuts only instead of a combination of nyloc and plain nuts; and
- increase the number of nuts to 32 (i.e. 2 at the top of each stud and 2 at the bottom).

[85] On 13 July 2015 the Chief Inspector of Marine Accidents issued MAIB Recommendation 2015/142 to Atlas UK to ensure that: all Atlas 170 cranes in the UK have been installed using the fastenings as specified by Atlas Germany; that the M24 nyloc nuts supplied be of the same grade or higher than their associated studs; and that the operators of all other Atlas crane installations in the UK for which Atlas UK has

provided fastenings be made aware that the nuts supplied may have been of an insufficient grade. Atlas UK complied with this recommendation and additionally implemented a system to verify the material grades of fastenings. Atlas UK also adopted a practice where the fitting kits for all marine cranes were personally checked by its managing director James Smith. As of January 2021, Atlas UK no longer supplies cranes for marine use in the UK or Republic of Ireland markets.

[86] In June 2016 the MAIB issued its Report No. 11/2016 in which four further recommendations were made to Atlas Germany, ALLMI, the MCA and Inverlussa. These are recorded at Section 5 of the report (which is available online[23]). All have been complied with except[24] Recommendation 2016/122 to Atlas Germany, which recommended that the company ensure that installation information and guidance be provided with its cranes irrespective of whether they are intended as mobile or static installations, or for use inside or outside the European Union. On 27 June 2016 Atlas Germany responded to the said recommendation setting out its reasons for declining to comply. MAIB was satisfied with that response and Recommendation 2016/122 is now closed.

[87] On 29 October 2015 MAIB notified West Yorkshire Trading Standards of the accident and highlighted that incorrectly marked locknuts had been a factor in it. After further enquiries and discussions with the Chartered Trading Standards Institute and industry experts, it was decided that because the nuts had been supplied primarily for

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[23] https://www.gov.uk/maib-reports/collapse-of-crane-on-workboat-carol-anne-with-loss-of-1-life.

[24] MAIB Recommendations are not binding on their addressees who can accept, partially accept, or reject them.

trade use, the appropriate body to investigate further was not Trading Standards (which deals with the safety of products supplied to the general public) but rather the Health and Safety Executive. Therefore on 27 September 2016 West Yorkshire Trading Standards referred the matter to the HSE. However the HSE apparently have no trace of e-mails or other records in connection with the case, and it does not appear that any further investigation was carried out by the HSE.

Submissions

[88] Following the conclusion of evidence the Crown lodged written submissions to which other participants responded. A hearing on submissions took place on 23 March 2021. At that hearing, the Crown made some adjustments in response to submissions made by some of the other participants. The modified Crown position was then largely adopted by the other participants.

[89] The submissions were made on the basis of evidence which was largely agreed. In particular the following points were agreed:

- On 30 April 2015 at the time of the accident the crane was being operated in accordance with the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997, the Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006 and the Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006;

- The crane was suitable for use on the workboat "Carol Anne" and the vessel was capable of being operated safely with the crane fitted and in use;
- The fitment and use of the crane did not adversely affect the stability of the vessel;
- In connection with the thorough examination, Inverlussa supplied any and all information requested by Mr Galbraith. Inverlussa were entitled to rely on the knowledge and expertise of Mr Galbraith in carrying out his examination of the crane;
- At the time of the accident the vessel was being operated in accordance with the operating criteria and limitations set out in its stability information booklet as approved by the Maritime and Coastguard Agency;
- At the time of the accident the crane was being properly used within its operating limits and safe working load and in particular it was not overloaded;
- At the time of the accident Jack Young was trained and qualified to operate the crane and was doing so properly and in accordance with his training.

[90] The formal Findings made in terms of Section 26(2)(a), (b) and (c) are based on facts agreed by the second joint minute.

