AIRCRAFT ACCIDENT REPORT 10/82

Accidents Investigation Branch

Department of Trade

Report on the accident to Bell 212 G-BIJF in the North Sea, south east of the Dunlin Alpha platform, on 12 August 1981

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ISBN 0 11 513514 6

Department of Trade
Accidents Investigation Branch
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28 January 1983

The Rt Honourable Lord Cockfield
Secretary of State for Trade

Sir,

I have the honour to submit the report by Mr L S H Shaddick, an Inspector of Accidents, on the circumstances of the accident to Bell 212 G–BIJF which occurred in the North Sea, south east of the Dunlin Alpha platform, on 12 August 1981.

I have the honour to be
Sir
Your obedient Servant

G C Wilkinson
Chief Inspector of Accidents

Accidents Investigation Branch

Aircraft Accident Report No. 10/82
(EW/C762)

Registered Owner and Operator:		Bristow Helicopters Ltd
Aircraft:	*Type:*	Bell
	Model:	212
	Nationality:	United Kingdom
	Registration:	G–BIJF
Place of Accident:		In the North Sea, approximately 1.3 miles south east of the Dunlin Alpha Platform Latitude 61° 15′ 18″ North Longitude 01° 37′ 46″ East
Date and Time:		12 August 1981 at 0435 hrs
		All times in this report are GMT

Synopsis

The accident was reported to the Department of Trade Accidents Investigation Branch by the operator and the investigation commenced the same day.

The accident occurred during a daytime flight, planned for VMC, between the Brent Field and the Dunlin platform in the North Sea. The helicopter encountered an area of reduced visibility and continued towards the Dunlin at a height of 200 feet until a decision was made to return to the Brent Field. During the turn, control of the helicopter was lost after the aircraft pitched 20° nose up and climbed to 300 feet with zero airspeed. It began yawing rapidly to the right and descending and struck the sea in an essentially level attitude. The single fatality and 13 survivors were retrieved by another helicopter and a rig support vessel after some 44 minutes. The wreckage was salvaged by the rig support vessel on the same day.

It is concluded that the accident was caused by the loss of control of the helicopter due to disorientation of the commander while attempting to fly in visual contact with the sea in conditions of very poor visibility.

1. Factual Information

1.1 History of the flight

G–BIJF was one of four Bell 212 helicopters based on the Treasure Finder semi-submersible rig located alongside the Brent Bravo platform in the North Sea. The helicopters were used in support of the offshore installations for inter-rig transport of personnel and freight and were also capable of providing emergency rescue coverage for the area.

The commander commenced his duty on the day of the accident at 0350 hrs in preparation for the first take-off at 0420 hrs. His initial flying task was to pick up 13 passengers from the nearby Treasure Hunter (located alongside the Brent Charlie) and take them to the Dunlin Alpha platform approximately 12 miles to the north. (A map showing the positions of the oil rigs is at Appendix 1.) Take-off from the Treasure Finder was uneventful and the commander reported to Brent Approach (located on the Cormorant platform) that the weather was overcast at approximately 1,500 feet with 10 kilometres visibility but that there was a line of weather to the north west with drizzle and a cloud base of approximately 500 feet. This was acknowledged by Brent Approach who replied that this weather had also just reached the Cormorant. The aircraft took-off from the Treasure Hunter at 0426 hrs and climbed initially to the normal inter-rig transit height of 500 feet and then let down to 200 feet before entering the drizzle at an IAS of 100 knots. The commander stated that the drizzle formed a belt and that after negotiating this there was an improvement in the weather until he was approximately 5 miles from the Dunlin. At this point there was a sudden deterioration in the visibility and the speed was progressively reduced to 65 knots. It was however, possible to remain clear of cloud at a height of 200 feet although visibility was such that it was necessary for the commander to cross-check the external visual references with the flight instruments. Brent Approach informed the commander at 0430:30 hrs that the Dunlin was reporting fog conditions and asked him if he required the Dunlin non-directional beacon (NDB) to be switched on. Initially the commander replied that he did not need the NDB because he had the Dunlin on the aircraft radar at a range of 2½ miles. After further consideration of the value of the NDB in giving a back-bearing if he did subsequently decide to turn back he then asked for the NDB to be switched on. With the NDB operating and identified the aircraft continued towards the Dunlin with the commander in visual contact with the sea. The commander was hoping for an improvement in the weather but at a range from the rig of 1¼ miles on the aircraft radar he decided to turn back by initiating a left turn at 200 feet and 65 knots with approximately 70% torque set, and he informed Brent Approach at 0432:50 hrs.

During the turn the pilot observed that the aircraft attitude was indicating 10° nose-up on the main attitude indicator and that the airspeed was decreasing through 20 knots. He armed the flotation equipment and applied a control correction but the aircraft climbed to 300 feet, reaching a maximum nose-up attitude of 20° and zero airspeed. The external visual references were much reduced at this height and during a subsequent instrument scan he noticed that the compass card was rotating rapidly anti-clockwise. At 0433:43 hrs he transmitted a distress message saying that he was 'disorientated in cloud unsure of position'. During the interval (approximately 53 seconds) between the start of this call and the impact the commander was unable to control the aircraft with the exception of maintaining a level attitude on the attitude indicator. He reported very heavy vibration and remembered seeing the rotor RPM at 90%.

Passenger opinion varies considerably as to the motion of the aircraft during the final minute or so of flight and also of the attitude of the aircraft at impact. The aircraft hit the water hard and immediately inverted with the cockpit and cabin rapidly filling with water. The main flotation equipment operated and the passengers escaped from the aircraft by opening the left main cabin door and by kicking out the windows in the right door. The pilot operated the jettison mechanism of his door and escaped by standing on his seat and detaching the door by pushing his back against it.

During the impact the liferaft broke free from its position on the starboard quarter door behind the pilot and was thought (incorrectly) by the passengers to have inflated in the cabin. They therefore inflated their lifejackets and tried to stay in contact with the floating aircraft. One passenger, who was the last to surface, was incapable of helping himself and in spite of assistance from the others drifted away from the wreckage. He was found dead on recovery.

The upturned helicopter and survivors were sighted at approximately 0519 hrs (some 44 minutes after the accident) by the rescue helicopter and the diving support vessel Stena Seaspread and were rescued soon afterwards.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	–	1	–
Serious	–	2	–
Minor/None	1	10	

1.3 Damage to aircraft

Although the aircraft primary structure was relatively intact the aircraft had suffered substantial damage as a result of the impact and the effects of immersion. Further minor damage was caused during recovery and the aircraft was beyond economical repair.

1.4 Other damage

None.

1.5 Personnel information

Commander:	Male, aged 27
Licence:	Airline Transport Pilot's Licence (Helicopters) valid until 18 November 1990
Helicopter type ratings:	Bell 47 Sikorsky S–61N Bell 206 Westland S–55 Series 3 Bell 212

Instrument rating:	Initial issue 12 April 1981
Medical Certificate:	Class 1 7 May 1981 valid until 30 November 1981
Certificate of test:	Bell 212 19 February 1981
Emergency and survival drill:	17 May 1981
Wet dinghy drill:	February 1980
Flying experience:	Total all types: 2277 hours Total helicopter: 2127 hours Total Bell 212: 497 hours Total instrument flying: 213 hours Total instrument flying on Bell 212: 10 hours 10 minutes Date of last instrument flight: 25 April 1981 Total flying during previous 28 days: 42 hours
Duty time:	Off duty 1410 hrs 11 August until 0350 hrs 12 August (13 hours 40 minutes) On duty 0350 hrs 12 August until 0435 hrs 12 August (45 minutes)

1.6 Aircraft information

1.6.1 Leading particulars

Manufacturer:	Bell Helicopter Company
Type:	Bell 212
Date of Manufacture:	1980
Certificate of Airworthiness:	UK Transport Category (Passenger) valid until 14 January 1982
Certificate of Maintenance:	Issued 13 July 1981 and valid for 330 hours or until 11 October 1981
Total airframe hours:	1,118 hours
Maximum weight authorised:	11,200 lb
Estimated weight at time of accident:	10,686 lb
Estimated Centre of Gravity (CG) at time of accident:	136.01 inches aft of datum
CG range applicable:	133.0 to 142.4 inches aft of datum

1.6.2 General description

The Bell 212 is a twin engined utility helicopter powered by Pratt and Whitney PT6T engines. The teetering main rotor is of conventional design and is controlled via the Bell flybar/damper system. The direction of rotation is anti-clockwise viewed from above. The collective and cyclic controls are each powered by tandem hydraulic cylinders pressurised by the aircraft's two independant hydraulic systems. The tail rotor pitch control is powered from the No 1 hydraulic system but can be operated in the manual mode in the event of a No 1 hydraulics failure. G–BIJF was fitted with the Bell stability augmentation system which operated in the roll, pitch and yaw axes. The system was signalled by rate gyros in the nose of the aircraft and was of limited authority. An attitude hold type of autopilot was also provided, which derived attitude data from the co-pilot's attitude indicating system. An interconnection between the collective and tail rotor pitch controls provided a degree of automatic compensation for main rotor torque.

