Accidents Investigation Branch

Department of Transport

Report on the accident to Cessna Citation 500 G-UESS 10 nm south-east of Stornoway aerodrome, Isle of Lewis on 8 December 1983

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 November 1982	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	August 1984
2/84	Bell 212 G–BDIL 14 miles from the Murchison Platform September 1982	September 1984
3/84	Cessna 404 Titan G–OEMA Over the North Sea April 1983	September 1984
4/84	Aerospatiale AS 332L G–TIGD Aberdeen Airport July 1983	
5/84	Cessna Citation 500 G–UESS Isle of Lewis December 1983	
6/84	Pilatus PC–6/H2–B2 Turbo Porter G–BIZP. Yarwell, Nr Peterborough December 1983	

First published 1985

ISBN 0 11 550675 6

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

23 November 1984

The Rt Honourable Nicholas Ridley
Secretary of State for Transport

Sir,

I have the honour to submit the report by Mr C C Allen, an Inspector of Accidents, on the circumstances of the accident to Cessna Citation 500, G–UESS, which occurred 10 nm south-east of Stornoway aerodrome, Isle of Lewis on 8 December 1983.

I have the honour to be
Sir
Your obedient Servant

G C WILKINSON
Chief Inspector of Accidents


G-UESS

Contents

Accidents Investigation Branch

Aircraft Accident Report No. 5/84
(EW/C857)

Operator:		Trans Europe Air Charter
Aircraft:	*Type:*	Cessna Citation
	Model:	500
	Nationality:	United Kingdom
	Registration:	G–UESS
Place of accident:		10 nm south-east of Stornoway aerodrome, Isle of Lewis, Scotland
Date and time:		8 December 1983 at 1746 hrs All times in this report are GMT

Synopsis

The aircraft was notified as missing to the Accidents Investigation Branch (AIB) by Stornoway Air Traffic Control on the evening of 8 December 1983. The investigation commenced the next day.

The aircraft left Liverpool to fly to Stornoway on a private flight carrying eight passengers, the pilot and a pilot's assistant. At a range of 10 nm from Stornoway, whilst descending at low altitude, the aircraft disappeared from the radar picture and ceased to reply to radio messages.

An intensive search was mounted that evening and continued for several days but was successful only to the extent of recovering a number of bodies of those on board. The main wreckage of the aircraft was not recovered.

The report concludes that the accident was probably caused by the pilot's lack of awareness of his true altitude, which resulted in his allowing his aircraft to descend until it struck the sea.

Likely contributory factors were that he was distracted by the need to establish visual contact with another aircraft and that he was misled by false cues from lights on the ground ahead of him.

1. Factual Information

1.1 History of the flight

On the day of the accident, the aircraft left Biggin Hill on a private flight at 1251 hrs with full fuel tanks to fly to Le Bourget, Paris, carrying a pilot, a pilot's assistant and two passengers. At Le Bourget, two more passengers embarked and the aircraft departed for Liverpool, without refuelling, at approximately 1355 hrs. It landed at Liverpool at 1525 hrs, where it was refuelled with 800 litres of turbine fuel, the pilot being seen to mix anti-icing additive to the fuel as it was dispensed. Two more adult passengers and two infants were embarked and the aircraft left Liverpool at 1632 hrs en route to Stornoway.

The pilot had submitted an Instrument Flight Rules (IFR) flight plan to fly from Liverpool to Stornoway at Flight Level (FL) 310 via Dean Cross and Glasgow. At 1653 hrs, when approximately over Dean Cross, he reported to the Scottish Air Traffic Control Centre (ScATCC) that he was at FL280 climbing to FL310. This radio call was heard by the pilot of another aircraft, registration N40GS. This aircraft was a Citation II, which had been leased by the operating company of G–UESS and was carrying other members of the same private party to which the passengers in G–UESS belonged. N40GS had taken off from Biggin Hill and was also en-route to Stornoway via Dean Cross at FL350. When just north of Dean Cross, the pilot of N40GS saw G–UESS ahead of him and established radio contact with its pilot on the company discrete radio frequency. From that point on, the two aircraft remained in intermittent radio contact on this frequency.