<u>26(2)(d): The cause or causes of any accident resulting in the death</u>

[91] The Crown invited the court to find that the cause of the accident was attributable to six factors. The first two factors were taken together; the failure by thread stripping of the lock nuts supplied in the M24 fitting kit, and the lower grade strength of

lock nut supplied in that fitting kit. The third factor was the use of Grade 8 nuts on grade 10.9 studs. It was submitted that given the strength of stud, a grade 10 or grade 12 lock nut should have been selected; the failure to do this led to risk of premature failure of the locknut. The fourth factor was the failure of the tab washers, which due to their smaller size and thinness had deformed. This deformation of the tab washers could have started during the installation but was most likely to have occurred during the overload test as this was the heaviest load that the crane had lifted. Localised yielding of the washers was likely to occur in all cases and would reduce the preload on the fasteners, through normal use of the crane. The fifth factor was the use of the smaller M24 kit to install the crane and in particular the reduced strength of the tab washers. The sixth factor was the failure to order the correct fitting kit, with Mr Donaghue erroneously ordering components because he did not have access to Atlas U.K.'s computer programmes and did not realise that the Atlas 170 crane required an M30 kit. Atlas UK also failed to identify that the wrong kit had been ordered.

[92] Counsel for Inverlussa, PMG Services, and HI-AT and James Donaghue adopted the Crown's submissions; counsel for Atlas UK, Atlas Germany and Ross Hunter took no issue with them. Counsel for Walter Galbraith identified broadly the same causes of the accident albeit characterising them somewhat differently.

<u>26(2)(e): Precautions which (i) could reasonably have been taken, and (ii) had they been taken, might realistically have resulted in the death, or any accident resulting in the death, being avoided</u>

[93] The Crown submitted that it would have been a reasonable precaution to supply an M30 kit that contained (i) grade 10 lock nuts and (ii) twelve studs instead of eight.

[94] Counsel for Walter Galbraith and Ross Hunter took no issue with the Crown's submissions on this point, while counsel for HI-AT and James Donaghue adopted them. So too did counsel for Inverlussa, who further submitted that the company was entitled to expect that Atlas would supply the appropriate fitting kit; that it was entitled to rely on the knowledge and expertise of PMG and their subcontractors in carrying out the fitment and installation of the crane; and that it was entitled to rely on the knowledge and expertise of Mr Galbraith in carrying out his examination, as well as the report issued by him. Consequently there was no basis on the evidence before the inquiry that any reasonable precaution could have been taken by Inverlussa which might have prevented the accident.

[95] PMG Services did not offer any criticism of the Crown's submissions. It was submitted that there were no reasonable precautions that could have been taken by PMG that might have prevented the accident. Reference was made to John Holland's evidence that it had been prudent of Mr MacGregor, given his own lack of experience, to have engaged the services of Scott Turnbull; that there was nothing unusual or complicated about the installation to be undertaken; that it was entirely reasonable for Mr MacGregor to have assumed that the correct fastener kit had been supplied by the manufacturer; and that there was nothing about its components or dimensions that should have put him on notice that the wrong kit had been provided.

[96] It was submitted that it was also entirely reasonable that Mr MacGregor took comfort from the knowledge that a thorough examination by the manufacturer would be undertaken; and that the torque applied by Mr MacGregor was neither inappropriate nor excessive, a point on which Dr Hobbs also agreed, and was based on the application of sound engineering practice and principles. Reliance was also placed on Mr Holland's evidence that it would not have been reasonable to expect Mr MacGregor to have attended any thorough examination in the absence of invitation, a matter with which Mr Simpson also agreed.

[97] Finally it was submitted that there was nothing in the applicable standards or guidance which would have required PMG as installer to have done anything differently to what they in fact did. Having regard to standard engineering practice, what Mr MacGregor did in relation to the installation of the crane was consistent with what Mr Holland would have expected from a competent engineer.

[98] Atlas UK and Atlas Germany did not take issue with the Crown's submission but observed that the evidence allowed an inference to be drawn that had true grade 8 or |8| nuts been provided, rather than the substandard grade 6 nuts, then the crane might not have failed and caused death on 30 April 2015, albeit failure would still have been likely at an unknown later date.

<u>26(2)(f): Defects in the system of working which contributed to the death or any accident resulting in the death</u>

[99] The Crown submitted that there were two such defects. Firstly Atlas UK failed to have in place a robust quality assurance procedure which would have facilitated tracking of the various fasteners; and secondly Atlas UK failed to notice that the M24 kit ordered for the crane was incorrect.

