AIRCRAFT ACCIDENT REPORT 2/84

Accidents Investigation Branch

Department of Transport

Report on the accident to Bell 212, G-BDIL 14 miles from the Murchison platform on 14 September 1982

LONDON
HER MAJESTY'S STATIONERY OFFICE

List of Aircraft Accident Reports issued by AIB in 1984

No	*Short Title*	*Date of Publication*
5/83	BAe HS 748 G–ASPL Nailstone Leicestershire June 1981	February 1984
6/83	Embraer Bandeirante G–OAIR Hatton Nr Peterhead Scotland June 1981	January 1984
7/83	Sikorsky S76A Spirit G–BNSH Aberdeen Airport October 1981	July 1984
8/83	DHC–6 Twin Otter 310 G–STUD Flotta Aerodrome Orkney April 1983	May 1984
9/83	Sikorsky S76A G–BGXY South Kirkton Aberdeen March 1981	July 1984
1/84	Douglas DC-8-51 RP-C830 London (Stansted) Airport September 1982	
2/84	Bell 212 G–BDIL 14 Miles from the Murchison Platform September 1982	

ISBN 0 11 550659 4

Department of Transport
Accidents Investigation Branch
Royal Aircraft Establishment
Farnborough
Hants GU14 6TD

22 June 1984

The Rt Honourable Nicholas Ridley
Secretary of State for Transport

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–BDIL which occurred 14 miles from the Murchison Platform, on 14 September 1982.

I have the honour to be
Sir
Your obedient Servant

G C Wilkinson
Chief Inspector of Accidents

Contents

Accidents Investigation Branch

Aircraft Accident Report No. 2/84
(EW/C800)

Registered Owner and Operator:	Bristow Helicopters Ltd
Aircraft: Type:	Bell
Model:	212
Nationality:	United Kingdom
Registration:	G–BDIL
Place of Accident:	In the North Sea, 030° (T) 14 miles from the Murchison platform Latitude 61° 35′ 58″ North Longitude 01° 58′ 51″ East
Date and Time:	14 September 1982 at 0242 hrs All times in this report are GMT

Synopsis

The accident occurred during a night search and rescue (SAR) flight and was reported to the Accidents Investigation Branch on 14 September. The investigation commenced the same day.

The Baffin Seal seismic survey vessel, operating 5 to 10 miles north of the Murchison platform, had reported that a man had been injured in an accident on board. At approximately 0200 hrs the Brent Field helicopter unit was alerted to take a doctor and medical attendant to the Baffin Seal and, because the helideck of the vessel was obstructed, a winch was fitted to the aircraft and a full SAR crew was carried. The aircraft took off at 0225 hrs and some minutes later was seen to pass close to the Murchison platform at low level and disappear on a north easterly heading in driving rain and poor visibility. The aircraft was in radio contact with the Baffin Seal on marine VHF and had given its position as 'FIVE MILES NORTH OF THE MURCHISON PLATFORM LETTING DOWN TO SURFACE CONTACT'. Soon after this at approximately 0242 hrs contact with the helicopter was lost on all frequencies. Small items of wreckage and two bodies were recovered later that day in an area 17 to 22 miles north east of the Murchison. The bulk of the wreckage was eventually recovered from the sea bed at a depth of 1,120 feet in a position 030°(T) 14 miles from the Murchison. All six occupants died.

The report concludes that there was insufficient evidence to enable the cause of the accident to be determined although there can be little doubt that the difficulty of the task, the adverse weather, the total darkness and the time of day were major contributory factors.

1. Factual Information

1.1 History of the flight

G–BDIL was one of a unit of four Bell 212 helicopters normally based on the Treasure Finder semi-submersible accommodation rig in the Brent Field. The aircraft 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 normal offshore pilot complement of the unit was 14 of which four were qualified as night Search and Rescue (SAR) captains. A similar number of pilots were on shore.

The Treasure Finder had been away for approximately 2 weeks in dry dock in Norway and during the period the helicopter unit had had to remove the majority of its equipment to enable it to continue to function while operating 2 of the aircraft from Unst, one from the Uncle John, a semi-submersible diving support vessel and one from the Treasure Hunter, a semi-submersible accommodation rig. At the time of the accident, the Treasure Finder was returning to the Brent Field and the helicopter unit was in the process of re-establishing itself on board. By the evening of 13 September the Treasure Finder was close to the Brent Delta platform with 3 of the helicopters on board and a number of the pilots. Of these pilots two were night qualified SAR captains; one had flown extensively during the day and the other, who was the Chief Pilot in the Brent Field, was the commander of the accident aircraft.

At approximately 0200 hrs on 14 September the unit was alerted to take a doctor and medical attendant to the assistance of an injured man on board the Baffin Seal, a seismic survey vessel operating in the area 5 to 10 miles north of the Murchison platform. Because the helideck of the vessel was obstructed it was decided to fit a winch to the aircraft and to carry a full SAR crew of commander, co-pilot, winch operator and winchman in order to transfer the two medical personnel to the deck of the vessel and if necessary lift off the injured man. The unit operations officer obtained the latest weather report which indicated the conditions were suitable for such a flight. He was also informed that the Baffin Seal did not carry aeronautical Very High Frequency (VHF) radio or a non-directional beacon (NDB). He was given the position of the vessel in latitude and longitude which he plotted on a Decca chart together with a track, bearing and distance from the Thistle platform. This chart was given to the co-pilot. A map showing the positions of the Baffin Seal and the relevant platforms is at appendix 1.

The aircraft took off at 0225 hrs and was given clearance to fly at 500 feet on an altimeter pressure setting (QNH) of 1012 millibars. Almost immediately after take-off the aircraft was given the actual and forecast weather for Bergen. The aircraft was then asked by Brent Approach to call the Baffin Seal on marine VHF channel 6. The co-pilot replied at 0231:45 hrs that he had been calling this vessel and he asked Brent Approach to contact the Murchison platform to switch on their NDB and to clear the helideck. A witness on the Murchison saw a Bell 212 approaching the platform from the south at about this time and pass by on the western side at a very low altitude. Two other witnesses on the Murchison stand-by vessel, Grampian Hunter, which was situated 300 yards to the north of the platform, saw the aircraft disappear rapidly from sight in driving rain and poor visibility in a north easterly direction.