After passing Dean Cross, both aircraft were given clearance by ScATCC to route direct to Stornoway. At 1700 hrs G–UESS was asked to climb to FL330 to avoid crossing traffic. At 1718 hrs the pilot of N40GS reported that he still had G–UESS in sight and would be ready to descend in 3 minutes. At this time, his aircraft was slowly overtaking G–UESS. At 1720 hrs ScATCC directed both aircraft to maintain a radar heading of 330°(M) so as to provide lateral separation during descent, and cleared N40GS to descend. Three minutes later, G–UESS was cleared to descend. During the descent, N40GS was cleared progressively to FL65 and G–UESS to FL85. At 1729 hrs ScATCC released both aircraft from their radar headings, advising them that there was no other air traffic to affect them. ScATCC also advised N40GS that G–UESS was 5 miles to his right and slightly behind him. The pilot of G–UESS responded to this message by reporting that he had the other aircraft in sight. ScATCC then instructed both aircraft to establish radio contact with Stornoway.

At 1734 hrs Stornoway ATC passed details of the present Stornoway weather to both aircraft and asked them to report at 25 miles range from Stornoway. The weather as reported was fine with a light wind, good visibility and one eighth of low cloud. The pilot of G–UESS acknowledged the weather but did not repeat back the QNH*. At this time, G–UESS was 49 miles from Stornoway descending through FL140. At 1738 hrs N40GS reported at 25 miles range, and immediately afterwards G–UESS reported 30 miles from the airfield. N40GS was then cleared to 2,000 feet on the QNH of 1001.

*QNH is the corrected mean sea level barometric pressure at an airfield or for a specific area, and is used to indicate the altitude of an aircraft above mean sea level (amsl).

At 1740 hrs the pilot of G–UESS reported that his range was 25 miles and that he had N40GS in sight. He asked for clearance to continue his descent and was cleared by the Stornoway controller to descend at his discretion with the aircraft ahead in sight. A moment later he was asked to report when he had the airfield in sight for a visual approach to runway 01. He acknowledged this message. No further communication was received from the aircraft and at 1751 hrs, after failing to re-establish contact, the Stornoway controller reported to ScATCC that he had lost radio contact with G–UESS.

The pilot of N40GS, who had meanwhile landed safely, stated afterwards that during the descent from FL350 they had passed through some layered stratus cloud and patches of altocumulus and cumulus cloud. The co-pilot in N40GS described a layer of lower cloud over the sea with tops between 3,000 and 4,000 feet, lying across the path of their descent into Stornoway. The pilot of N40GS was tracking directly to Stornoway airfield during the descent, using Omega/VLF area navigation equipment. At 1745.20 hrs he reported to Stornoway ATC that he was just breaking cloud at 1,400 feet but stated later that he had cleared the base of the lowest cloud at between 1,100 and 1,000 feet, close to Stornoway. He also stated that the visibility below cloud was very good, even though the night was dark and he could not see the sea beneath him. N40GS experienced no icing and no significant turbulence during the descent.

An intensive search was made for G–UESS that night, and two bodies were recovered one mile north-west of the last observed radar position. During the next 4 days, five more bodies and some small pieces of aircraft wreckage were found near the same position. The bodies of two more passengers were recovered from the sea bed on 28 February and 5 June 1984, and that of the pilot's assistant on 18 July 1984. Attempts to recover the main wreckage were not successful.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	2	8	–
Serious	–	–	–
Minor	–	–	

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

There was no other damage.