[100] Counsel for PMG, Walter Galbraith and Ross Hunter took no issue with the Crown's submissions on this point, while counsel for Inverlussa, HI-AT and James Donaghue adopted them.

[101] Atlas UK and Atlas Germany did not dispute the Crown's submission "in so far as it goes". However it was submitted that regard should be had to evidence showing that Atlas UK sourced its fasteners from reputable suppliers. It was unclear how nuts of grade 6 strength had come to be marked as grade |8|, or how they had been accepted by a supplier as grade 6 notwithstanding their marking; but that process predated the acquisition of the nuts by Atlas UK and there was no evidence to suggest that Atlas UK was aware of the latent defect in that the nuts were weaker than their marking indicated.

[102] Regarding the failure to recognize that the wrong fitting kit had been requested, it was submitted that the systems of working of Atlas UK and Mr Donaghue had to be looked at "in tandem". Had Mr Donaghue requested the correct kit then there was no reason to doubt that that is what would have been provided. Mr Higson had been a highly competent parts manager, but it might be that following his operation his health had been a factor in not noticing the error[25]. However Atlas UK accepted that it should

[25] Mr Higson left the business on 18 November 2015 for health reasons.

have had a system of working in place to ensure that the correct kit was issued even if an incorrect request was received.

26(2)(g): Other facts relevant to the circumstances of the death

[103] The Crown identified three such facts. The first was the failure by Atlas Germany to provide installation instructions in line with its policy of not doing so for cranes being fitted on marine vessels. The Crown noted that Atlas Germany had declined to follow a recommendation on this point from MAIB and that the latter body had been satisfied with their explanation.

[104] The second relevant fact was that the M30 kit that should have been issued by Atlas UK in 2015 would have different components to the same kit issued now, since Atlas UK now followed Atlas Germany's recommendations in that regard.

[105] The third relevant fact was the lack of information given to Mr Galbraith by Atlas UK to assist with the thorough examination. Had he been given information regarding the type of crane and the fitting kit required he may have noticed that the wrong size had been used.

[106] These submissions were adopted on behalf of HI-AT and James Donaghue. Counsel for Inverlussa, PMG, Ross Hunter and Walter Galbraith took no issue with them. On the first aspect of the proposed Finding, Atlas Germany set out its position as to why it had not complied with the Recommendation and noted that the MAIB had accepted that explanation. On the other two aspects it adopted the position of Atlas UK.

[107] On behalf of the latter company it was submitted that Atlas UK's policy at that time had been not to provide installation guidance for marine cranes, since by its nature each marine installation was different. With the benefit of hindsight it was accepted that more information could have been provided, for example regarding which fitting kit to use, but even there the crane's buyer would require to specify bolt length and ensure safe installation. Although it was submitted that a fatal accident inquiry's purpose was not to determine criminal or civil liability for statutory contraventions, counsel nonetheless summarised the relevant statutory provisions and submitted that Atlas UK had not contravened any obligation laid upon it by statute.

[108] As for the Crown submission regarding the components of an M30 fitting kit now and in 2015, no issue was taken; Atlas UK had complied fully with the Recommendation that the MAIB had addressed to it. With regard to the lack of information provided by Atlas UK to Mr Galbraith it was pointed out that, as the Crown itself accepted, the inspection had been arranged by Raymond Allison and there was no evidence that Atlas UK was aware prior to 23 March 2015 that it was to take place.

Discussion

<u>26(2)(d): The cause or causes of any accident resulting in the death</u>

[109] There was no real dispute as to the cause of the accident. I accept the opinion evidence given by Mr Birkett and Dr Hobbs and concurred in by Mr Holland.

[110] The crane collapsed because its outboard fasteners failed due to thread stripping. That failure arose from the fact that the wrong size of fitting kit was ordered and

provided. The kit's tab washers were too weak, too small and too thin to properly perform their function or avoid deformation. Their deformation, and the freedom of movement and misalignment of the studs in the larger slots, allowed for movement in the joint and the loss of preload. These problems were aggravated by the fact that the nuts used were too soft and weak for the bolts that they were matched with, all of which led to an ongoing process of thread stripping of the nuts culminating in the failure of the fasteners.