Main rotor driving torque is displayed at each pilot's station by a combined indicator, which displays total torque as a percentage value and individual torque, in percentage terms, being delivered by each engine. The main transmission cannot cater for the maximum torque which can be developed by both engines together and a torque limiting system reduces engine power to prevent the nominal limiting torque value of 104% from being significantly exceeded. The torque limiting system cannot be overridden. The instrument fit included a large spherical display attitude indicator driven by a remote 3 axis gyro reference unit. An independent standby attitude indicator was also provided. The aircraft was equipped with the 'Decca' Navigation system and a radar altimeter. G–BIJF was configured to carry a total of thirteen passengers in the cabin. (The co-pilot's position was not used for the carriage of passengers.) The seating was arranged with a 4 man back-to-back sideways facing seat, known as the 'Metair' seat, immediately aft of the crew seats and a 5 man forwards facing seat across the rear of the cabin. Two pairs of sideways facing seats were located aft of the 5 man seat, one pair in each of the side wells outboard of the main gearbox tunnel. A plan of the seating positions is shown in Appendix 2.

1.6.3 Emergency exits

Normal access to the passenger cabin was via very large sliding doors on each side of the cabin, which when open, provided access to almost the whole length of the cabin space. These doors are vulnerable to jamming in an accident and emergency exits were provided in the form of four large windows, two in each sliding door. Earlier production standards necessitated turning a handle covered by a guard in order to jettison each window. G–BIJF was fitted with windows which could conveniently be kicked or pushed out of their frames and, by virtue of their size and ease of removal in emergency, were significantly superior to emergency exits commonly found in helicopters. The hinged crew doors could be jettisoned by the operation of levers adjacent to the doors inside the cockpit.

1.6.4 Emergency flotation equipment

The aircraft was fitted with an emergency flotation system comprising four inflatable floats, two on each side of the fuselage. Each float contained four separate gas cells. During normal service the floats were stowed, in their deflated state, in cylindrical packs attached to the fuselage sides just above the skids. Activation of the system, either automatically by the operation of float switches on the underside of the aircraft or manually via a lever in the cockpit, resulted in the discharge of nitrogen under pressure from a gas cylinder in the nose of the aircraft to each of the float packs. The inflation pipework was almost exclusively rigid stainless steel, which was routed internally. The exceptions were two short flexible pipes, one on each side of the aircraft, which externally bridged across from the fuselage pipework to the rigid manifold pipe on the float packs, and flexible hoses leading from the manifold pipes via non return valves to each of the gas cells.

1.6.5 *Safety equipment*

The helicopter contained the following items of safety and survival equipment:

(i) Inflatable liferaft

One RFD, Type 18U Mk 1, 18 man liferaft was contained in a valise which was stowed, on end, on a pedestal behind the pilot's seat and secured to the starboard quarter-door by a seat belt fitted with a quick release buckle. The mechanism of the inflation bottle was operated by a lanyard stowed inside the valise and the end of the lanyard was secured to a cargo tie-down ring in the floor immediately below the life-raft. The liferaft was intended to be launched through the right main cabin doorway and there was no means of releasing the liferaft from outside the aircraft. The life-raft contained a survival pack consisting of, amongst other things, 6 parachute flares, 6 day/night distress flares, first aid equipment and drinking water.

(ii) Lifejackets

Crew: The pilot was wearing a Beaufort Mk 15 military type lifejacket which operated satisfactorily.

Passengers: All the passengers were wearing RFD 50C Mk 5 or Mk 8 lifejackets which operated satisfactorily.

(iii) Emergency board

Located in the cockpit between and just to the rear of the pilot's seats was a readily detachable 'emergency board' on which were fastened a number of items including a BE 369 floating SARBE beacon operating on 121.5 MHz and 243 MHz. Neither the emergency board nor any of the equipment attached to it was recovered during salvage.

(iv) Personal locator beacon (PLB)

The pilot's lifejacket was equipped with a SARBE Mk 5 type BE 375 beacon for operation on 121.5 MHz. A speech facility was provided for use on 121.5 MHz or a pre-set alternate frequency, in this case 123.45 MHz, which was selectable by a rotary switch on the top of the unit.

An intermediate position of the rotary switch could be selected to switch off the unit. When selected to emergency (121.5 MHz) the beacon automatically transmitted a distinctive swept-tone radio beacon signal which could be heard faintly if the loud-speaker was held close to the ear. When selected to auxiliary (123.45 MHz) the equipment was in permanent receive mode (unless the speech transmit switch was depressed) and typical radio 'hiss' could be clearly heard from the loudspeaker. The range of transmission was reduced if the speech facility was used and further reduced if the alternate frequency was selected. The last inspection on the PLB was on 25 April 1981 and was valid for three months. However, a check made after the accident showed that the beacon's performance was normal and within the production specification.

(v) Underwater acoustic beacon

An underwater acoustic beacon, activated by water immersion and operating on 37.5 KHz, was fitted to the cabin roof immediately to the starboard of the main rotor gearbox. This equipment is normally used to locate sunken wreckage and therefore played no part in the search and rescue operation.

(vi) Survival suits

Company regulations required the crew of the helicopter to wear immersion suits for over water flights during the winter months, during summer for night flights, and at any time when the wind speed was forecast in excess of 35 knots. The commander was wearing a Musk Ox immersion suit. The passengers were required by their company to wear survival suits for flights beginning or terminating on the mainland. There was no requirement for them to be worn on inter-rig flights and the passengers were wearing working clothes and in most cases thermal jackets.

1.7 Meteorological information

SYNOPTIC SITUATION

The area was covered by a moist westerly airstream following the passage of a cold front.

FORECAST

No forecast was issued by the Meteorological Office for this flight but the following Terminal Approach Forecast (TAF), for the period 0500 – 2400 GMT, was produced by Ocean Routes and was used by the pilot:

Wind:	250°/30 knots
Visibility:	more than 10 kilometres
Cloud:	2 oktas stratus 600 feet
	7 oktas strato-cumulus 1,100 feet

and during the period 0500 – 1200 GMT a 30% probability of:

Visibility:	6 kilometres
Cloud:	4 oktas at 500 feet
Weather:	Rain

REPORTS

The majority of weather observations offshore are made by personnel who have little or no formal instruction in meteorological reporting. A routine observation made by Meteorological staff in the Brent Field at 0350 hrs was also used by the pilot:

Wind:	250°/17 knots
Visibility:	more than 10 kilometres
Cloud:	1 okta stratus 600 feet
	7 oktas strato-cumulus 1,000 feet

Air temperature: +13°C, dew point +11°C

During the hour immediately following the accident while the rescue operation was in progress, eye witnesses reported that there was patchy fog with visibility at times down to 150 metres and a cloud base of approximately 100 feet. The commander of the rescue helicopter reported that the sea was calm producing very little surface texture and that the visibility at times reduced to an extent that there was barely adequate visual reference for hovering. The accident occurred in daylight.

1.8 Aids to navigation

a) On the ground

Decca
Medium frequency non-directional beacon (NDB)

b) In the air

The aircraft was equipped with:

Very High Frequency Omni Range (VOR) - twin installation
Automatic direction finder (ADF)
Decca
Radar
Radio altimeter

The equipment was serviceable with the exception of the radio altimeter on the co-pilot's instrument panel but this was not a factor in the accident.

1.9 Communications

Within the East Shetland Basin Helicopter Flight Information Service Area (HFISA) aircraft were controlled by Viking Approach on 129.95 MHz. The sub-area of the Brent and Dunlin platforms was controlled by Brent Approach on 122.25 MHz. The Brent and Viking controllers were co-located on the Cormorant platform and G–BIJF was operating under the control of Brent Approach throughout. Speech recording equipment was operating on the Cormorant platform and the recorded RTF messages on 122.25 MHz were transcribed by the CAA Transcription Unit in Edinburgh. (An extract of the tape transcript is shown at Appendix 3.) The rescue helicopter was also operating under the control of Brent Approach but in addition was making extensive use of marine VHF to co-ordinate its movements with surface vessels in the immediate area of the accident. The marine VHF frequencies were not recorded. Although not necessarily required by UK regulations in force at the time the rig support vessels operating in the area were fitted, in addition to their normal radio equipment, with aeronautical VHF transceivers and some also had associated homing equipment although those vessels involved in the rescue were not fitted with homers.