1.5 Personnel information

1.5.1 *Commander:* Male, aged 33 years

Licence: Commercial Pilot's Licence, valid until 20 February 1987

Aircraft ratings:	Cessna 150, 170, 172, 175 and 182, Cessna 310 and 320 series, Piper Aerostar 601P, PA 30 and 39, PA 31, PA 28 and 32, Cessna Citation I and II
Instrument rating:	17 February 1983, valid until 16 March 1984
Last medical examination:	5 January 1983, valid until 31 January 1984 with no limitations
Flying experience:	Total hours as pilot: 3,300 (approximately)
	Total hours in command: 3,000 (approximately)
	Total hours on type: 350 (approximately)
	Total hours in preceding 28 days: 32
	Total hours in preceding 24 hours: nil

The pilot was the Managing Director of an air taxi company that was also responsible for the management of G–UESS, which was a corporate aircraft. In the year preceding the accident, he had rarely flown aircraft other than G–UESS, which he had flown to Stornoway on many occasions by night and by day. The owner of G–UESS, who had flown with him frequently, considered him to be a careful and conscientious pilot.

1.5.2 *Pilot's Assistant:*	Male, aged 42 years
Licence:	Private Pilot's Licence (Helicopters), permanent
Aircraft ratings:	Bell 206, Enstrom F28 and F280 series, Agusta A109A
Instrument rating:	Not instrument rated
Last medical examination:	4 October 1983, valid until 31 October 1984 with no limitations
Flying experience:	Total flying hours: 278

The pilot's assistant had no reported pilot hours on fixed-wing aircraft. He had been employed as Operations Manager by the company that managed G–UESS since 11 October 1983 for operations and co-ordination duties, mainly in regard to passengers. He flew regularly with the pilot concerned, habitually occupying the right-hand cockpit seat in the aircraft and looking after the welfare and comfort of the passengers in flight and on the ground. He had flown approximately 50 hours in G–UESS in this capacity but he had no responsibility for the handling of the aircraft or the control of the flight.

1.6 Aircraft information

1.6.1 Leading particulars

Type:	Cessna Citation 500
Constructor's number:	500–0326
Date of Manufacture:	November 1976
Certificate of Registration:	Registered in the name of Brencham Ltd in November 1979
Certificate of Airworthiness:	UK Private Category, first issued by the Civil Aviation Authority (CAA) on 1 July 1980 and valid until 6 July 1984
Maintenance:	The aircraft had been maintained in accordance with an approved manufacturer's schedule
Total airframe hours:	1871.7
Airframe hours since last inspection:	141
Engines (2):	Pratt and Whitney JT15D–1
Total engine hours (both):	1871.7
Engine hours since last inspection:	6.4

1.6.2 Weight and balance

Maximum weight authorised for take-off:	5375 kg (11,850 lb)
Actual take-off weight:	4959 kg (10,909 lb) (estimated)
Estimated weight at time of accident:	4306 kg (9,474 lb)
Estimated fuel remaining at time of accident:	405 kg (892 lb)
Type of fuel:	JET A–1
Centre of Gravity (CG) limits:	Aft limit: 255.9 inches aft of datum Fwd limit: straight line variation from 246.4 inches at 3409 kg to 250.0 inches at 5375 kg Fwd limit at estimated accident weight: 248.0 inches aft of datum

Estimated CG at time of accident:	248.9 inches aft of datum

1.6.3 *Autopilot and flight director system*

The aircraft was equipped with a Sperry SPZ 500 flight guidance system incorporating a Sperry RA 125 radio altimeter and a vertical navigation computer. Height indications were provided by an electric servo altimeter on the left-hand instrument panel, with the radio altimeter directly beneath it, and a simple mechanical altimeter on the right-hand panel. The automatic pilot could control pitch attitude to maintain constant altitude, indicated airspeed, vertical speed or vertical angle. A pitch synchronisation mode was also provided to maintain a constant pitch attitude that could be varied by rotation of the pitch control wheel on the autopilot controller. The autopilot could be used in any of these modes to fly to and maintain a preselected altitude. It was programmed to enter the altitude capture mode at a displacement from the selected altitude corresponding to one quarter of the rate of climb or descent. At 40 feet from the selected altitude, the autopilot would switch to altitude hold. The altitude capture mode could be overridden by selection of a new altitude, selection of a different vertical mode or by movement of the pitch wheel. The altitude hold mode could be overridden by movement of the pitch wheel. The altitude selector provided aural and visual warnings irrespective of whether the autopilot was engaged. At 1,000 feet from the selected altitude, an amber light on the left-hand altimeter would illuminate and a tone would sound. At 250 feet from the selected altitude, the light would extinguish. If the aircraft then diverged by more than 250 feet from the selected altitude, the light would illuminate and the tone would sound again. Altitude warnings were also provided by the radio altimeter in the range 0 to 2,500 feet, whereby at the selected decision height a light would illuminate on the instrument and an intermittent tone would sound. These warnings could be inhibited by winding the decision height bug above 2,500 feet.