Just after 0236 hrs Brent Approach told the aircraft that the Baffin Seal had a searchlight and asked if it would help them if this was pointed vertically. The co-pilot replied at 0237 hrs 'ROGER HE IS FULLY ILLUMINATED AND HE'S LOOKING FOR US

WE'RE TALKING TO THEM'. A new QNH of 1011 was passed by Brent Approach at 0239:40 hrs and the immediate acknowledgement of this by the co-pilot was the last tape recorded transmission from the aircraft. Brent Approach called the aircraft next at 0241:20 hrs and after receiving no reply continued to attempt to make contact at frequent intervals. The Brent Logistics Operations Controller, who is co-located with the Brent Approach controller on the Cormorant platform, was keeping a diary of the SAR call out and noted that the last call on marine VHF channel 6 at 0242 hrs from the aircraft was 'FIVE MILES NORTH OF THE MURCHISON PLATFORM LETTING DOWN TO SURFACE CONTACT'.

After the repeated attempts by Brent Approach to contact the aircraft without success and similar lack of success by other agencies on other frequencies a state of alert was declared at 0250 hrs. A search by sea and air was put into operation and co-ordinated by the Aberdeen Coastguard and by the Rescue Co-ordination Centre (RCC) at RAF Pitreavie.

A Bell 212 searching in the area 8 to 10 miles north of the Murchison reported at about 0355 hrs that he was in and out of cloud while searching at a height of less than 200 feet. Similar reports of low cloud and poor visibility with driving rain at the time of the accident were received from surface vessels in the area.

Two inflated liferafts floating inverted were found 16 miles north east of the Murchison at 1023 hrs and other pieces of helicopter wreckage and three bodies were sighted during the day in an area 17 to 22 miles north east of the Murchison. The floating debris and two of the bodies were recovered and the search continued until the end of the following day. With the aid of the Underwater Acoustic Beacon fitted to the aircraft the bulk of the wreckage with two more bodies was located on 17 September in a position 030°(T) 14 miles from the Murchison at a depth of 1,120 feet. The wreckage was recovered by vessels under contract to Shell Exploration and Production on 10 October after delays due to extreme weather conditions.

1.2 Injuries to persons

Injuries	Crew	Passengers	Other
Fatal	6	–	–
Serious	–	–	–
Minor/None	–	–	

1.3 Damage to aircraft

The aircraft was destroyed on impact with the sea.

1.4 Other damage

None.

1.5 Personnel information

(a) Commander: Male aged 44 years

Licence: Airline Transport Pilot's Licence (Helicopters) valid until 16 August 1986

Helicopter type ratings: Bell 47

Hughes 269 series A & B

Enstrom F28

Gazelle SA 341

Bell 212

Instrument rating: Renewed 3 May 1982

Medical certificate: Class 1 valid until 30 September 1982

Certificate of test: Bell 212, 4 May 1982

Flying experience:

Total all types (approx)	5,563 hours
Total helicopters (approx)	5,443 hours
Total Bell 212 (approx)	1,271 hours
Total flying last 28 days (approx)	18 hours

Duty time: Duty hour records and personal log book were not recovered. Flying hours were calculated with the aid of aircraft documentation.

As a result of the disruption caused by the absence in dry dock of the Treasure Finder the commander of the aircraft, who was also the Chief Pilot in the Brent Field, was involved throughout the day preceding the accident with co-ordinating the flying programme and overseeing the re-establishment of the unit back on the Treasure Finder. He had also flown during the evening as co-pilot between 1850 hrs and 2110 hrs.

(b) Co-pilot: Male aged 39 years

Licence: Airline Transport Pilot's Licence (Helicopters) valid until 29 June 1988

Helicopter type ratings: Gazelle

Sikorsky S–58T

Sikorsky S–61N

Bell 212

Instrument rating: Initial instrument rating on Bell 212 issued on 13 May 1982

Medical certificate:	Class 1 valid until 31 December 1982	
Certificate of test:	Bell 212, 9 May 1982	
Flying experience:	Total all types	5,426 hours
	Total helicopter	5,356 hours
	Total Bell 212	155 hours
	Total flying last 28 days	24 hours
Duty time:	Off duty 1030 hrs 13 September until 0200 hrs 14 September (15 hours 30 minutes)	
	On duty 0200 hrs 14 September until 0242 hrs 14 September (42 minutes)	

Although he was acting as co-pilot on the accident flight, he was also a qualified commander on the Bell 212.

1.6 Aircraft information

1.6.1 Leading particulars

Manufacturer:	Bell Helicopter Company
Type:	Bell 212
Date of Manufacture:	18 July 1975
Certificate of Airworthiness:	Transport Category (Passenger) valid until 30 January 1983
Certificate of Maintenance:	Valid until 27 October 1982 or 7,567.50 total airframe hours
Total airframe hours:	7,532.25 hours
Maximum total weight authorised:	11,200 lb (5080 Kg)
Estimated weight at time of accident:	9,378 lb (4254 Kg)
Estimated Centre of Gravity (CG) at time of accident:	136.5 inches aft of datum
CG range applicable:	131.0 to 143.4 inches aft of datum

1.6.2 General description

The Bell 212 is a twin-engined utility helicopter powered by Pratt & Whitney PT6T engines. The teetering main rotor is of conventional design and rotates anti-clockwise when viewed from above. The collective and cyclic pitch controls are powered by duplicated servos supplied by the aircraft's two independent hydraulic systems. The tail rotor pitch control is powered by a single servo but can be operated manually in the event of failure of the associated hydraulic system. A mechanical inter-link between the collective and tail rotor pitch controls provides a degree of automatic compensation

for main rotor torque. Main rotor torque is displayed on both pilot's instrument panels by a combined instrument showing the torque of individual engines and the combined total torque. G–BDIL was fitted with a limited authority three axis stability augmentation system signalled by rate gyros in the nose of the aircraft. An attitude hold type of autopilot was also provided which derived attitude data from the co-pilot's attitude indicating system.

Each engine was fitted with a starter-generator which provided electrical power for the 28 volt direct current (DC) systems. Alternating current (AC) was delivered by three solid state inverters which were supplied from the DC systems. In the event of a failure of one of the starter-generators or one of the inverters the remaining system would supply all essential requirements. The aircraft was fitted with a 24 volt, 34 ampere hour battery for engine starting and also to provide an emergency source of DC power.

The pilots' flight instrument display included a large Attitude Director Indicator (ADI) for each pilot with independent vertical gyros providing a reference for each indicator. A self contained stand-by attitude indicator was also provided for the commander. Each pilot had a Horizontal Situation Indicator (HSI) presenting magnetic heading and navigation information from common sources. Radio altimeter indications gave each pilot a reading of true height above the surface and both indicators were supplied with information from a single transmitter/receiver unit. In addition both pilots were provided with conventional pressure altimeters, airspeed indicators and rate of climb and descent indicators. The electrical flight instruments, in most cases, required both AC and DC electrical power for normal operation.