[111] It was not submitted by any party that the torque applied to the fasteners was a cause of the accident. Although the torque applied on Mr MacGregor's direction was well above that recommended by Atlas UK, Dr Hobbs commented that the Atlas recommendation of 350nm seemed unusually low[26] and that the 600nm torque which had been applied was closer to what would be expected for that size and grade of stud. Mr Holland's report comments[27] that "Atlas' torque specifications are inconsistent within their own tables and assembly guidance" and he too in evidence commented that the Atlas recommendation was "unusually" and "extremely" low and indeed that he could not think of a valid engineering reason for it to be so low. I accept the evidence of Mr Holland and Dr Hobbs that the level of torque applied to the fasteners was not inappropriate and did not contribute to the failure.

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[26] This view was concurred in by Ian Simpson's Supplementary Report at paragraph 10.

[27] Paragraph 9.2.19

26(2)(e): Precautions which (i) could reasonably have been taken, and (ii) had they been taken, might realistically have resulted in the death, or any accident resulting in the death, being avoided

[112] I agree with the Crown's submission that it would have been a reasonable precaution to supply the correct grade strength of nut as well as additional studs, but I would approach the matter somewhat differently.

[113] The reasonable precaution, which if taken might have prevented the accident and the death, would have been to use the correct fitting kit to install the crane. With the benefit of hindsight - which a fatal accident inquiry is entitled to apply[28] - the correct fitting kit for this crane would have been an M30 kit with the components that Atlas Germany included in such kits at that time and which Atlas UK have since come to include in their M30 kits; in particular containing 12 grade 8.8[29] studs matched with 32 grade 8 nuts. If a kit of that kind had been used to install the crane on board the "Carol Anne" then it is beyond any doubt that this accident and the resultant death would have been prevented. I have therefore made a Finding to that effect.

[114] However the matter does not end there, because if in 2015 an "M30" kit had been ordered from or supplied by Atlas UK, it would not have had all of those components.

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[28] See Sheriff Reith's Determination following the inquiry into the death of Sharman Weir (issued on 23 January 2003 at Glasgow Sheriff Court, reproduced in Carmichael's *Sudden Deaths and Fatal Accident Inquiries*, 3rd edition, p.421, paragraph 11-17).

[29] The Crown's analysis seems to be that grade 10.9 bolts should be used. However that is not the grade of bolt that Atlas Germany used before the accident nor is it the grade that either Atlas company uses now.

In particular, it would only have had eight bolts of grade 10.9 strength, matched with eight grade 8 nyloc nuts and sixteen grade 8 plain nuts.

[115] Having regard to what is said in the foreword to BS 3692:2014 quoted above, as well as Mr Birkitt and Dr Hobbs' findings at paragraph 102 of their report, it seems clear that to use a grade |8| nut on a grade 10.9 stud increases the risk that thread stripping may take place. To a lesser extent this would also be true if a harder grade 8 nut were used, which is why the tables in the relevant standards do not recommend matching nuts of this strength with grade 10.9 studs.

[116] As against that, the other factors which contributed to thread stripping in this case - specifically the weakness of the tab washers, and the poor fit and misalignment of the studs in the channels - would not have been present if an M30 kit as defined in 2015 had been supplied. Mr Holland's report at paragraph 9.2.13 notes that:

> "M30 fasteners, being larger, are stronger than M24 fasteners of the same Class and therefore would normally have been less likely to have failed in the same loading environment, although the difference in Class of the fasteners that were supplied (i.e. Class 10.9 versus Class 8.8) would have negated this to a significant extent. Nevertheless the joint would have been stronger with the M30 fasteners, mainly because if the larger M30 fasteners (i.e. those that appear to have originally been selected by the designers of the crane) had been supplied and used, then the square tab washers provided with that kit would have been better supported by the side plates of the slots, as illustrated in Figure 2, creating a much more secure connection and considerably reducing the risk of a loss of clamping force due to dishing of the washers."

[117] Taking that into account together with James Smith's written statement that M30 kits - using grade 8 nuts on grade 10.9 studs - had been issued by Atlas UK since approximately 1999 without any issue arising from that, I conclude that if an M30 kit

with those components had been issued in 2015 then on the balance of probabilities it would not have failed.