1.6.4 *Intercommunication and radio telephone (RTF) equipment*

The aircraft was equipped with headsets for both cockpit positions. There were, in addition, hand microphones for each cockpit occupant, a boom microphone for use by the pilot, and cockpit loudspeakers. Noise level in the cockpit was low, and headsets were not usually worn, nor was there any requirement for them to be worn on private flights. It was the custom of the pilot to use microphone and loudspeaker for radio communications and to communicate with the other occupant of the cockpit without using the interphone amplifier.

1.7 Meteorological information

1.7.1 *Synoptic situation*

A depression centred to the west of Ireland was moving slowly eastwards and a slack, unstable, westerly airstream covered the area. Medium and high cloud associated with frontal systems extended as far north as the Hebrides. Although little low cloud was reported in the area of Stornoway, some reporting stations in the Hebrides reported developing cumulus and limited shower activity. The wind structure below 18,000 feet was fairly uniform in speed and direction.

1.7.2 *Actual weather conditions*

The winds and temperatures measured over Stornoway at 1800 hrs were as follows:

2,000 feet	280/15 kt	+5°C
5,000 feet	290/17 kt	–1°C
10,000 feet	300/16 kt	–10°C
18,000 feet	270/26 kt	–26°C

The 1650 hrs weather observation at Stornoway was:

> Surface wind 250/6 kt, visibility 20 km, 1 okta at 1,200 feet, 6 oktas at 22,000 feet, temperature +7°C, QNH 1001, QFE for runway 01 999.

The present weather passed to the aircraft at 1743 hrs was:

> Surface wind 290/5 kt, visibility 20 km, 1 okta at 1,200 feet, no other low cloud, temperature +7°C, QNH 1001, QFE for runway 01 999.

The 1750 hrs weather observation at Stornoway differed from that at 1650 hrs only in respect of the surface wind, which was then 290/4 kt.

An aftercast of the weather at the time of the accident prepared by the Meteorological Office estimated that cloud conditions near Stornoway comprised scattered cumulus, base 1,200 feet to 1,800 feet and tops 10,000 feet, with occasional layers of autocumulus, altostratus and cirrus between 12,000 and 30,000 feet. Occasional showers were possible, although none were reported at Stornoway, Benbecula or Tiree. The sea temperature was +10°C and the dew point over the sea was +8°C. There was little likelihood of low cloud over the water. The accident occurred at night.

1.8 **Aids to navigation**

It was customary for the aircraft to be equipped at all times with aeronautical charts, airfield approach plates and flight information documents for the United Kingdom and Western Europe and there is no reason to believe that it was not so equipped on the accident flight. The aircraft was equipped for flight under IFR with 2 VHF omni-directional range (VOR) receivers, one distance-measuring equipment (DME) and one automatic direction finding (ADF) receiver. A weather radar with mapping facility was installed. The aircraft was not equipped with area navigation equipment.

At Stornoway there is a VOR transmitting station located 4.6 nm from the aerodrome on a bearing of 105°(T), frequency paired with a TACAN beacon located 3/4 nm west of the aerodrome, which responds to interrogation by aircraft DME. There is a non-directional locator beacon (NDB) situated 3.9 nm north of the aerodrome. There were no reports of faults of these radio aids at the pertinent time. A secondary surveillance radar (SSR) head located 1.0 nm west of Stornoway airfield is provided for use by ScATCC to control en-route traffic but the picture from this radar is not displayed to the Stornoway controller.