For the accident flight, which necessitated the fitting of a rescue winch, the 4-man Metair seat and the 5-man bench seat were removed. The liferaft which was normally attached to the right forward hinged cabin door (known as the quarter-door) was stowed on the pair of seats on the left side immediately outboard of the main gearbox tunnel. The second liferaft remained in its normal position attached to the left quarter-door and a rescue winch was fitted to the forward right position. Only the two seats on the right side immediately outboard of the main gearbox were therefore available for the rear crew but two dispatchers harnesses were also in use.

1.6.3 Defects

There were no outstanding defects at the time of the aircraft's departure and the defects log showed no evidence of recurring defects which might have had a bearing on the accident. During October 1981 the aircraft had experienced an oscillatory malfunction in the roll channel of the automatic flight control system (AFCS) of such severity that the pilot stated that control of the aircraft would have been lost within a few seconds had he not selected the AFCS out. The roll amplifier was subsequently found to be defective and was replaced. There have been no further reports of AFCS malfunctions since this incident.

1.6.4 Emergency equipment

The helicopter contained the following items of emergency equipment:

(i) Liferafts

One RFD Type 18U Mk 1, 18 man liferaft contained in a valise was stored on a pedestal behind the co-pilot's seat and secured to the left quarter-door by a seat belt fitted with a quick release buckle. The mechanism of the inflation bottle was operated by a lanyard the other end of which was secured to a cargo tie-down ring

in the floor immediately below the liferaft. Another similar liferaft was removed from the right quarter-door and stowed on the pair of seats on the left side of the cabin outboard of the main gearbox tunnel.

(ii) Lifejackets

All of the six occupants were wearing Beaufort Mk 15 military type lifejackets. Four of the lifejackets were recovered and were found to be serviceable although no attempt had been made to inflate them. A number of spare passenger type lifejackets had been stowed on the seats at the left rear of the cabin alongside the second liferaft.

(iii) Personal locator beacons (PLB)

The lifejackets worn by the two pilots, winch-operator and winchman were equipped with SARBE Mk 5 type BE 375 beacons for operation on 121.5 MHz.

Two of the beacons were recovered in the lifejackets and neither had been deliberately switched on or inadvertently operated by impact forces.

(iv) BE 369 floating SARBE beacon

The aircraft was carrying in the cabin a BE 369 floating SARBE beacon for operation on 121.5 MHz and 243 MHz. The beacon was recovered from the sea bed with the main bulk of the wreckage.

(v) An underwater acoustic beacon, activated by water immersion and operating on 37.5 KHz was fitted to the right hand side of the main gearbox tunnel close to the cabin roof. The beacon emits an acoustic pulse of short duration approximately once per second. This equipment played a major role in helping to locate the wreckage on the sea bed although the beacon and the immediate area of structure to which it was attached had been torn from the bulk of the wreckage and was not recovered.

(vi) Automatically deployed survival radio beacon

An automatically deployed survival radio beacon was not required by United Kingdom regulations and neither was one fitted.

(vii) Survival suits

All of the occupants were wearing immersion suits.

1.7 Meteorological information

Synoptic situation

The area was covered by a moist south westerly airstream and a warm front orientated approximately north east/south west was close to the Murchison platform at 0300 hrs.

Reports

No forecast was issued for this flight but the following routine weather observation was made by meteorological personnel on the Treasure Finder at 0150 hrs and was available to the crew:

Wind:	200°/35 knots
Visibility:	8 kilometres
Cloud:	6 oktas stratus 600 feet
	7 oktas stratus 1,000 feet
Weather:	Rain
QNH:	1012 amended to 1011 at 0237 hrs

The routine observation on the Treasure Finder at 0250 hrs was:

Wind:	210°/34 knots
Visibility:	8 kilometres
Cloud:	5 oktas stratus 800 feet
	8 oktas strato-cumulus 1,200 feet
Weather:	continuous light rain
QNH:	1011

Approximately 8 minutes before the accident witnesses on a vessel close to the Murchison platform stated that there was driving rain and very poor visibility. At about the time of the accident personnel on board the Baffin Seal similarly reported driving rain with an estimated cloud base of 100 feet and visibility of one mile. The SAR helicopter which went in search of the accident aircraft reported at 0340 hrs that the weather at the Murchison platform was 4-6 oktas at 200 feet and overcast at less than 300 feet with visibility no greater than ½ mile in rain. Some 15 minutes later while searching to the north of the Murchison the same helicopter reported that there was cloud below 200 feet.

1.8 Aids to navigation

(a) In the air

The aircraft was equipped with:

Very high frequency omni range (VOR) – twin installation

Automatic direction finder (ADF)

Radar – with mapping mode

Radio altimeter

Decca/Danac

The Decca/Danac navigation equipment fitted to the aircraft received signals generated by Decca ground stations enabling positions on a hyperbolic grid to be derived. The grid comprised position lines in three colours with each colour being

split into zones. The Danac computer operating in conjunction with the MK 19 receiver selected the two colours which cut at the best angle and calculated the zone-fractions (the relative position between zone boundaries) of each colour and used this information to drive the moving chart display situated on top of the instrument panel coaming. The system was largely automatic in operation and provided a continuous up date of position on the display.

There were circumstances in which it was possible for the chart display to indicate an incorrect position. If the system gave an incorrect indication during the initial setting up procedure and this was accepted by the operator it would continue to indicate incorrectly thereafter. A similar effect could occur in the event of a temporary loss of signal and it was possible for the display to indicate the correct zone-fraction but in the incorrect zone. Temporary loss of signal could be caused by static electricity generated by heavy precipitation.

The system in G-BDIL could also be used to drive the decometers on the right of the commander's instrument panel provided that these were also correctly set up during the initial procedure.

(b) On the surface

Decca

The area was covered by the Decca Vestlands chain OE. A post-accident check of the transmission monitor log indicated stable transmissions throughout the period.

Non-directional beacons (NDB)

The offshore installations were equipped with non-directional beacons (NDB) which were available on request. While en route from the Treasure Finder the co-pilot of the accident aircraft asked for the Murchison NDB to be switched on. Statements from personnel on the Murchison platform indicate that the NDB was not switched on until after the accident had occurred because at the time the request was made, the radio operator was attending to an equipment problem elsewhere.

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 but since this was a specific Medevac flight in the early hours of the morning only one controller was called out and he controlled the aircraft on the Brent Approach frequency throughout. The Air Traffic Control (ATC) frequencies were tape recorded and the 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 2.