1.10 Aerodrome and ground facilities

Not relevant

1.11 Flight recorders

None fitted and none required by UK regulations.

Critical portions of the ATC tape were frequency analysed in the AIB laboratory to determine the main rotor rpm of the helicopter during the final seconds of flight. The lowest rpm measured was 85%.

1.12 Wreckage and impact information

1.12.1 On site examination

The fuselage structure was very extensively damaged during the impact but there was no significant deformation of the cabin space. The lower fuselage skins were stoved in and the fuselage frames, keel members and cabin floor structure had suffered extensive damage. The vertical box members at the forward end of the cabin door apertures, which join the cabin roof and floor structures, were both crippled as a result of vertical 'g' loading. The lower fuselage skin did not have a high visibility paint scheme (to aid detection when floating inverted) but was painted plain white. The damage suffered by the rotor assembly, mast and gearbox was compatible with the main blades striking the water under considerable power. The tail rotor drive shaft had failed and there was flail damage to the shaft tunnel in the vicinity of the failure. The tail rotor was not damaged during the accident.

The pattern of damage sustained by the aircraft as a whole was compatible with an impact with the aircraft in a substantially flat attidue in roll and pitch, with little or no forward speed and a high rate of descent. There were no indications that the aircraft was rotating in yaw at the time of impact, but a water impact of the type which evidently occurred would be unlikely to leave positive evidence of fuselage rotation unless the yaw rate was extremely high.

Structural distortion had resulted in the collective levers being jammed close to the maximum pitch position and the yaw pedals being jammed close to the full left pedal position. The cyclic sticks were in the full forward full left stick position.

The emergency flotation bags were deployed from their stowages and the forward float on the left side was fully inflated. The floats on the right side of the aircraft were both deflated but there were no large tears or cuts. Some small punctures were found but there is little doubt that these were caused during the recovery of the aircraft onto the ship after the accident. The rear float on the left side was torn from its mounting during the recovery of the aircraft from the sea and its inflation state could not be determined.

The right cabin door was almost fully closed and could not be opened because of distortion at its upper edge. Both of the emergency kick out windows in the door were missing. The left cabin door was in the fully open position. The rear kick out window was missing but the forward window was still in position and there was no evidence to indicate that any attempt had been made to push it out of its frame. With the door in its fully open position, as found, both windows would be inaccessible from within the cabin. The pilot's door had been jettisoned and the co-pilot's door had been wrenched from its hinges and was missing.

All seats in the aircraft, except the unoccupied co-pilot's seat, were distorted in a manner indicative of high vertical 'g' loading. None of the seat distortion had presented a significant hazard to its occupant and all of the seats had remained securely attached to the floor and all harness attachments were secure. The distortion of the 'Metair' 4-man seat (seat numbers 1-4) occurred in a manner which would have probably attenuated the 'g' forces experienced by the occupants.

The roof head lining material and the air conditioning ducts attached to the roof in the area forward and above the 5 man seat became partially detached from the roof and hung down into the cabin space, restricting movement in the cabin. The dinghy pack support shelf had collapsed under vertical 'g' loading, and the dinghy pack had evidently slipped downwards out of its restraining strap, which remained secured. The dinghy lanyard was attached to a floor ring beneath the support shelf and the free end trailed over the top of the 4 man seat and out of the port cabin door.

1.12.2 Detailed examination of the wreckage

The detailed examination of the wreckage was concentrated in those areas of the aircraft which affect the aircraft's control characteristics or which affect survivability. During the examination of the aircraft as a whole no evidence was found of any defect or malfunction which could have caused, or contributed to the accident.

a) Flying controls and hydraulics

The flying control circuits and hydraulic systems had suffered extensive damage during the impact. Witness marks in the collective pitch circuit, which were produced during the initial stages of impact, corresponded to a collective pitch setting close to maximum. Similar witness marks in the yaw control circuit corresponded to a pedal position close to maximum left yaw. Witness marks in the cyclic pitch circuit were found to conflict with one another and no positive conclusion could be drawn as to the pre-impact cyclic pitch position. It was found that the position transducer in the fore and aft pitch circuit was bent at a position corresponding to an approximately neutral stick position, and there was indications that this had occurred early in the impact sequence, before the stick had moved to its final position. The interconnect link between the collective circuit and the tail rotor pitch circuit had been broken away by impact forces and was missing. Both hydraulic pumps and reservoirs were torn from their systems by the breakaway of the main gearbox. Following temporary repairs to those areas of the hydraulic systems which were damaged during the impact, the hydraulic systems were subjected to a combination of in-situ and bench checks. No evidence indicative of pre-impact malfunction was found.

All of the mechanical damage to the flying control circuits was consistent with the forces of impact and there was no evidence of any disconnection or other pre-impact malfunction.

b) Engines and transmission

Both the pilot's and the co-pilot's torque indicators were frozen at values indicating limiting (i.e. maximum) total torque, with balanced torque levels from each engine. The torque meter indicators were considered to be reliable indications that both engines were delivering sufficient power to activate the torque limiting system and consequently the power plants were not examined in detail.

The failure of the tail rotor drive shaft occurred at the middle of the centre shaft as a result of torsional overload in the normal drive direction. The drive shaft bearings and gearboxes were examined and found to be free turning with the exception of the intermediate gearbox which had suffered severe corrosion resulting from salt water ingestion during the ditching. The tail rotor was undamaged, but slight water impact damage to the under surfaces of the tail boom and horizontal stabilizer indicated that the tail rotor would, if it were turning at the time of impact, have dipped into the sea. The tail rotor is of substantial construction and visible damage might not necessarily be expected as a result of a light water strike.

c) Instruments and stability augmentation systems

The pilot's attitude indicating system was examined. The gyro reference unit had been damaged by sea water corrosion and could not be tested. The pitch adjustment potentiometer on the pilot's attitude indicator was also found to have suffered corrosion damage as a result of the entry of sea water. Following replacement of the potentiometer, bench checks were carried out and the display performed normally.

The rate gyro units, which control the stability augmentation systems, had suffered a main rotor strike during the impact and consequently it was not possible to carry out a performance check of this system.

d) Emergency flotation equipment

The emergency flotation system was found to have been activated automatically by the float switches. The nitrogen inflation cylinder had fully discharged and there were no significant leaks in any of the rigid pipework in the fuselage or on the float packs. The flexible pipe between the fuselage pipework and the manifold pipe on the right side of the aircraft was found to be ruptured. The pipe comprises an inner tube of a teflon type material, which forms the gas passage, enclosed by an outer sleeve of braided stainless steel wire. It was evident that the distortion of the lower fuselage had wrenched the flexible pipe to the extent that the inner plastic tube had ruptured. The leak rate of gas under pressure through the braided steel outer sheath, which was still intact, was substantial. The corresponding pipe on the left side of the aircraft had been wrenched in an identical manner, but although the inner tube was badly distorted it had not quite ruptured and did not leak. Following the repair of float punctures caused by the recovery of the helicopter, each of the starboard floats was test inflated via the inflation cylinder charging valve. All of the cells inflated correctly.

e) Safety belts

All the passenger seats were fitted with safety belts complete with quick release buckles. The safety belts were adjustable by pivoting the entire buckle in the same direction as that required to open the buckle release and then continuing to pull in the same direction to allow the belt to feed past the snubbing mechanism. This was basically a very similar action to that required to release the buckle. After salvage it was noted that with one exception all the passenger safety belts were unfastened. The one remaining safety belt, belonging to seat number 3 which was occupied by the single fatality, was found to be still fastened but adjusted to about 4 inches from maximum extension. Subsequent examination of this safety buckle showed that it was in working order. The belts were attached to securing rings on the seat frames by hooks and it was possible to reverse the entire belt so that the buckle operated 'left handed' rather than in the more usual 'right handed' manner. It was noted that, as found, five of the buckles were 'left handed' and the remainder (including the seat occupied by the fatality) were 'right handed'.

f) SARBE

The operation of the pilot's SARBE beacon was tested and the unit strip examined. Its performance was normal and within the production specification in all significant respects, even during a prolonged immersion in salt water. The unit's performance was re-checked, following a period of vibration in the manufacturer's environmental test laboratory, and was found to be unchanged.