[118] The reason why an M30 kit of that kind was not used was because Mr Donaghue ordered an M24 kit in error and Atlas UK did not recognize that error. Mr Donaghue's error arose from the fact he made an assumption as to the sort of fitting kit that the crane required. That assumption was based on his knowledge that larger cranes used an M24 kit, and there was a logic in assuming that this model of crane required the same kit. However, I consider that it would have been a reasonable precaution for Mr Donaghue to refrain from making an assumption, and instead to positively confirm the sort of kit that the crane required. Although he did not have access to the "dealer portal" on the website it would have been a simple matter for him to have telephoned Atlas UK and asked. As for Atlas UK, I consider that it would have been a reasonable precaution for it to have issued an M30 kit based on its own knowledge of the crane that it was supplying and that crane's requirements, notwithstanding the erroneous request made by Mr Donaghue.

[119] Had either of these precautions been taken then an M30 kit (albeit one of the type used by Atlas UK in 2015) would have been supplied and used, and both the accident and death could have been avoided. I have therefore made Findings to that effect.

[120] For completeness I should make clear that I do not accept that the accident might have been avoided if true grade 8 or |8| nuts - instead of the wrongly marked grade 6 nuts - had been part of the M24 kit issued. Instead I accept the evidence of Dr Hobbs and Mr Holland that the difference made by this would have been marginal.

[121] I accept the submissions made on behalf of Inverlussa, PMG Services, Ross Hunter and Walter Galbraith that there were no reasonable precautions that could have been taken by them which could have prevented the accident or death. As far as Inverlussa and PMG were concerned, the fitting kit was effectively being provided to them by the crane's manufacturer, and there was no reason for them to think it was unsuitable.

[122] John Holland gave evidence that oversize slots on a crane mounting are not unusual. His report[30] cites two models of crane, the PM 50024P and Jonsered 1088, which have slots "that are considerably wider than the fasteners that are used to mount them", and cites a third model, the Palfinger PK 18502 SH, which has slots sized to accept M30 fasteners but which can safely be assembled using M24 fasteners. Mr Holland's position on this point is concurred in by Ian Simpson's supplementary report of 21 December 2020.

[123] Given that M24 kits can be used to fasten cranes of this size or larger; given that slots can often be much wider than the studs used in them; given that the M24 kit appeared to fit this crane's channels; and, crucially, given that this was the kit that Atlas had sent out to fit an Atlas crane that was due to be examined later by an Atlas engineer, I do not consider that it would have been a reasonable precaution for Mr MacGregor or those assisting him to have queried the use of this kit.

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[30] Paragraph 9.2.20

[124] Once the fitting kit was used to install the crane, the only precaution that could have prevented this accident and the resultant death would have been for someone to inspect the fasteners and identify that they were the wrong ones for this model of crane. It would not have been reasonable for Ross Hunter's inspection of 8 April 2015 to inspect the fasteners; his inspection, conducted in terms of the Code of Practice, focussed on different matters.

[125] Similarly, the examination conducted by Walter Galbraith was intended to address a number of specific matters which were set out in the Atlas Crane Service Inspection/Thorough Examination Report matrix. Whilst that matrix includes reference to "Item Code 2 – Hold down bolts", the evidence before the inquiry suggests that refers to a check that the fasteners are in place and sufficiently tight. There was no suggestion in the evidence that the examiner was expected to check whether the fitting kit is the correct one for the model of crane. Mr Galbraith's own experience led him to expect to see an M24 kit; and, given that he was provided with no other information, there was no basis for him to query that.

<u>26(2)(f): Defects in the system of working which contributed to the death or any accident resulting in the death</u>

[126] I deal first with the Crown's proposed Finding regarding the lack of a robust quality assurance procedure. The submission relies on the evidence of Adrian Lambert and section 1.15.3 of the MAIB report. This explains the supply chain for the nuts following their importation from a Taiwanese manufacturer; and also details how, once

they arrived at Atlas UK they were not stored separately by batch but were "piled together" by type and size in bins. The only other relevant evidence on this matter is the written statement of James Smith. I accept Mr Smith's evidence that Atlas UK have always used reputable suppliers, and I wish to make it absolutely clear that there is no evidence that any part of the supply chain has dishonestly attempted to "pass off" fasteners as being of a higher grade than they truly were.