Also seated alongside the Brent Approach controller were the Brent Logistics Operations controllers operating mainly on marine VHF radios and whose function was to co-ordinate the day to day requirements for helicopter flights. In view of the fact that the Baffin Seal did not carry aeronautical VHF radios whereas the aircraft was fitted with marine VHF it was decided that marine Channel 6 would be a compatible frequency. Much of the RTF communication and in particular conversations between the aircraft and the Baffin Seal were conducted on this frequency. From statements

taken from members of the crew of the Baffin Seal there was evidently some confusion as to whether they thought they were talking to the aircraft or to one of the offshore installations.

The marine VHF communications were not tape recorded and it was therefore not possible to resolve the above confusion or to confirm the time of the last logged transmission from the aircraft 'FIVE MILES NORTH OF THE MURCHISON PLATFORM LETTING DOWN TO SURFACE CONTACT'.

1.10 Aerodrome information

Not relevant.

1.11 Flight recorders

None fitted and none required by United Kingdom regulations. With effect from June 1984 the Air Navigation Order will require Transport Category helicopters which have either a maximum total weight authorised exceeding 2700 kg or which may carry more than 9 passengers to be fitted with a 4 channel cockpit voice recorder.

1.12 Wreckage and impact information

1.12.1 Sea bed examination

The first examination of the wreckage was via a study of the underwater video survey carried out by manned submersibles. These films revealed the fuselage lying inverted on its left side with the main rotor assembly detached but lying close by. The fuselage had suffered severe impact damage particularly to the forward right quarter. The right skid had been torn off in sections whereas the left remained in position with its associated emergency float unpacked but not inflated; the rear left float was still in its pouch. The complete tail rotor assembly remained attached to the fin which was linked to the tailboom but only just, the rear end of the boom having suffered a main rotor blade strike at the fin base. The left elevator tip had also received impact damage. Many of the double skinned sections of structure and fairings had collapsed due to the ambient water pressure at a depth of 1,100 ft. Several items of the helicopter including doors, the winch and various fairings were found separate to the fuselage on the sea bed but close by.

1.12.2 Ship-board examination

A limited examination was undertaken on board the salvage vessel before the wreckage was washed and inhibited for transfer to a support vessel for shipment, initially to Aberdeen and then on to the AIB facility at Farnborough.

The tail rotor assembly along with the fin had separated from the tail boom during the salvage and was recovered separately.

All of the material recovered was washed with fresh water and then sprayed with a water repellent compound in an attempt to retard the corrosion due to immersion in sea water which was already advanced on some items.

The assessment of structural damage made from viewing the video recordings was confirmed. The aircraft had been subjected to a severe impact centred on the right forward quarter.

The main rotor mast and gearbox assembly with the two main rotor blades attached had separated from the fuselage by failure of the main gearbox case. The stabiliser bar remained attached to the rotorhead by the control tubes only. One main rotor blade was slightly bent upwards and was damaged close to the tip consistent with having struck the left elevator and the tail boom. The spar remained intact although the honeycomb trailing edge had detached over the mid span section. The other blade was more severely damaged having been bent down at the tip through approximately 180° with disruption of the honeycomb filled sections and spar failures near the tip.

The instrument panel and centre console were recovered attached to the fuselage by the wiring looms only. The following indications and settings were noted:–

		Commander	Co-Pilot
Pressure Altimeter:		Subscale set 1011	Subscale set 1011
Radio Altimeter Switch:		'On'	
Radio Altimeter Indicator:		Bug 60 ft	Bug 75 ft
Attitude Indicator:		85° Right Bank	45° Right Bank
		14° Nose-down	12° Nose-down
Standby Attitude Indicator:		70° Right Bank	
		58° Nose-down	
Horizontal Situation Indicator:		Missing	Heading 057°
Torque:	Eng 1	68%	68%
	Eng 2	64%	60%
	Combined	66%	63%
Clock:		18 minutes past 5	1½ minutes past 4 Labelled 'no minute hand, loose'.

Radio Selections

Intercom Box Rotary Switch:		Comm 1
Communications:	VHF 1	122.25 (Brent App)
	VHF 2	129.85 (Murchison)
	ADF	323.0 or 223.0 (323.0 Murchison NDB)

System Indications	Hydraulics Systems No 1	1000 psi
Engine Control Switches	Selections consistent with two engine operation	

1.12.3 Detailed examination

All structural damage observed other than that associated with the salvage operations was consistent with impact with the sea at high speed when flying nose-down and banked to the right. Some elements of the structure had suffered corrosion consistent with immersion in sea water despite the attempts to inhibit the wreckage at sea.

Both engines exhibited damage indicative of rotation at impact and neither main rotor nor tail rotor drives or gearboxes showed evidence of pre-crash defect.

Examination of the mechanical linkage of all flying controls failed to identify any pre-crash failure or disconnection. However, it was not possible to determine the control positions at impact.

The two hydraulic systems had both suffered disruption during the impact, the two reservoirs being torn from the airframe. Strip examination of the two pumps revealed them both to be in good mechanical condition with their drives from the main transmission intact. All four filter blockage indicators, two pressure and two return per system, indicated that the filters were clear and visual examination of the filters did not reveal any significant debris.

The Decca-Danac moving map display was recovered and although most of the information had been 'washed' from the moving map film a small section was identifiable beneath the travelling cursor. This indicated the position of G–BDIL at the moment power was lost to be virtually overhead the Murchison platform, that is one red zone and one green zone away from the impact position. Examination of the various components in the system with the aid of the manufacturer failed to identify the cause for this difference in indicated position and the known impact location. However, the manufacturer was able to indicate a number of possible circumstances capable of producing such an error.

(1) Incorrect setting-up before take-off

(2) Incorrect re-setting during flight

(3) Temporary loss of signal

  (a) Decca chain transmission interruption

  (b) Precipitation static interference

(4) Temporary aircraft system fault

  (a) Interruption in aircraft power supply

  (b) Transient equipment fault

The components of the radio-altimeter system were removed from the aircraft and transported to the manufacturer for examination. After considerable attempts to wash and dry the transmitter/receiver unit, attempts to function it were finally abandoned following the discovery of multi-component failures. These were consistent with exposure to water at the high pressures experienced at a depth of 1100 ft. The two indicators which are of the type that indicate zero at the loss of the power supply were damaged beyond functional testing.

The two gyro platforms used to drive the commander's and co-pilot's attitude indicators were also examined at the manufacturer's premises but they were found to have been undamaged during the impact and had run down on loss of electrical supply. Consequently they afforded no information on their impact attitude signals.