1.13 Medical and pathological aspects

All of the survivors suffered to some extent from bruising, shock and exposure and two had sustained spinal injury as a result of the impact of the aircraft with the water.

Post mortem examination of the single fatality showed that the man died by drowning.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 Post ditching

As the commander and the passengers surfaced after evacuating the helicopter they found that it was floating inverted with the fuselage hanging at an angle in the water almost completely submerged but being prevented from sinking by the left flotation bags. Those that had not already done so inflated their lifejackets and swam to the aircraft and held onto the tail, flotation bags or left skid. At least one passenger was assisted in donning his lifejacket by the commander who was checking that the passenger lifejackets had all operated correctly. During this period one more passenger was seen to surface and was in obvious difficulties. The commander swam to this man and pulled out his lifejacket and inflated it after putting it over his head. The man was unable to help himself and was pulled back to the aircraft and prevented from drifting away by the commander. After a period, estimated at 15 minutes, the commander became concerned because of a deterioration in the condition of the man and with the help of some of the passengers was able to position the man higher up on the flotation bags where he was held by passengers who handed him over to one another as each became tired. There were several occasions when the lifejacket slipped over the head of the man and had to be replaced by whoever was holding him at the time. A short time before rescue the passengers were too exhausted to hold the man any longer and he started to drift away from the aircraft. There were also occasions when other passengers began to drift away from the aircraft and had to be retrieved by those who were less exhausted.

1.15.2 SARBE operation

Because of the inverted attitude of the aircraft the emergency board and the floating BE 369 beacon would have been well under water (assuming that they were in their normal position) and for this reason no attempt was made by the commander to recover the beacon. However, the commander operated his SARBE soon after surfacing and was then initially occupied with attending to the passengers. The weather was still very misty and when he heard a helicopter he climbed onto the aircraft into a position between the flotation bags. Having removed the SARBE transmitter from its pocket in the lifejacket he tried calling the helicopter using the speech facility on the distress frequency and then the auxiliary frequency of 123.45 MHz but received no reply. The noise of the helicopter faded and it was not until the Stena Seaspread was sighted immediately before rescue that the helicopter reappeared. With the helicopter in sight the commander again attempted to contact it using the SARBE and again he did not receive a reply. After the rescue was completed and the aircraft emergency equipment was being collected together on the deck of the Treasure Finder the crewman heard a SARBE transmission breaking through on his deck radio. Finding the commander's LSJ among the equipment he switched off the SARBE by turning the rotary switch to OFF and the breakthrough ceased.

1.15.3 Helicopter search

At the latitude of the Shetland Islands the ICAO Search and Rescue area boundary follows the Greenwich meridian. The Brent Field being well to the east of this line is therefore in the Stavanger area and the responsibility for SAR lies with the Norwegian authorities. However, the time taken by rescue helicopters based on mainland UK or Norway to reach the Brent Field is such that the probability of finding anyone alive during the winter months is minimal. For this and other reasons Shell UK have made arrangements for the helicopter operator to provide a search and rescue capability, which is not part of the formal UK SAR organisation, using the helicopters based in the Brent Field. On receipt of the commander's 'Mayday', Brent Approach immediately alerted the Dunlin stand-by vessel, Ben Gairn, and also a second helicopter which was on the Treasure Finder with the engines already running and preparing to start its daily flying programme. After fitting the rescue winch and collecting a winchman and winch operator the rescue helicopter took-off at 0443 hrs and flew towards the accident location which was estimated by Brent Approach to be 3 miles south of the Dunlin.

As the aircraft flew north it encountered an area of fog with the visibility as low as 150 metres making it necessary to fly at reduced speed and at heights as low as 50 feet in order to maintain visual contact with the surface. There were no SARBE transmissions heard on 121.5 MHz but at 0453 hrs, when 2½ miles south of the Dunlin, the helicopter reported that deflections of the homing pointer were indicating a SARBE to the east of them. After 5 minutes of attempting to locate the SARBE it appeared that the homer was giving spurious indications as a result of a breakthrough from the second VHF radio in the aircraft. This is a known characteristic of the homing equipment which could with advantage be brought more prominently to the attention of aircrews likely to use the equipment. Because of the lack of reliable SARBE indications a creeping line ahead search was started from 5 miles south of the Dunlin spanning the standard inbound and outbound tracks to and from that rig. The visibility was still variable and very occasionally improved to an estimated 800 metres. At 0519 hrs when in one of the clearer patches the survivors and the Stena Seaspread, which was by then co-ordinating the vessel search, were sighted at the same time as the ship called 'survivors in sight' on the marine VHF which was being monitored by the search helicopter.

1.15.4 Rescue

On approaching the survivors the rescue helicopter crew noted that the survivors were, with the exception of one man, close to the flotation bags and were waving and gesticulating. One man was floating some 20 metres from the aircraft and in view of the fact that he was showing no signs of life he was rescued first using a double lift and taken to the Stena Seaspread immediately. The helicopter then lowered the winchman into the water with a 4 man liferaft which he held onto while assisting one of the survivors into the lifting strop. He then inflated the liferaft but this subsequently drifted away as he hurriedly prevented another survivor from drifting away. After the second survivor had been lifted the helicopter moved to one side as the rescue boat could be seen approaching. The winchman who was still in the water noticed under the water the securing line of the 18 man liferaft belonging to G–BIJF and when he pulled the line towards him the liferaft, still in its valise, appeared from under the flotation bags. He inflated it and then helped one survivor into it. The rescue boat had by this time arrived and picked up all the remaining survivors and the winchman and took them to the Stena Seaspread where they received medical treatment.

1.16 Tests and research

SARBE trial

During the investigation it became evident that tests had not been carried out to determine the range at which rescue beacons in general could be detected at altitudes below approximately 1,000 feet and that little formal information was available. A short trial was therefore arranged in the Brent Field with a SARBE Mk 5 of the same type as that used by the commander of G–BIJF and using Bell 212 G–BARJ, the aircraft which was actually involved in the rescue. This aircraft was fitted with a Chelton Series 7 Homer which operated on signals received from the No 1 VHF radio, a KTR 900A. This radio, like many similar types of equipment, had an automatic squelch control incorporated in its circuitry to suppress weak signals and therefore eliminate constant and unwanted 'noise' during normal operation. This automatic squelch control could be removed by pressing a test button on the radio controller and this allowed all incoming signals (and 'noise') to be heard and also passed onto the Chelton Homer. With the radio operating normally the squelch was found to suppress distant (i.e. weak) SARBE signals which were therefore neither heard in the headset nor received by the Chelton Homer. The graph at Appendix 4, giving the results of the trial, shows the effect of the squelch control on the detection range of the SARBE beacon. The automatic squelch control was removed only while the test button was being pressed. If this button was changed to a switch it could be left in the squelch out position during homing procedures and would therefore require no further attention.

It was not possible in a limited trial of this nature to measure the effect upon the detection range of using the speech facility on the SARBE Mk 5. The manufacturer advises that the power output of the equipment in the 'beacon' mode is a mean 200 milliwatts (MW) and that this is reduced to 50 MW minimum if the speech facility is used. This clearly would result in a considerable reduction in detection range.

1.17 Additional information

1.17.1 Instrument flying requirements

The shuttle-type flights which were carried out by the Brent based Bell 212 helicopters were always conducted as VMC operations and the accident flight was planned to be in this category. The minimum licensing requirement for the flight, therefore, was a Commercial Pilot's Licence (Helicopters)(CPL(H)). The requirements for the issue of a CPL(H) included at least 10 hours instruction in instrument flying in a helicopter and the candidate then had to pass the instrument flying section of the General Flight Test which included, amongst other items, recovery from unusual attitudes.

There was no legal requirement for the pilot of the flight to hold an Instrument Rating. However, it was a characteristic of the contract for these operations that the operator was required to ensure that its pilots were instrument rated. Notwithstanding the legal requirements for pilot licensing, Bristow Helicopters' policy also was to train all North Sea commanders to full Instrument Rating standard and all co-pilots to at least Instrument Base check standard. In order to obtain a helicopter Instrument Rating a pilot had to meet the flying experience requirements laid down in the Aeronautical Information Circular (AIC) 26/1980 or have completed a course of training approved by the CAA. An approved course would have covered procedural instrument flying but not necessarily have included instruction in recovery from unusual attitudes. The pilot then had to pass the Instrument Rating Test (IRT) which was entirely procedural and largely conducted in controlled airspace.