1.9 Communications

VHF communication between the aircraft and ground radio stations was satisfactory and routine on all ATC frequencies used on the route from Liverpool to Stornoway. The aircraft also communicated satisfactorily with N40GS on the company frequency of 130.65 MHz on a number of occasions during the flight, but these communications were not recorded. The last communications with the aircraft were as follows:

1739.50	G–UESS to Stornoway	"AND SIERRA SIERRA'S TWENTY FIVE NOW. ARE WE CLEARED DOWN? WE HAVE GOLF SIERRA IN SIGHT."
1739.55	Stornoway to G–UESS	"ROGER GOLF SIERRA SIERRA, AT YOUR DISCRETION DESCEND WITH THE NUMBER ONE IN SIGHT."
1740.02	G–UESS to Stornoway	"SIERRA SIERRA COPIED."
1740.05	Stornoway to G–UESS	"AND GOLF SIERRA SIERRA ALSO REPORT GETTING THE FIELD IN SIGHT FOR VISUAL RUNWAY ZERO ONE."
1740.10	G–UESS to Stornoway	"SIERRA SIERRA."

Four and a half minutes later, the Stornoway controller asked N40GS if he had the airfield in sight, to which the pilot replied "NEGATIVE THIS TIME". At 1745.20 hrs, the pilot of N40GS reported that he was just clearing cloud at 1,400 feet. At 1746 hrs, immediately after passing landing clearance to N40GS, the controller called G–UESS but received no reply to this or to his subsequent transmissions. No emergency or distress messages were heard from G–UESS on the frequency in use, 123.5 MHz, or on the international distress frequency, 121.5 MHz. After the accident, the controller stated that when, at 1739.50 hrs and 25 nm from Stornoway, G–UESS requested clearance to continue descent, he permitted descent at pilot's discretion because he was convinced that with N40GS in sight, the pilot of G–UESS would not have accepted any restriction to his descent. The controller also expected both aircraft to establish visual contact with the airfield at an early stage of their approach.

1.10 Aerodrome information

Stornoway aerodrome is situated on a peninsula 1.5 nm east of Stornoway town at an elevation of 30 feet amsl, and lies outside controlled and special use airspace. It is operated by the Civil Aviation Authority, licensed for public use, and its operating hours are 0815 hrs to 1700 hrs Monday to Friday and 0930 hrs to 1500 hrs on Saturdays, except by prior arrangement. The Stornoway Air Traffic Unit provides aerodrome control and an advisory approach service. There is a Category 1 instrument landing system (ILS) on runway 19. Runway 01 has a Calvert approach lighting system with a centre-line of 914 metres and 5 bars but no visual approach slope indicators (VASIs). The approach to runway 01 is over the sea until 1500 metres from the runway threshold. The minimum safe altitude in the south-east quadrant within 25 nm is 2,100 feet.

1.11 Flight recorders

Neither a flight recorder nor a cockpit voice recorder was required or fitted.

1.12 Wreckage and impact information

1.12.1 The search for the aircraft wreckage

On 9 December, a suitably equipped vessel was chartered by the AIB to search for the wreckage of the aircraft; however adverse weather and sea conditions prevented the start of this search for several days. On 13 December, the nets of the vessel encountered a substantial object on the sea bed at a position half a mile north-west of the last radar position of the aircraft, at a depth of approximately 360 feet. As the object was lifted off the sea bed, a strong smell of kerosene surrounded the vessel. At approximately 60 feet from the surface, the object broke through the nets and sank again to the sea bed. When the trawl gear was hauled, it was substantially damaged but was found to contain several pieces of aircraft wreckage.

After repairs to the trawl gear, the area around where the object had been dropped was searched again without success. The salvage operation was terminated on 14 December 1983.