Some 28 volt DC light bulbs recovered from the pilot's instrument panel along with others from the external navigation lights had stretched filaments consistent with the bulbs having been lit as the aircraft impacted the sea.

1.13 Medical and pathological information

The bodies of the commander and one of the rear crew members were not recovered. Post mortem examination of the bodies of the three rear crew members recovered showed that they had suffered severe multiple injuries. There was nothing distinctive about the pattern of injuries which were compatible with decelerative and crushing forces consistent with the crew being 'free and moving' and not restrained by seat belts. The injuries sustained by the co-pilot were less severe and were mainly to the right side of the body suggesting that he was thrown to the right on impact.

Although the medical aspects of this investigation did not cover all of the aircrew there was no pathological evidence to suggest that a medical factor might have caused or contributed to the accident.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 Survivability

The accident was not survivable.

1.15.2 Search and Rescue

A full scale air and sea search operation was initiated 8 minutes after the loss of radio contact. Although the accident occurred within the Norwegian SAR area, control of the air search was assumed by the RCC Edinburgh after discussion with the RCC at Stavanger.

A second Bell 212 was airborne from the Treasure Finder at 0311 hrs and subsequently other helicopters became available from both UK and Norwegian sources. The Bell 212 was designated the scene of search commander and at 0327 hrs, in view of the adverse weather in the area of the Murchison, he requested a fully equipped SAR Sea King helicopter from the mainland. A US Navy Orion maritime patrol aircraft was diverted to the area and assumed the duties of scene of search commander at 0424 hrs to be relieved at 0607 hrs by an RAF Nimrod which was succeeded in turn by two other Nimrods.

Concurrent with the air search a surface search was being co-ordinated by the Aberdeen Coastguard through Shell and approximately 30 vessels were involved. The search concentrated initially on an area around the last reported position of the helicopter 5 miles north of the Murchison.

At 0548 hrs one of the surface vessels reported a SARBE indication to the south east of the main search area. A helicopter was sent to investigate but nothing was found and no signals were received by the helicopter.

At about 0645 hrs as a result of many reports of the sighting of a smoke flare approximately 1½ miles south west of the Dunlin platform four vessels and a rescue helicopter were diverted from the main area of search to concentrate on the area close to the Dunlin. Nothing was found and the presence of the smoke flare could not be explained.

At 1005 hrs two overturned and inflated liferafts were sighted by a search helicopter at a position 032° (T) 14 miles from the Murchison. A body was located about 3 miles from the liferafts shortly afterwards and subsequently recovered by a surface vessel. Two more bodies (only one of which was recovered) and pieces of aircraft wreckage were found in the same area.

The sea and air search continued throughout the day and the surface vessels continued throughout the night. The air search was resumed at first light on the following day. The operation was formally terminated at 1200 hrs on 15 September although surface vessels under contract to Shell continued their search until dusk. There was excellent co-operation and co-ordination throughout the search operation which for the searching helicopters was carried out in very difficult weather conditions. The standard of control exercised by the Nimrod crews was of a very high order.

1.16 Tests and research

A Seiko quartz analogue watch showing a time of 0345:20 (0245:20 hrs GMT) was recovered from the body of one of the rear crew members which remained in the wreckage. All watches of this type were subjected to a static pressure test equivalent to a water depth of 30 metres before leaving the factory. Tests at increased pressure were conducted by Seiko on a watch glass of the same type. The results showed that a pressure equivalent to a water depth of approximately 100 to 110 metres (330 to 360 feet) was required before the glass collapsed inwards sufficiently to crack it and allow water to penetrate.

1.17 Other information

1.17.1 SAR Contract

The local SAR arrangements in the Brent Field were the subject of a contract between Shell UK Exploration and Production and Bristow Helicopters Limited. The contract stated that 'The Contractors staff are expected to use their discretion with respect to helicopter performance, weather conditions and other circumstances in accepting a measure of risk in order to carry out rescue operations'. The contract also called for sufficient pilots to be trained to ensure 24 hour cover and for a stand-by roster of available nominated crews to be maintained.

1.17.2 Weather limitations

The company operations manual laid down weather limitations and minimum operating heights for day and night, overland and offshore flights. The minimum operating height for offshore-night was 500 feet with a cloud base of 800 feet and visibility of 5 kilometres. The manual also stated that for day or night casualty evacuation 'Flights may proceed at the discretion of the aircraft captain. In weather conditions when route and terminal conditions are below the company minima, two crew must be carried', (ie two pilots).

1.17.3 Circadian rhythms

One of the most important of the natural rhythms which are known to exist in the human body is the 24-hour or circadian rhythm. An example of this is the daily variation

of oral temperature which rises rapidly between 0800 hrs and 1100 hrs and continues to increase more slowly to a peak at 2000-2100 hrs. There then follows a steady drop to a low point 0400-0500 hrs.

Tests have demonstrated that both the level of vigilance and the standard to which an individual performs various tasks also vary to a daily rhythm which closely follows the 24-hour variation in body temperature. The more complex the task the greater the amplitude of the human performance variation.

Human performance has also been shown to be affected by a number of factors. A high degree of motivation for example will be beneficial, whereas fatigue and sleep deprivation will result in an overall lowering of performance.

1.17.4 Wreckage search and recovery

The initial air and sea search for the helicopter resulted in the recovery of various items of floating debris with the bodies of two of the crew members. The body of a third crewman was seen from a surface vessel but adverse weather precluded its recovery. As it appeared that the majority of the helicopter had sunk a salvage vessel was chartered by AIB to attempt to find and recover it.

At 2200 hrs on the day of the accident a suitable ship, the 'Kommandor Michael' equipped with accurate surface navigation equipment, sidescan sonar, two remote control submersibles with underwater video equipment and adequate lifting gear was joined at Peterhead by an Inspector of Accidents in company with marine salvage advisers. In addition to the ship based equipment a Dukane underwater location beacon receiver belonging to AIB was available; the helicopter being equipped with a Dukane acoustic transmitter. A further ship on charter to Shell, the 'British Voyager' equipped similarly to the 'Kommandor Michael' except that it carried manned submersibles, was made available to assist with the search.

The information on the times and locations at which floating debris was recovered from ships involved in the initial surface search enabled a drift plot to be constructed indicating the likely impact positions. This resulted in a location approximately 14 nm on a bearing of 030° (T) from the Murchison platform. It was agreed that the 'Kommandor Michael' would approach this location from the Murchison 'listening out' with the Dukane receiver covering an area 2 nm either side of the direct track whilst the 'British Voyager' searched with sidescan sonar in the area of the helicopter's last position report, 5 nm north of the Murchison.