The retention of the pilot's instrument flying competency depended mainly on the Instrument Meteorological Conditions (IMC) line flying experience gained during the period between the annual IRT renewal and the six-monthly IMC Base Checks. The nature of North Sea operations dictates that the majority of instrument flying experience is also procedural and there are therefore few North Sea pilots who have the opportunity to practise basic instrument flying manoeuvres and recovery from unusual attitudes.

1.17.2 Crew strength requirements

G–BIJF, with the type of autopilot fitted, was certificated for flight by a single pilot in both VMC and IMC outside controlled airspace provided that take-offs and terminal approaches were made under visual flight conditions. Under day VMC a single pilot flying offshore was authorised by company regulations to continue in a minimum cloud base of 300 feet and visibility of 1 km with a minimum operating height of 200 feet. Also by company regulations, in order to fly in IMC for Public Transport, the commander was required to have recent experience of not less than two hours actual or simulated instrument flying during the previous 60 days.

1.17.3 British Civil Airworthiness Requirements (BCARs)

1.17.3.1 The following extracts from BCARs were current at the time of the accident:

a) Emergency Alighting on Water (G3-5 paragraph 7.3)

'The rotorcraft, together with any equipment fitted for emergency alighting on water shall achieve an Ultimate Factor of Safety of 1.0 on the loads arising from impact with the water at a vertical velocity of 1.5 m/sec (5ft/sec), and a forward speed equal to two-thirds of the best autorotational descent speed (Vy) and with angles of yaw up to 15°.

NOTE: This requirement is intended to cover the strength of any emergency flotation gear and its attachment to the aircraft structure. However, where no such gear is required it may be assumed that rotor lift is equal to the rotorcraft weight.'

b) Landing Gear Design – Energy Absorption (G4-5 paragraphs 3.1 and 3.2)

'3.1 Limit Case. The design of each unit of the landing gear shall be such that it is able to absorb without permanent deformation the energy equivalent to a vertical velocity of descent at touch down:-

a) for single-engined rotorcraft, 2.6 m/sec (8.5 ft/sec), or the maximum probable vertical velocity of descent likely to occur at ground contact in a normal power-off landing if less, but not less than 2.0 m/sec (6.5 ft/sec).

b) for multi-engined rotorcraft 2.0 m/sec (6.5 ft/sec)

3.2 Ultimate Case. The design of the landing gear shall be such that it is able to absorb 150% of the energy of 3.1, without failure.'

1.17.3.2 The following extracts are from BCAR Chapter G6-6 (Liferafts and escape chutes/slides), issued 17 December 1980:

a) '2.1 General

The location of liferafts and their method of release shall be suitably chosen in relation to the ditching and flotation characteristics of the rotorcraft, and escape facilities of the rotorcraft, and the disposition of the occupants.'

b) '2.2.2

The design of the installations shall be such that, in emergency conditions, the liferafts can be launched quickly, the right way up, and clear of any obstructions liable to foul or damage them during launching and during boarding.'

c) '2.4.2 Manual Launching

a) Where launching is by hand, the necessary actions shall be within the capacity of an untrained person of average strength, and shall not require exceptional agility or skill.'

1.17.4 Passenger briefing

The passengers were given a briefing on helicopter emergency procedures on the mainland before embarking for the flight to the rigs at the beginning of their tour of duty. Several of the passengers had also completed (or were booked onto) a course in helicopter safety run by the Robert Gordon's Institute of Technology. This course includes instruction in helicopter emergencies and survival, dinghy drill and in some cases practical training in underwater escape. In addition oil company personnel received safety briefings on individual rigs and although there was no specific helicopter briefing for the inter-rig flights there was no lack of safety posters on the rigs. There was a good general awareness of helicopter safety matters among the passengers.

2. Analysis

2.1 Cause

Three possible causes for this accident have been considered; mechanical malfunction, autopilot or instrument malfunction, and disorientation of the pilot.

a) The most probable mechanical malfunctions which could have produced the attitude and airspeed changes described by the aircraft commander are a failure of the tail rotor drive or a fault in the flying controls. Examination of the wreckage revealed considerable damage to the flying controls in the area of the main rotor gearbox and the lower fuselage area, but no evidence was found of any pre-impact malfunction. The ability of the commander to maintain a level attitude during the descent also supports the view that the primary flying controls were functioning correctly to the time of impact. The tail rotor, tail rotor gearbox, pitch control mechanism and control runs were found to show no signs of pre-existing failure, although the intermediate gearbox was badly damaged by the effects of salt water immersion. The tail rotor drive shaft had failed in torsional overload in the normal drive direction, but the failure was entirely consistent with the tail rotor having entered the water, thus creating excessive loading on the shaft. There was no further evidence of pre-impact malfunction which could have caused or contributed to the accident.

b) Autopilot or instrument malfunction

Flying in conditions of such poor visibility at low altitude requires the pilot to be positively handling the flying controls and to be constantly cross-referring from external visual references to the flight instruments. Any malfunction of the autopilot should have been detected and the aircraft controlled without difficulty. It is also unlikely that a failure of the main attitude indicator would occur unnoticed, particularly as the stand-by attitude indicator is close to the primary instrument. Furthermore the commander stated that he was able to stabilise the aircraft in pitch and roll and maintain a level attitude on the attitude indicator until the impact which the examination of the wreckage confirms was essentially in a level attitude. It was not possible subsequently to carry out tests of the complete autopilot or flight instrument system because of the damage caused by salt water immersion. However, those elements which could be tested were found to function correctly and the probability of a malfunction of either the flight instruments or the autopilot occurring just at the point where the aircraft was turning back in adverse weather is extremely remote.

c) Disorientation

During the one hour period immediately following the accident, ships in the area and the helicopter involved in the rescue all reported that the visibility was variable with patches down to 150 metres. The commander of the rescue helicopter also stated that the sea was calm with little surface texture and that when the visibility was at its lowest there was barely adequate visual references for hovering. The Dunlin platform reported at 0426 hrs that they were in fog and this information was passed onto the aircraft when it was approximately 2½ miles south of that platform. At that time the aircraft had encountered an area of decreasing visibility to the extent that the aircraft commander had had to reduce speed to 65 knots at 200 feet above the sea in order to maintain visual contact with the surface. Marked differences in the statements taken from the passengers aboard Juliet Foxtrot as to the initial direction of turn of the aircraft, the direction in which the aircraft was spinning when out of control, and the attitude of the aircraft at impact also suggest that the visibility at the time of the accident had reduced visual cues to a minimum. Such conditions can be conducive to pilot disorientation and the most probable explanation of the sequence of events is as follows. While in a left turn at 65 knots the aircraft was allowed to adopt a nose-up attitude which resulted in the airspeed reducing to zero and the height increasing from 200 to 300 feet. Having lost the directionally stabilising influence of the airspeed the torque reaction yawed the aircraft to the right at a time when external visual cues were further diminished due to the increase in height. The aircraft started to descend and the rotation to the right was accelerated as the commander then attempted to arrest the rate of descent by applying power. Collective pitch was increased until the torque limiting mechanism prevented further increases in torque and additional application of collective pitch resulted in overpitching down to at least 85% main rotor rpm with an associated reduction in tail rotor control power. From this position recovery was not possible without considerable loss of height and the aircraft continued to descend with a level attitude being maintained by the aircraft commander until water impact.

2.2 Torque limiter

With the collective pitch applied by the commander after the airspeed had dropped to zero, the aircraft's rate of descent should have been arrested, albeit by exceeding the transmission torque limitation. However, with a torque limiter, whose effect is to reduce engine power and consequently main and tail rotor rpm if 104% torque is exceeded, application of this amount of collective pitch resulted in a decrease of main rotor thrust and loss of yaw control. Torque applications in excess of the present limiter setting should be studied to determine the effect on the aircraft and transmission with a view to either removing the torque limiter or increasing the setting at which it operates. This should provide a greater reserve of power for emergency situations but it may also be advisable to fit a torque/time recorder to measure the size and duration of transients occasionally experienced in service.

2.3 Instrument flying training and testing

It is possibly significant that the commander of G–BIJF, through no fault of his own, had not flown on instruments for over three months prior to the accident. The inter-rig shuttle-type flights on which the helicopter was engaged were planned as VMC operations and therefore there was no requirement for the pilot to be instrument rated. However, over the North Sea and other areas that experience similar rapid and unpredictable weather changes, it is always possible that an aircraft will inadvertently enter conditions which preclude flying by visual references. These conditions when met over the sea where ground features are absent and to the eye the sky and surface seem to merge, are the sort of conditions which can induce disorientation. Therefore it would seem essential for the pilots to be sufficiently proficient in instrument flying to be able to remain in control of their aircraft until VMC can be regained. In order to achieve this standard they should be given not only training in basic instrument flying, including recovery from unusual attitudes, but also be given sufficient opportunities later for practice in order to retain their proficiency. The experience needed before a Commercial Helicopter Pilot's Licence can be issued goes some way to satisfy these requirements but once the licence has been obtained there is no further obligation on the pilot to demonstrate his continued ability to fly on instruments.