1.12.2 Wreckage

A small quantity of wreckage was recovered from the sea in the area where the last radar return was seen. This wreckage consisted of:

- left and right main landing gear wheels and legs
- nose wheel
- left nose baggage door
- two unpacked lifejackets
- one inflated lifejacket*
- interior furnishings and trim (small pieces)*
- one passenger seat*
- forward lower fuselage skin
- sections of right wing/fuselage fairing skin
- right nose baggage door rear frame structure
- left cockpit seat

1.12.3 Subsequent detailed examination

The wreckage was recovered to the AIB engineering facility at Farnborough, where identification and examination were undertaken. None of the items showed any evidence of fire, smoke or explosion damage.

1.12.3.1 Landing gear

The main landing gear was virtually intact except for the hydraulic actuators. The gear uplock rollers were undamaged and showed no evidence of having been engaged in the gear uplocks at impact. The fractures on the trunnions indicated a large amount of rearward bending prior to failure.

* Items recovered from the sea surface within 24 hrs of the accident

1.12.3.2 Passenger seat

The front, left-hand, rearwards facing seat was recovered. Examination of the fractures indicated that the forward aisle side of the seat pan had failed in download, the aisle side of the seat back had failed from a rearward load, and the fuselage arm and seat-back had failed from a rearward load which had been applied predominantly at the upper forward left side of the seat-back. There was no evidence on the seat belt or its buckle to show whether it had been fastened or unfastened at impact.

1.12.3.3 Aircraft structure

The pieces of the airframe structure recovered were mainly small areas of metal skinning that gave no indication as to the type of impact that had occurred. The left nose baggage door was virtually undamaged but there was no indication of pre-impact failure or opening. The right nose baggage door rear frame structure was severely distorted.

1.12.3.4 Cockpit seat

The left-hand cockpit seat was recovered in the nets of a fishing vessel on 18 July 1984. The seat back had been subjected to a heavy rearwards load that had caused it to fold backwards to a near horizontal position. There was insufficient evidence to establish whether or not the safety harness had been fastened at impact.

1.13 Medical and pathological information

The bodies of the pilot and 6 of the passengers were recovered from the sea within 6 days of the accident. Post-mortem examination revealed that all had died from drowning. The pilot had suffered several broken ribs, laceration of the upper scalp and a violent impact injury to the left leg with severe dislocation of the pelvis. There was no evidence that he had any pre-existing medical condition that could have had any bearing on the accident.

None of the passengers had suffered broken limbs and body marks showed only minor bruising, consistent with a ditching of the aircraft rather than an impact with the sea. Similarly, examination of the bodies of the 2 passengers and the pilot's assistant recovered from the sea some time later revealed no major injuries and no cause of death other than by drowning.

No evidence was revealed at the post-mortem examinations to indicate who, if anyone, had occupied the right-hand cockpit seat at the time of the accident.

1.14 Fire

There was no evidence of fire.

1.15 Survival aspects

1.15.1 Reaction of emergency services

At 1749 hrs, when it was clear to the ATC controller at Stornoway that he had lost radio contact with G–UESS, he asked ScATCC if the aircraft could still be seen on radar. By 1754 hrs it was apparent that radar contact with the aircraft had also been lost. The Stornoway controller reported to ScATCC that, to the best of his recollection, his last radio contact with G–UESS had been at about 1746 hrs. The crew of N40GS reported that they had last had visual contact with G–UESS at about the same time in a position south-south-east of Stornoway at a range of 28 to 30 nm. The Distress and Diversion Cell (D&D Cell) at ScATCC, whose task it was to establish the last known position of the aircraft and pass it to the Rescue Co-ordination Centre (RCC), used the position reported by the crew of N40GS as the most up-to-date information available at that time, and passed this position to the emergency services. It was also established that the aircraft had carried a life-raft, a life-jacket for each passenger and one hand-held emergency locator beacon capable of transmitting on 121.5 and 243 MHz. At 1757 hrs HM Coastguard at Stornoway broadcast to shipping in the area, requested the launch of the Stornoway and Lochinver lifeboats and alerted the coast rescue companies around the shores of the sea area south of Stornoway. Two surface vessels responded immediately to the broadcast and proceeded to the search area, to be supplemented later by several fishing vessels. At 1802 hrs a search and rescue helicopter was ordered to scramble from Lossiemouth, and a Nimrod aircraft was alerted at Kinloss. The helicopter was standing by at 45 minutes readiness, having relaxed from a 15 minute stand-by at dusk, as is usual, and was required to refuel to full tanks in preparation for a long search. It took off at 1823 hrs. A Nimrod about to take-off from Kinloss on another task was diverted to the search area at 1822 hrs. A United States Air Force F111 aircraft already airborne near the area, diverted to the search area and arrived overhead Stornoway at 1842 hrs, whence it conducted a line search from Stornoway to the last known position of G–UESS. The Nimrod arrived in the search area at 1915 hrs and the rescue helicopter, having been delayed by bad weather en-route, arrived at 1927 hrs.