The underwater transmitter on the helicopter was first heard close to the predicted location for the wreckage in the early hours of the 17 September, emitting two pulses per second and not one as specified. Having refined the location using the Dukane equipment a manned submersible from the 'British Voyager' confirmed that the signal was an emission from G–BDIL lying in approximately 1,100 ft of water. The submarine undertook an extensive video survey of the wreckage during which the bodies of two further crewmen were located one inside and the other outside the fuselage.

The AIB team transferred to the 'British Voyager' and, with the assistance of the semi-submersible lifting vessel the 'Uncle John' provided by Shell, the wreckage was finally lifted to the surface on 10 October. The delay between location and recovery was due to the difficulties resulting from the depth of the wreckage along with its flimsy nature making attachment for lifting extremely difficult, and a prolonged period of extreme weather which halted operations for many days.

2. Analysis

2.1 Recording equipment

The aircraft was not fitted with a cockpit voice recorder (CVR) or a flight data recorder (FDR) and neither was there any tape recording of the conversations on marine VHF frequencies between the aircraft, Brent Logistics and the Baffin Seal. Because of the lack of hard evidence it has been necessary to derive the possible flight path of the aircraft from the other evidence available so that the circumstances which caused the accident can be considered.

There are no requirements for the recording of marine VHF frequencies as there are for aeronautical VHF communications. A taped record of the messages passed on the marine frequencies, however, could do much to aid aircraft accident investigation and might also provide useful information to the SAR authorities should an aircraft go missing. The controllers for Viking Approach, Brent Approach (aeronautical) and Brent Logistics Operations (marine) were located in the control room on the Cormorant platform. At the time of the accident only the aeronautical frequencies including Viking and Brent Approaches were tape recorded. Subsequently a similar facility has been installed in the control room to record a number of the marine frequencies and this could provide useful information in the future. It is therefore recommended that whenever an air traffic controlling authority is established on an offshore installation and arrangements made to record the aeronautical communications, consideration be given to extending the scope of the recording to cover the marine frequencies likely to be used by aircraft.

2.2 Time of the accident

The ATC tape recording showed that at 0241.20 hrs the Brent Approach controller called the aircraft but did not receive a reply to that or any subsequent calls although communications had been normal up to 0239.44 hrs. The Brent Logistics controller noted in his log that the last transmission from the aircraft was at 0242 hrs. The two mechanical clocks fitted to the aircraft instrument panels did not give meaningful readings but a quartz analogue watch was recovered from one of the bodies showing a time of 0245.20 hrs. It is possible that this watch was not damaged by the impact and continued to run until the watch glass was crushed by water pressure as the wreckage sank.

Because the aircraft was not fitted with a CVR it was not possible to establish an accurate time of impact. From the information available the impact was certainly not earlier than 0239.44 hrs and unlikely to be later than 0245 hrs and it was considered that the most likely time was within one minute of 0242 hrs.

2.3 Probable flight path of the aircraft

On take-off at 0225 hrs the aircraft was given clearance to fly at 500 feet, the normal inter-rig transit height, but it is not known what height the aircraft actually reached since during the flight it would have encountered weather considerably worse than that around the Treasure Finder on departure. Eye witnesses confirmed that it had certainly descended to a much lower altitude on reaching the Murchison Platform where it would have arrived (assuming a normal cruising speed of 100 knots IAS) at between 0233 and 0234 hrs. General opinion was that from then on while flying at low altitude in the prevailing weather conditions, the commander would have reduced speed to 70 knots which, with a 30 knot tail wind, would have given him a maximum ground speed of

100 knots. The wreckage was located on a bearing of 030° (T) 14 miles from the Murchison Platform. At its assumed ground speed, the aircraft would have taken 8 to 9 minutes to cover the distance from the Murchison to the point of impact. This would put the impact time at between 0241 and 0243 hrs which is in general agreement with the ATC tape recording and the time logged by the Brent Logistics controller. It therefore seems likely that the aircraft left the Murchison in a north easterly direction, as confirmed by eye witnesses, and did not deviate far from a direct track to the point of impact.

The type of radar fitted to the aircraft was capable of locating the platforms and ships in the Brent Field and the crew probably used it to navigate the aircraft around the Murchison. However, it is evident that for some reason they were unable to detect the Baffin Seal on radar and therefore they would have had to rely on other navigation assistance. It is not clear why the aircraft should have been so far to the north east of the Murchison when the ship's position was approximately 5 to 10 miles north of the platform. The operations officer on the Treasure Finder plotted on the chart which he gave to the crew, the latitude and longitude of the Baffin Seal and drew a track from the Thistle to this vessel with a bearing and distance written beside the track. This he confirmed with the Brent Logistics controller as being approximately 027° (T) 7 miles. It must be of some significance that this bearing was virtually the same as the one on which the aircraft flew outbound from the Murchison rig. It is possible therefore that the crew were under the impression that the bearing and distance given them before departure was from the Murchison and not the Thistle. Alternatively it is also possible that the crew received ambiguous directions in flight from the Baffin Seal. Whatever the reason for the aircraft's track being away from the ship, the incorrect position which must have appeared at some time on the Decca chart display would only have added to the crew's difficulties.

2.4 Final stages of the flight

The fuselage had sustained very severe damage, primarily to the front and right-hand side areas which is consistent with an impact with the surface at a significant forward speed in a slightly nose-down attitude and banked to the right. Its heading was 057° (M). It was not possible to say if the fuselage attitude had been significantly altered prior to impact by a main rotor blade hitting the surface. However, the impact heading and the damage to the aircraft, suggest that the aircraft was in a turn to the right when it hit the sea. The turn could have been either part of an unintentional deviation from heading or it could have been deliberate, possibly the result of a decision to return to a known datum and start the search again following the failure to locate the Baffin Seal. However, the manoeuvre was also accompanied by sufficient loss of height to cause the aircraft to make contact with the sea. Consideration was given to possible explanations as to why this happened and various factors such as equipment failure or malfunction, the behaviour of the Decca/Danac chart display, the weather and the accuracy of the altimeter pressure settings were examined along with human factor problems such as crew distraction, loss of concentration and disorientation.