It is not the intention here to suggest that all helicopter pilots who fly on VMC operations should hold Instrument Ratings although it is clear that the advantages of having such a qualification in areas where weather plays a major part have already been recognised. For example, the operator of the helicopter was required by the terms of its contract to ensure that its pilots were instrument rated and it was indeed the operator's policy to train all North Sea captains to full instrument rating standard. However, the Instrument Rating largely involves procedural flying practices and the use of radio navigational aids and may not perhaps be the most suitable means of ensuring that competency in the more extreme elements of instrument flying practices is maintained. There are advantages in being instrument rated, however, in that the pilot is required to demonstrate his skills not only during a demanding initial test but also later at regular intervals and also that the pilot cannot exercise the privileges of the rating unless he has complied with a stated currency requirement. All public transport pilots are required to take biannual flying checks and it is suggested these flights provide a good opportunity for both training and testing. Consideration should therefore be given to see whether the contents of these checks can be extended to ensure continued competency in instrument flying including recovery from unusual attitudes and inadvertent entry into IMC.

2.4 Meteorological observations

The pilot was advised during the flight that the Dunlin was 'in fog'. Although obviously giving a warning of adverse weather conditions, the term 'fog' gives a pilot no indication of the actual visibility except that it can be expected to be below 1 km. The pilot of G–BIJF had already passed through a narrow band of drizzle and he considered that the reported fog might also prove to be of a localised nature. It would obviously be an advantage if some means of defining the actual visibility could be introduced on the rigs. There is also widespread use of untrained meteorological observers in the North Sea and it would seem to be an advantage in providing the best possible weather service if Helicopter Landing Officers and others responsible for providing weather reports could attend one of the short courses in weather reporting that are available.

2.5 Crew strength

For this particular North Sea operation and other operations on different types it has so far been accepted that the carriage of two pilots on day VMC flights is not necessary. G–BIJF was being flown by a single pilot in VMC who attempted to turn back when he encountered adverse and deteriorating weather and became disorientated in the turn. However, if the aircraft had been operated with two pilots whose responsibilities were divided so that one was permanently 'on instruments' it is probable that the accident would have been prevented. It is not intended here to examine all the factors which are relevant to the question of how many pilots should be carried on such operations but simply to suggest that this aspect should be reviewed by the CAA.

2.6 Location and search aspects

Of the two emergency radio beacons in the accident helicopter the BE 369 beacon was lost thus leaving available to the survivors only the SARBE Mk 5 in the lifejacket of the commander. If the commander had been incapacitated by the impact there would have been no emergency beacon to guide rescue ships and aircraft to the wreckage. A way to overcome this failing would be to require public transport helicopters of this size to be fitted with an emergency beacon which is automatically deployed on immersion in water, or by impact forces.

The performance of helicopter VHF homing equipment when used at heights below approximately 1,000 feet was relatively unknown and the inhibiting effect on the Chelton Homer of the pre-set squelch within the main VHF radio was not generally appreciated. The subsequent trial showed (Appendix 4) that with the squelch disabled (by pressing the test button) the test helicopter at 50 feet could detect a SARBE in the sea at about 8 nautical miles, whereas, with the radio operated normally the pre-set squelch reduced the detection range to 2 nautical miles or less.

It is likely that the survivors in the water would have heard the rescue helicopter at ranges greater than 2 nautical miles and it was when the helicopter was within earshot that the commander of G–BIJF operated the SARBE speech facility (thereby reducing the power output of the transmitter and therefore the range at which detection was possible) and then changed to the auxiliary frequency to try and establish radio contact. The auxiliary frequency of 123.45 MHz was not monitored by the rescue helicopter and neither could it be expected to do so while operating under the control of Brent Approach and also monitoring 121.5 MHz. It is not known when the SARBE was switched back to 121.5 MHz although it was found on this frequency when the safety equipment was subsequently collected together. There was, therefore, a period during which the SARBE was selected to a frequency which was not being monitored by the rescue helicopter. This could account for the fact that no SARBE signals were received and underlines the necessity for rescue beacons to remain selected to 121.5 MHz. In addition the speech facility should not be used until the survivor is certain that he has been located.

The weather during the search phase was marginal for the operation of the rescue helicopter and further deterioration would have made rescue possible only from surface vessels. The rig stand-by and support vessels involved in the rescue had difficulty in locating the survivors and although the ships were fitted with aeronautical VHF they did not have the associated homing equipment. The combination of an automatically ejected emergency beacon deployed from the crashed helicopter, and 121.5 MHz homing equipment on the stand-by vessels should have enabled at least one vessel to reach the survivors within 15 minutes of the accident even allowing for the poor visibility. This aspect of the rescue was discussed with the Marine Division of the Department of Trade with a recommendation that stand-by vessels be fitted with aeronautical VHF communications and homing equipment. The stand-by vessel code has now been amended to incorporate this requirement with restrictions being placed on the use of the 121.5 MHz frequency for transmission purposes.

2.7 High visibility paint scheme

AIB Report 8/78 recommended that high visibility paint schemes should be used to facilitate location after ditching. Although there is no evidence to suggest that the plain white underneath of G–BIJF made detection more difficult a more conspicuous paint scheme could only have been beneficial.

2.8 Survival clothing

After some 44 minutes immersed in sea water at +13°C some of the passengers were close to exhaustion and had to be prevented from drifting away by other passengers. If the accident had occurred during the winter or spring months there would have been an increased probability of additional fatalities due to hypothermia since the passengers would not have been wearing survival suits. Although it is appreciated that there may be practical difficulties in providing all passengers with survival suits the recommendation of AIB Report 8/78 that 'both crews and passengers in helicopters operating over cold water should wear anti-exposure clothing' must be considered seriously if needless fatalities are to be prevented.

2.9 Liferafts

The survivors made no attempt to locate the 18 man liferaft, probably because several of the passengers thought (incorrectly) that it had inflated inside the cabin on impact, but it is likely that, because it broke away from its stowage, it could have been retrieved. However, if it had remained stowed in its proper position it would have been impossible for either passengers or crew to reach and release it because of the attitude of the aircraft in the water. A second life-raft stowed on the opposite side of the fuselage would have been much more accessible and with the use of an externally operated mechanism would have been readily deployed. The carriage of two liferafts has the additional advantage that it provides a back-up should one become damaged during launching. There is a definite possibility that a helicopter will come to rest floating inverted after an emergency landing on water and ideally, therefore, the provision of two liferafts deployable from either inside or outside regardless of the attitude of the helicopter would enhance the chances of survival of crew and passengers. These considerations have previously been discussed with recommendations in AIB Reports 11/71 and 8/78.

Since the issue of BCAR chapter G6-6 on 17 December 1980, the design of liferaft installations must ensure that liferafts can be launched in emergency conditions without being damaged and, in general terms, this appears to cover the situations discussed above. It is considered, however, that the requirements could be strengthened with advantage by emphasising the risk of the helicopter taking up an inverted attitude and also by highlighting the advantages in having more than one liferaft. It is possible that future helicopter designs will incorporate built-in liferaft stowages but in the meantime it is recommended that the conditions of BCAR G6-6 should be made retro-active to include present helicopter types.

2.10 Safety belts

The fact that five of the seat buckles were 'left handed' did not appear to create a problem in this accident, and the single fatality was sitting in a seat with a 'right handed' buckle. However, it is possible that in attempting to release the buckle the passenger, instead of just lifting the release lever, pulled the entire buckle in the correct direction thus extending the belt sufficiently to enable him to wriggle free eventually. It is considered desirable that the 'handing' of seat belts and buckles should be standardized and that the design of the buckle should be such that the possibility of confusion between the release mechanism and the method of adjustment is minimised.

2.11 Emergency flotation equipment

The extent of the failure of the flotation equipment is itself uncertain because the inflation state of the left rear float could not be determined. What is clear is that the right side did not inflate at all whereas the left floats did inflate to some extent. There can be little doubt that the incorrect inflation resulted from the rupture of the right flexible pipe between the fuselage and the float pack. It is also apparent that the corresponding pipe on the left side of the aircraft was also on the point of failure, and had this occurred, the survivors would have been deprived of their primary means of support. There is clearly a shortcoming in the impact strength of these pipes when compared with the rest of the float system and with the general strength of the cabin.