Whilst these aircraft and surface vessels were in transit to the search area, efforts continued to determine more accurately the most likely position of G–UESS. No controller at ScATCC had followed the aircraft on radar after it descended through FL85 because, by then, it was no longer in controlled airspace and was in contact with Stornoway. At 1913 hrs ScATCC informed the RCC that radar recordings were to be replayed. From the recording of the SSR head at Stornoway it was discovered that G–UESS had been seen on radar to a position estimated to be 9.6 nm from Stornoway on a bearing of 160°T. At 1929 hrs this latest "last known position" was passed to the RCC and used as a new search datum.

1.15.2 The search for survivors

When the new datum was notified to the search forces, the Stornoway lifeboat was in transit close to the new position and was able to search immediately. The Nimrod, the rescue helicopter and several other surface vessels moved to the new datum and began an intensive search. At approximately 2250 hrs a surface vessel found the body of a female passenger wearing a partially inflated life-jacket. The life-jacket was fitted back to front and the securing straps were tied between the legs. The light on the jacket was not illuminated. Both of the CO_2 inflation capsule seals and safety ties were intact but one of the two chambers of the jacket had been inflated to a fairly high pressure. The crew member who recovered the body from the water reported a strong smell of "diesel", which appeared to come from the clothing on the body. At approximately 2230 hrs the Lochinver lifeboat recovered from the sea the body of another passenger, which had no life-jacket on.

The search continued that night until 0330 hrs, when it was temporarily halted by deteriorating weather, although a Nimrod aircraft remained at the scene throughout the night. The search began again at first light on 9 December and continued until last light on 10 December. During this period the bodies of two more passengers were recovered. The bodies of the pilot and one more passenger were recovered from the sea bed by the vessel that searched for the aircraft wreckage on 13 and 14 December 1983. The bodies of three more passengers were found in the nets of fishing vessels on 13 December 1983, 28 February 1984 and 5 June 1984, and that of the pilot's assistant on 18 July 1984.

1.15.3 *Playback of radar recordings*

The installation of new radar recorders with a video replay facility began at ScATCC in March 1983. At the time of the accident, the equipment was still undergoing technical evaluation, and transfer of responsibility for the equipment to ScATCC telecommunications engineers did not take place until a month later. Accordingly, on the day of the accident, the recorders were not at operational status and no formal procedures had been prepared whereby ATC staff could readily review playbacks of radar recordings to establish the last known radar position of a missing aircraft. Nevertheless, the ATC staff were aware of the equipment and its capability. At an early stage of the search, the watch supervisor called for a replay of the relevant radar recordings but, in the event, because of some lack of liaison within ScATCC, information from these recordings was not available to the search forces until 1½ hours after G–UESS had been reported missing.

1.16 Tests and research

1.16.1 *Radar recording*

A recording of SSR returns to the radar at Stornoway from both N40GS and G–UESS was available covering the tracks of both aircraft from 1738 hrs to 1747 hrs. The data available from the recording were: aircraft range from the radar head, accurate to 1/16th nm; aircraft bearing, accurate to 1/10th of a degree, and aircraft height from Mode C SSR, accurate to ± 125 feet. Mode C height is from a datum of 1013 mbs. With a QNH of 1001, the height of the aircraft above mean sea level would be approximately 350 feet below the Mode C height. A plot of radar positions is at Appendix 1.