2.5 Detailed examination of the wreckage

Detailed examination of the wreckage showed that both engines were producing power and that the transmission system contained no evidence of pre-existing abnormalities. The hydraulic pumps and hydraulic servos were normal apart from the damage caused by impact and there was no evidence of any failure or disconnections in the flying control runs. The aircraft therefore appears to have been mechanically sound up to the moment of impact. Because of the extent of the damage and the subsequent effects of

salt water corrosion and water pressure at depth it was not possible to test components of the electrical systems or of the automatic flight control system (AFCS). However, meaningful readings were given by instruments such as the torquemeters and attitude indicators thus showing that AC electrical power and therefore also DC electrical power was available. This limits the possibility of electrical failure to a single system only.

There was no evidence of any recurring defects in the aircraft's records which might have indicated a continuing problem in one of the aircraft systems. There had also been no further reports of malfunctions of the AFCS after rectification had been made following the report of malfunctioning in October 1981. However, the possibility of a single electrical system failure or a malfunction of the AFCS could not be discounted.

2.6 Decca/Danac

The fact that the chart display of the Decca/Danac was showing the aircraft position as exactly one red zone and one green zone removed from the actual position cannot be adequately explained as being mere coincidence. The manufacturer advised that the most likely reasons for the incorrectly displayed position were either that the equipment had been incorrectly set up before take-off, incorrectly reset in flight, or that there had been a temporary loss of signal. Because there is no record of what the crew actually did on the flight, it is not possible to comment on the first two explanations except to say that although they cannot be ruled out, their likelihood is not considered to be very great. As far as loss of signal is concerned, there was no interruption of the transmitted Decca chain signals and the manufacturer advised that a transient fault in the aircraft equipment was unlikely; in addition the probability of such an occurrence at that time is considered extremely remote. A temporarily interrupted aircraft power supply could not be discounted but communications with the aircraft gave no indication of such problems. Since the aircraft was known to be flying in heavy rain the most probable cause of the signal loss was considered to be the effect of precipitation static. However, the correct zone fractions (at the incorrect position) were displayed on the chart and this indicates that, at the time of impact, Decca signals were being received by the aircraft equipment and confirms that electrical power was available. Regardless of the reason, the incorrectly displayed position, while not being a cause of the accident, could have been a source of confusion or distraction to the crew.

2.7 Weather

The weather in the Murchison area was stated by witnesses to be bad with low cloud and driving rain and the aircraft was seen leaving the area of the platform at low altitude in a north easterly direction. It is probable that the commander would try to establish visual contact with the Baffin Seal from then on which, considering the low cloud, would have required him to fly at about 100 feet. There is some evidence to support this in that the decision height 'bugs' on the radio altimeters (which under normal procedures are set to 200 feet) were found in the wreckage to have been set at 60 feet (commander's) and 75 feet (co-pilot's). With these 'bug' settings the crew of an aircraft flying at 100 feet would at least have been given some warning of excursions below 100 feet. Nevertheless flight at such low altitude leaves a minimum of time to recognise and deal with an increasing rate of descent, from whatever cause, and there can be little doubt that the adverse weather and total darkness were major contributory factors in the accident.

2.8 Pressure altimeter setting

When operating at such low altitude the only accurate indication of the height above the sea would have been given by the radio altimeter. However, the accuracy of the altimeter pressure setting given to the crew and the effects of any ambient pressure gradients on the pressure altimeters were also examined. Unknown to the meteorologist who calculated the pressure setting (QNH) the Treasure Finder semi-submersible rig, on which he was based, was in the process of being 'ballasted down' and therefore the true height of his barometer above sea level was 17 feet lower than he realised. The error which this introduced to the QNH was, however, eliminated by the normal process of rounding the pressure setting down to the nearest whole millibar. Acknowledgement of the revised pressure setting of 1011 mb, based on the observation made on the Treasure Finder, was the last tape recorded transmission from the aircraft and both pressure altimeters were found to be correctly set when the wreckage was recovered. With the existing synoptic situation the track of the aircraft lay almost parallel to the isobars and therefore any errors of the aircraft barometric altimeters caused by ambient pressure gradients would not have been significant.

2.9 Human factors

There were a number of human factors relevant to the accident. The temporary absence of the Treasure Finder had disrupted the running of the offshore helicopter unit and resulted in a reduction in the number of night SAR qualified captains available at the time of the accident. Because the only other night SAR captain had flown extensively during the previous day the commander of the accident aircraft, as chief pilot, had little alternative but to place himself on the night stand-by duty. However, he had been fully occupied during the day co-ordinating the flying programme, overseeing the re-establishment of the unit on the Treasure Finder, and had also flown as co-pilot during the evening for a short while.

The commander was woken at about 0200 hrs at a time when, from the point of view of circadian rhythms, he was approaching a low ebb, and also when he might have otherwise been expected to sleep for another 3-4 hours. Performance studies of individuals following sleep loss have been made and although the results were not consistent it has been shown that moderate sleep loss has an adverse effect on complex decision making and also results in occasional lapses of alertness. The combined effect of circadian rhythms, loss of sleep and a busy day previously would not have been beneficial and an overall lowering of performance level of the commander cannot be discounted.

It was determined from the air traffic tape recording that it was the co-pilot throughout who was talking to the Brent Approach controller. It therefore seems almost certain that the commander was the handling pilot and this would leave the co-pilot with the tasks of operating the radios, navigating the aircraft and looking out to try to locate the Baffin Seal. These duties would leave the co-pilot little capacity to monitor the flight instruments for any equipment failures or for the timely recognition of an unsafe aircraft flight path or attitude.

2.10 Summary

Both the weather at the Treasure Finder at the time of take-off and the forecast conditions were reasonable enough for the commander to consider that the flight was possible. However, at some point near the Murchison Platform the conditions became very bad with driving rain and low cloud. Under normal circumstances the commander

would not have continued the flight. However, since the purpose of the operation was to bring medical aid to an injured person, and probably because the helicopter was in fairly close proximity to the ship concerned, the commander decided to continue the flight. The crew's only hope of finding the ship would have been to sight it visually and this necessity of remaining in visual contact with the surface is the probable reason why the aircraft was flying at a very low altitude. Unfortunately the helicopter's track after leaving the Murchison did not take it over the ship's position. It is a matter of conjecture what happened at the end of the flight. The crew would have realised that they had missed the ship and it is probable that they had decided to retrace their flight path. It would have been a period of intense activity on board the aircraft. The co-pilot's workload would have been high and under such conditions he could not be expected to maintain a continuous monitor on the aircraft's flight instruments. Because the flight took place at a time of day when human performance is at its lowest ebb, the possibility of the commander becoming disorientated cannot be ruled out. With the aircraft flying at such a low altitude any distraction or loss of concentration or the slightest malfunction within the aircraft could have resulted in the slight loss of height necessary for the helicopter to make contact with the sea. Undoubtedly if the helicopter had been equipped with a height hold facility and the radio altimeter system had been fitted with an audio warning it would have made the pilot's task easier. In making any assessment as to what may have happened it should be borne in mind that the crew were attempting a mercy flight at night in extreme weather conditions.