It is probable that the rate of descent was rather greater that the 1.5 m/sec vertical velocity requirement in BCARs, but the forward speed was much less than the BCAR forward speed component of 2/3 optimum autorotation speed. It is difficult to assess the actual yaw angle at impact compared to the quoted 15°. The fact that the left inflation tube did not quite fail suggests that, if the descent rate had been slightly less, the right tube may also have survived and it could therefore be argued that the system probably met the requirements laid down in BCARs. However, the adequacy of the BCAR requirements does require examination.

Given that autorotation would typically be in the order of 1,800 to 2,000 ft/min and taking into account the known difficulty of judging height over the sea, there is clearly a greater risk of misjudgement of height during ditching than there is during an autorotation over land. The difference between the BCAR requirements for emergency flotation equipment and those for undercarriages, which must withstand rates of descent almost twice as great, is therefore difficult to understand. It would appear that the BCAR requirement for vertical rate of descent is probably too low to be of practical value during a ditching, as opposed to a precautionary landing on water, and it is recommended that the strength criteria detailed in the BCARs covering emergency flotation gear be reviewed.

2.12 Observations

The commander alerted ATC that he was about to ditch and his position was known to be close to his destination rig. The SAR helicopter was dispatched without delay and had only 13 miles to run to the estimated crash position. Several ships were close at hand and immediately joined the search. Those taking part in the rescue carried out their duties expeditiously and diligently and yet 44 minutes elapsed before the crashed helicopter was located and the recovery of the survivors began. By that time they were seriously affected by their immersion in water and close to exhaustion. These circumstances highlight the importance of the comments which have been made in this analysis regarding action to safeguard those taking part in North Sea operations.

3. Conclusions

(a) *Findings*

(i) The helicopter had been correctly maintained in accordance with an approved maintenance schedule and was correctly loaded.

(ii) No evidence was found in the helicopter of any defect or malfunction which could have caused or contributed to the accident.

(iii) The commander was properly licensed to carry out the flight. He held a valid Instrument Rating although the legal requirements for the flight did not require this qualification.

(iv) The pilot's reactions to his initial disorientation was probably affected by his lack of recent instrument flying practice. The requirements for periodic instrument flying training and testing did not include basic instrument flying manoeuvres or the recovery from unusual attitudes.

(v) The emergency flotation equipment did not inflate correctly because the flexible pipe to the right float pack was ruptured during the impact. The corresponding pipe on the left side was severely distorted and had this pipe ruptured the aircraft would have sunk.

(vi) The liferaft support shelf had collapsed as a result of the vertical 'g' loading at impact and the liferaft had slid downwards and out of its restraining straps.

(vii) The pilot's SARBE beacon was serviceable after the accident but it was not possible to determine why its signals were not received by the rescue helicopter. The effect of the squelch function on the homing equipment and the use of the alternate frequency on the beacon itself by the pilot are probable reasons.

(viii) The emergency board on which was attached the SARBE floating beacon was not available to the survivors. There was no facility to automatically deploy the SARBE and neither was there a requirement that there should be.

(ix) Had the aircraft been fitted with an automatically deployed emergency beacon and if all the stand-by vessels had been fitted with the associated homing equipment the nearest stand-by vessel should have been able to reach the survivors within 15 minutes.

(x) None of the passengers was wearing a survival suit and if the accident had occurred in the winter months it is probable that there would have been more fatalities due to hypothermia.

(b) *Cause*

The accident was caused by the loss of control of the helicopter due to disorientation of the commander while attempting to fly in visual contact with the sea in conditions of very poor visibility.

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Bas 95874/R151 750 3/83 TP

4. Safety Recommendations

It is recommended that :

4.1 The 6-monthly base check requirements be modified to include basic instrument flying and the recovery from unusual attitudes and inadvertent entry into IMC.

4.2 Consideration be given to a review of instrument flight recency requirements and company procedures for ensuring their compliance within helicopter companies.

4.3 Public transport helicopters be fitted with an emergency beacon which is automatically deployed on immersion in water or by impact forces.

4.4 An Aeronautical Information Circular (AIC) be issued giving advice on the correct use of emergency locator beacons and the inhibiting effect of squelch control settings on some homer installations.

4.5 High visibility paint schemes be applied to helicopters to facilitate location after ditching, particularly if the aircraft is floating inverted.

4.6 The conditions of BCAR Chapter G 6-6 (Liferafts and escape chutes/slides) be made retro-active to apply to all present helicopter types and attention drawn in the introduction to the probability of the helicopter capsizing.

4.7 The requriements for the number of liferafts on helicopters be reviewed to provide for the possibility that a single liferaft may become unusable because of damage.

4.8 The dinghy support structure on the Bell 212 be modified to prevent collapse of the shelf and subsequent break-away of the dinghy pack.

4.9 The crew strength requirements for North Sea operations be critically reviewed.

4.10 Passengers in helicopters operating over cold water be required to wear anti-exposure clothing. (The attention of the Department of Energy is drawn to this recommendation).

4.11 The feasibility of using a higher torque limiter setting in the Bell 212 in conjunction with a torque/time recorder be studied.

4.12 The adequacy of the 1.5 m/sec vertical rate of descent component, required by the BCARs covering the strength of emergency flotation equipment, be reviewed.

4.13 The flexible pipe on the Bell 212 emergency flotation equipment be modified to permit a greater degree of structure distortion before the pipe ruptures.

4.14 Consideration be given to providing Helicopter Landing Officers and other personnel responsible for making weather observations with formal meteorological training. (The attention of the Department of Energy is drawn to this recommendation).

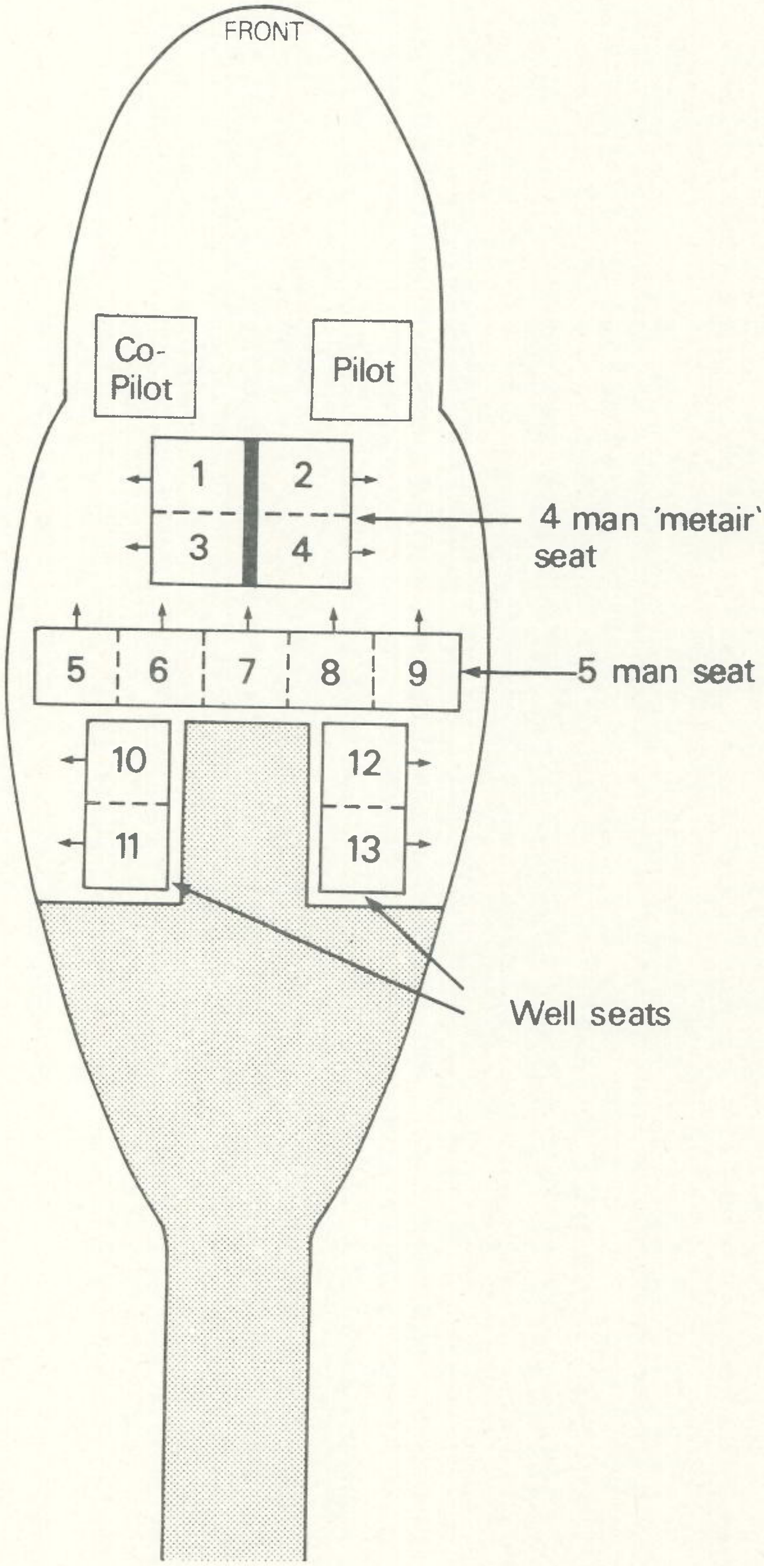
4.15 The opening and adjustment mechanisms on safety belt release buckles be designed to avoid similarities in their operation.