[127] Instead, what seems to have happened is that due to some error in the manufacturing process the grade 6 nuts were wrongly marked as grade |8|. However, at the point when they were imported into the UK, and again when they were later provided to Atlas UK's supplier, they were correctly described as grade 6. When the supplier provided them to Atlas UK the delivery invoices supplied with them described them as "M24 metric nylon insert nuts, type T, fine pitch, zinc, 2mm pitch". There does not appear to have been any reference to their strength grade at all, which may explain how they came to be taken at "face value" as grade |8| nuts[31]. There was no provision in the system of working for their apparent grade to be checked. Mr Smith's statement makes clear that since the accident Atlas UK now source all of their nuts from a single supplier; and crucially, they come with a certificate of conformity.

[128] I consider that had a system of the kind now in place been used in 2015 then the apparent inconsistency between the certificate of conformity and the nuts' markings would have allowed their true nature to be ascertained, and they would not have been

[31] Although Atlas UK's original order for plain nuts stipulated that they be grade 8.8, the accompanying order for locknuts does not appear to have mentioned grade at all – see MAIB report at section 1.15.3.

included in the kit issued for the Atlas 170 crane. Whilst true grade |8| nuts were themselves problematic for the reasons discussed above and would have been only marginally superior to grade 6 nuts, it is undeniable that the latter grade is weaker and more liable to thread stripping. The lack of rigour in quality assurance which allowed them to be sent out to fit this crane was therefore a defect in the system of working which contributed, at least to some degree, to the accident and the resultant death.

[129] With regard to the second defect identified by the Crown, Atlas UK accepted that it ought to have had a system of working in place to ensure that the correct fitting kit was issued even if the incorrect kit had been requested. As far as Mr Donaghue is concerned his mistaken order did not form part of a "system of working", but was instead a departure from his normal practice in which he would normally only specify the model of crane without detailing components. In other words whilst Mr Donaghue undeniably committed an error, it was not a systemic error, and it has already been addressed in the Finding made in terms of Section 26(2)(d) above.

[130] Finally, I consider that there was a third defect in Atlas UK's system of working which contributed to the accident and death, in that its system did not provide details of the appropriate fitting kits to the purchasers of marine cranes. I accept that there were valid reasons for the Atlas companies not to provide full installation guidance for marine cranes. The Atlas Installation Manual is designed for vehicle-mounted cranes, not marine cranes. I accept Mr Smith's evidence that each installation of a marine crane is different and that consequently, there could not be a standardised installation guide.

Presumably, this is why both European[32] and British[33] law exempt machinery on seagoing vessels from the general requirement that machinery must be accompanied by installation instructions.

[131] However, the type of fitting kit that a model of crane requires is the same regardless of whether it is for vehicular or marine use (albeit that in the latter case there may be variance regarding the length of the studs). Therefore, there was no reason why this information could not have been provided. In fairness to Mr Smith he conceded this at paragraph 37 of his witness statement.

[132] The failure to provide this information was a defect because it meant that, once the wrong kit was issued, no-one dealing with the crane thereafter had a way of identifying the problem. Outside of the Atlas companies, no-one else knew or could have been expected to know what sort of fitting kit was appropriate. Had information on the correct kit been provided to HI-AT or Inverlussa, it would have been passed on to Mr MacGregor and his team, who would then have been alerted to the fact that they had been given the wrong kit. The installation stage was the crucial one. Afterwards, when the fasteners had been put in place it would have been much harder for any visual inspection to identify the problem[34].

<u>26(2)(g): Other facts relevant to the circumstances of the death</u>

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[32] Directive 2006/42/EC ("the Machinery Directive"), Article 1(2)(f).

[33] Supply of Machinery (Safety) Regulations 2008, Schedule 3, paragraph 1(f), which incorporated the Directive into domestic law.

[34] Ian Simpson's report of 20 November 2015 comments on this, specifically on the fact that the markings on the studs and nuts denoting their grades would have been obscured.