2.11 Helicopter emergency call out procedures

The contractural arrangements between the oil company and the helicopter operator, with reference to the provision of Search and Rescue Helicopters, stated that the helicopter operator's staff "were expected to use their discretion in accepting a measure of risk in order to carry out rescue operations". By the very nature of their tasks emergency services such as fire brigades and lifeboats etc, also accept on occasions a level of risk which sometimes results in tragedy while attempting to bring aid to others. Criticism of the efforts of the helicopter crew would therefore be totally unjustified and it is intended here only to suggest safeguards in the emergency call out procedures.

It is to the credit of the crew that the helicopter took off only 25 minutes after they were awakened. Clearly, however, it is difficult in such a short time for anybody to collect their thoughts and make a balanced judgement of the risks involved while at the same time physically preparing for the flight and mentally attuning themselves to the task. In any emergency situation where assistance is being sought, there would seem to be some advantage if, before the operating crews are alerted, consultations first take place between representatives of the flying operations, the medical authorities and the source requesting help, so that the degree of emergency can be balanced against the level of risk involved taking into account the type of aircraft equipment available. In this way an assessment can be made as to whether a delay until daybreak or there is an improvement in the weather, would be acceptable. The flying staff representative would ideally be the supervisor authorising the task and not a member of the crew undertaking the flight. Having considered the degree of difficulty involved, he could then allow adequate time for a properly rested crew to become fully alert and undue haste could be avoided. It is accepted that there will always be instances when an immediate response is required and that in such cases the discretion as to whether to proceed must rest with the aircraft commander. Were it not for the disruption caused by the absence of the Treasure Finder these aspects would have largely been covered in the case of the accident flight. However, it is considered that, whenever a SAR service is established, the operations manual should include an expanded discussion on the call out procedures and the relevance of any operational limitations and weather minima to the task involved.

2.12 Additional aircraft equipment

Because SAR flights are likely to be conducted in adverse conditions and involve a very high work-load, any equipment which makes the pilot's task easier must be beneficial. For those helicopters whose primary task is SAR it is highly desirable that they should be equipped with an automatic flight control system capable of automatic hovering and automatic transition to and from the hover to permit operation in the most adverse weather. Consideration should be given to equipping helicopters having a secondary SAR role with automatic stabilisation equipment with at least an altitude hold mode.

The type of radio altimeter fitted to the accident aircraft can be modified to provide an audio warning when the aircraft descended below the decision height 'bug' setting although it was not so equipped at the time. Such an audio warning could have been vital in preventing this accident and it can in general only be beneficial. Consideration should be given to requiring helicopters operating offshore around the British Isles to be equipped with radio altimeters modified to give such audio warnings.

2.13 Subsequent air and sea search

The subsequent air and sea search was promptly initiated, well co-ordinated and involved approximately 30 surface vessels, 4 maritime patrol aircraft and many North Sea helicopters. Nevertheless, because the initial search was concentrated primarily on an area immediately to the north of the Murchison, almost 8 hours elapsed before the first wreckage was sighted. It is obviously an advantage if those engaged in a search can be directed at an early stage to the correct area. Quite apart from greatly aiding the rescue of potential survivors, this would make it possible to reduce the resources required, time involved and therefore the cost of the search operation. One problem is that helicopters engaged in offshore operations are frequently out of range of ATC radar coverage. If a data link system is developed whereby the aircraft's position is periodically transmitted to ATC, this could be used to provide accurate information on a missing aircraft's last known position. An alternative solution would be to fit to helicopters an automatically deployed survival radio beacon which could be homed on by the searching forces.

3. Conclusions

(a) *Findings*

(i) Both pilots were properly licensed and had ample experience to carry out the flight.

(ii) The helicopter had a valid Certificate of Airworthiness and had been correctly maintained in accordance with an approved maintenance schedule.

(iii) At the time of departure the weather conditions were reasonable for the flight to commence; the degree of urgency attached to the medevac operation entitled the commander to use his discretion with regard to the adverse conditions encountered en route.

(iv) Because there was no radio beacon on the Baffin Seal, the helicopter's crew had to remain in visual contact with the surface in order to locate the ship and the weather conditions made it necessary to fly low in order to maintain this visual reference.

(v) After leaving the Murchison the aircraft flew a track which did not take it in close proximity to the ship's position but the reason for this could not be determined.

(vi) The crew had probably decided to discontinue their present track in order to extend the search area and were making a right turn when the aircraft struck the sea.

(vii) Although no evidence was found in the helicopter of any pre-impact malfunction, damage and immersion in the sea made it impossible to rule out the possibility of a failure in one of the electrical systems, the radio altimeter, or the stability augmentation system.

(viii) At the time of the accident the only navigational aid available to the crew was Decca, and the Decca/Danac flight log in the aircraft was showing an incorrect position and possibly causing a distraction to the crew.

(ix) The flight took place without pre-notice at a time of day when human performance is at a low ebb and more likely to be affected by distractions and disorientation.

(b) *Cause*

There was insufficient evidence to enable the cause of the accident to be determined although there can be little doubt that the difficulty of the task, adverse weather, the total darkness and the time of day were major contributory factors.

4. Safety Recommendations

It is recommended that:

4.1 Radio altimeters incorporating audio as well as visual decision height warning be fitted to all helicopters operating offshore around the British Isles.

4.2 Helicopters operating in the SAR role be equipped with automatic stabilisation equipment with at least an altitude hold facility.

4.3 Flight data recorders be fitted to as wide a range of helicopters as is practicable.

4.4 Public transport helicopters be fitted with a survival radio beacon which is automatically deployed on immersion in water or by impact forces.

4.5 Whenever an air traffic controlling authority is established on an offshore installation and arrangements made to record the aeronautical communications, consideration be given to extending the scope of the recording to cover the marine frequencies likely to be used by aircraft. (For the attention of the Department of Energy).

4.6 Whenever a SAR service is established, the operations manual should include an expanded discussion on the call out procedures and the relevance of any operational limitations and weather minima to the task involved.

L S H SHADDICK
Inspector of Accidents
Accidents Investigation Branch
Department of Transport

June 1984

Dd 736987 C7 3/84

Produced in England by Her Majesty's Stationery Office, Reprographic Centre, Basildon

Bas 258588/737610 700 8/84 TP