4.16 The 'handing' of seat safety belts be standardized to avoid the possibility of confusing the opening direction of the buckles.

L S H SHADDICK
Inspection of Accidents
Accidents Investigation Branch
Department of Trade
January 1983

Map showing the positions of the offshore installations

Seating plan of BELL 212 G-BIJF



ACCIDENT TO BELL 212 REGISTRATION G–BIJF IN THE NORTH SEA ON 12 AUGUST 1981
TRANSCRIPTION OF THE BRENT APPROACH TAPE

GMT	*FROM*	*MESSAGE*	*REMARKS*
0421	GBIJF	BRENT APPROACH JULIETT FOX THE WEATHER GENERALLY WAS EH QUITE GOOD TILL A FEW SECONDS AGO IT'S GREATER THAN TEN K'S I SHOULD THINK AND CLOUD ABOUT FIFTEEN HUNDRED FEET BUT THERE'S A LARGE PATCH OF SHOWER COMING IN FROM THE NORTH-WEST BRINGING IT DOWN TO ABOUT FIVE HUNDRED FEET AND THE VIS IS JUST LESS THAN FIVE MILES IN DRIZZLE	
	BRENT	EH ROGER EH JULIETT FOX THAT'S COPIED SIR AND EH I THINK IT EXTENDS TO THE CORMORANT AS IT'S JUST GOING THROUGH US	
	GBIJF	I WILL HAVE TO DODGE IT	
	BRENT	BREAKFAST WAS VIRTUALLY IN SUNSHINE PEH HE SAYS OPTIMISTICALLY BUT EM IT'S COME DOWN SINCE BREAKFAST TO EH WHAT YOU'VE JUST ADVISED ME	One second pause between 'SUNSHINE' and 'PEH'.
	GBIJF	O K THANKS	
0422		(ZERO FOUR HOURS TWO TWO MINUTES)	
	GBIJF	HUNTER DECK GOOD MORNING JULIETT FOX LANDING CLEARANCE	
	BRENT	EH JULIETT FOX WILL ADVISE THEM ON MARINE	
	GBIJF	ROGER	
	GBIJF	MORNING CLEAR LAND HUNTER JULIETT FOX	
	GBIJF	JULIETT FOX LANDING HUNTER	
	BRENT	JULIETT FOX	
0423		(ZERO FOUR HOURS TWO THREE MINUTES)	No transmission between these times.
0425		(ZERO FOUR HOURS TWO FIVE MINUTES)	
	GBIJF	JULIETT FOX LIFTING HUNTER DUNLIN FOURTEEN	
	BRENT	JULIETT FOX	
0426		(ZERO FOUR HOURS TWO SIX MINUTES)	No transmission between these times
0430:30	BRENT	BRENT JULIETT FOXTROT EH DUNLIN HAVE JUST ADVISED LOGISTICS THEY'RE IN FOG AT THE MOMENT SIR DO YOU WISH THEIR BEACON	

GMT	FROM	MESSAGE	REMARKS
	GBIJF	EH NEGATIVE THIS TIME I'VE EH GOT TWO AND HALF MILES TO RUN I'VE GOT THEM ON RADAR	
	GBIJF	AND APPROACH JULIETT FOX I THINK I'LL CHANGE OUR MIND ON THAT WE'LL HAVE THE BEACON PLEASE	
0431	BRENT	ROGER THAT'S COPIED EH (ZERO FOUR HOURS THREE ONE MINUTES)	
	BRENT	DUNLIN RADIO DUNLIN RADIO THIS IS BRENT APPROACH CAN I HAVE THE BEACON ON PLEASE	
	DUNLIN A	BRENT APPROACH DUN RADIO YES BEACON GOING ON NOW	
	BRENT	THANK YOU SIR THAT'S COPIED	
	BRENT	AND EH JULIETT FOX IT'S DELTA XRAY THREE TWO THREE	
	GBIJF	ROGER JULIETT FOX	
	GBARJ	BRENT APPROACH GOLF BRAVO ALFA ROMEO JULIETT GOOD MORNING FIELD INFORMATION PLEASE	
0432		(ZERO FOUR HOURS THREE TWO MINUTES)	
	BRENT	EH IS THAT ROMEO JULIETT	
	GBARJ	AFFIRMATIVE	
	BRENT	OH GOOD MORNING AH THE WEATHER IF I CAN FIND IT SOMEWHERE THERE WE GO IT'S AT TWO FIVE ZERO SEVENTEEN KNOTS PLUS THIRTEEN QNH ONE ZERO ONE SIX AND BE ADVISED IT'S BEEN REPORTED THAT THE EH DUNLIN IS IN EH FOG AT THE MOMENT JULIETT FOX IS APPROACHING THERE AT THE MOMENT	
	GBARJ	EH ROGER THE WEATHER DOES LOOK A BIT MURKY TO THE NORTH JULIETT ONE ZERO ONE SIX COPIED	Break in transmission between 'NORTH' and 'JULIETT'.
	BRENT	?????	One word unintelligible.
	GBIJF	BRENT APPROACH JULIETT FOX IS RETURNING TO THE HUNTER I DON'T WANT TO PROGRESS FURTHER DUNLIN	
	BRENT	ROGER THAT'S EH COPIED AND EH REPORT PASSING ABEAM THE EH DELTA SIR	
	GBIJF	JULIETT FOX WILCO	
0433		(ZERO FOUR HOURS THREE THREE MINUTES)	
	BRENT	AND EH ROMEO JULIETT TO COPY SUGGEST YOU HOLD ON THE FINDER DECK SIR AND EH WE'LL TAKE A SITREP	

GMT	*FROM*	*MESSAGE*	*REMARKS*
	GBARJ	ROGER	
	GBIJF	MAYDAY MAYDAY MAYDAY JULIETT FOX IS DISORIENTATED IN CLOUD UNSURE OF POSITION	Time 0433 plus 33 seconds
	BRENT	EH ROGER JULIETT FOX EH THAT'S COPIED AND EH ARE YOU EH GONNA CLIMB THROUGH THE CLOUD OR DESCEND EH TO V M C OVER	
0434	GBIJF	JULIETT FOX IS OUT OF CONTROL (ZERO FOUR HOURS THREE FOUR MINUTES)	From this point GBIJF has transmitter on continuously until 0434 plus 34 seconds.
	BRENT	ROGER JULIETT FOX IS	
	GBIJF	UNABLE TO CONTROL JULIETT FOX	
	BRENT	ROGER JULIETT FOX WE'RE SCRAMBLING THE S R A WE'RE SCRAMBLING THE S R A	
	GBIJF	JULIETT FOX UNABLE TO CONTROL	
	BRENT	–GER JULIETT FOX ROGER JULIETT FOX WE HAVE EH WE HAVE SCRAMBLED THE S R A I SAY AGAIN WE HAVE SCRAMBLED THE S R A EH ESTI– GIVE AN ESTIMATE OF YOUR POSITION OVER	'–GER' - Part of word. 'ESTI–' - Part of word.
	GBIJF	ARTIFICIAL HORIZON IS STABILISING BUT VERY HEAVY VIBRATION CRASHING CRASHING	Three second pause between 'VIBRATION' and 'CRASHING'. Time 0434 plus 34 seconds.
	BRENT	ROGER JULIETT FOX ROGER JULIETT FOX	

Sarbe Detection Range v Search Aircraft Altitude