[133] For the reasons set out, above I shall not make the first Finding sought by the Crown under this heading. Turning to the components of M30 fitting kits at the date of the incident, I consider that it was a fact relevant to the circumstances of the death that, until this accident took place, Atlas UK was unaware that its parent company used significantly different components in its kits. Atlas Germany, as manufacturer, was the ultimate authority on what equipment the interests of safety required. If the manufacturer considered that 12 bolts were necessary for marine cranes to be safely installed, then this ought to have been communicated to the subsidiary company which supplied such cranes to the UK and Ireland. Again, if Atlas UK had been aware that its parent company matched grade 8.8 studs with grade 8 nuts, then it would presumably not have continued its own practice of matching grade 10.9 studs with grade 8 nuts (which was in any event contrary to consensus standards). I consider that this fact affects the public interest in that it highlights the importance of disseminating best practice on safety matters within a group of companies.

[134] I agree with the Crown that it was also a relevant fact that Mr Galbraith did not have information regarding the sort of fitting kit to be used. As discussed above, I consider that this information should have been provided to the purchaser; had that happened, it could have been provided by the purchaser to Mr Galbraith as well as to the installation team. Like Mr Holland[35], I have some difficulty understanding how an examination aimed at assessing whether machinery has been safely installed can be said

[35] Report, paragraphs 9.3.6 and 10.6.

to be "thorough" when the examiner has no information regarding the fitting kit that should have been used to install it. As against that, the evidence of Mr Simpson suggests that once a fastener is in position there is limited scope for the examiner to see much of it, and it does not appear that examiners are trained to consider the type of fasteners used as opposed to their condition.

Recommendations

[135] I was not invited by any party to make recommendations in terms of section 26(1)(b) and section 26(4) of the Act. However, I am concerned that the investigation into how misleadingly marked locknuts came to be accepted into the supply chain has apparently been discontinued due to a breakdown in communication. It is not clear whether this problem with the locknuts was an isolated incident or is part of a wider issue. If it is the latter then there is some risk that another error as to the true nature of the locknuts might contribute to injury or death in similar circumstances. To address this risk and, notwithstanding the passage of time, I recommend that the HSE investigates how these incorrectly designated locknuts came to enter the supply chain, and whether any ongoing risk to safety arises from their importation.

Conclusions

[136] I asked the Crown for an explanation regarding the passage of time which has elapsed between the death of Jamie Kerr and the commencement of these proceedings. I was informed that, following the receipt of the HSL and HSE reports in late 2015, there

was a meeting between the Crown and the police at which the police were instructed to make certain further enquiries. Following the conclusion of those enquiries, a Standard Prosecution Report was submitted by the police to the Crown on 14 June 2016. Thereafter, consideration was given to potential criminal charges against certain participants in this Inquiry, and as a result there were discussions and correspondence between those parties and the Crown, as well as between the Crown, the police and the MCA. Crown Counsel initially issued an instruction on 18 December 2019 to the effect that no criminal proceedings should be raised and that a Fatal Accident Inquiry should be held. Following the engagement of the Victims' Right to Review scheme, a final instruction from Crown Counsel was issued on 6 January 2020 confirming the initial instruction. Progress was then hampered by the start of the pandemic. The case had been complicated by a number of factors, including the complexity of the engineering aspects, but notwithstanding this the Crown accepted there had been an unsatisfactory degree of delay and expressed its regret for that delay. New case management procedures are now in place which should prevent similar delays in future. I would respectfully ask the Crown to keep these procedures under continuous review to ensure that they achieve that aim.

[137] Finally, I would like to join the representatives of all parties in expressing my condolences to Jamie Kerr's family and loved ones. On the final day of evidence Mrs Crowe, on behalf of the family, asked if I would read out a statement that they had prepared, which described Jamie Kerr's life as well as the sense of immense and irreplaceable loss that they felt. I was glad to do so. There can be no doubt that

Jamie Kerr was a highly impressive young man who had achieved a great deal, and who held out great promise of further achievement to come. In his family's words, he left them nothing but great memories; they could not be more proud of him and all that he achieved. There is no better epitaph that any of us can hope to earn.

Sheriff Patrick Hughes

Oban, 26 April 2021