Aircraft groundspeed and rate of descent for each 10 second period of the last 8 minutes of flight were calculated from the radar recording. Groundspeed was converted to true airspeed (TAS), allowing for the wind velocities measured at Stornoway at 1800 hrs. TAS was then converted to calibrated airspeed (CAS), allowing for height, ambient temperature and local pressure.

1.16.2 *Analysis of radar plot*

The radar plot shows that at 1737 hrs G–UESS was 40 nm from Stornoway, descending through 11,000 feet amsl at a groundspeed of approximately 287 kt. N40GS was 4.8 nm ahead of G–UESS, 1,000 feet lower and flying at a slightly lower groundspeed. Both aircraft were tracking approximately 332°(T), the track of G–UESS being displaced to the right of that of N40GS by less than half a mile. During the next 4 minutes, the track of N40GS altered slowly to the left through some 20°. G–UESS followed this track change, maintaining the same displacement to the right. By 1740 hrs G–UESS had reduced its groundspeed to approximately 260 kt and was 4.5 nm behind N40GS. At this time, G–UESS checked its descent for about 20 seconds at 6,750 feet amsl, whilst obtaining clearance for further descent. At 1741.30 hrs N40GS was descending through 4,000 feet at a groundspeed of approximately 240 kt, decelerating slowly. G–UESS was 500 feet above N40GS decelerating more rapidly through approximately 235 kt. Both aircraft were still maintaining similar tracks. Shortly before 1743 hrs, at a range of 11 nm from Stornoway, N40GS descended below the lowest reported height of the cloud tops at 3,000 feet amsl and continued descending until it levelled off at 1,400 feet, which it maintained until 1746 hrs, when its radar range from Stornoway was 4 nm. G–UESS descended through 3,000 feet very shortly after N40GS, at a groundspeed of approximately 160 kt, when its radar range from Stornoway was 14 nm. Its rate of descent then increased significantly and its groundspeed continued to reduce. G–UESS descended from 3,000 to 1,000 feet in approximately 85 seconds and, during this time, it began to turn slowly to the right, directly towards the Stornoway VOR. At 1944.30 hrs, G–UESS descended below 1,000 feet amsl at a range of 12 nm from Stornoway. At this time its groundspeed was approximately 140 kt, still reducing, and its rate of descent had reduced to approximately 1,200 fpm and stabilised. It continued to descend and decelerate until it disappeared from radar at 1745.20 hrs at a height of approximately 50 feet amsl, ± the possible maximum error of 125 feet. During the last 1,000 feet of the descent its groundspeed reduced to approximately 124 kt but the radar trace showed no significant variation of track or rate of descent, which remained at approximately 1,200 fpm, a rate appropriate to the use of not less than idle power.

1.16.3 *Flight tests*

Flight tests were conducted in a Citation of the same model as G–UESS to measure power settings and rates of descent at different airspeeds and configurations. The test aircraft was flown at the same weight as that estimated for G–UESS at the time of the accident. Engine power was measured in fuel flow as this gave the most accurate measure of power in the cockpit and could be set more precisely than N1 rpm. The rates of descent measured on the first flight were compared with those calculated for G–UESS from the radar plot, and the likely times at which flaps and landing gear were selected on G–UESS were determined. A hypothetical flight profile was constructed to emulate the last 10,000 feet of the descent of G–UESS towards Stornoway.

This hypothetical profile was then flown and recorded on radar, again at the estimated accident weight of G–UESS. In the descent from 10,000 to 4,500 feet, power settings between 450 and 600 lb/hr/engine were found to parallel closely the flight path of G–UESS. At 4,500 feet it was found necessary to reduce to idle power in order to decelerate to the maximum speed for lowering approach flap. Idle power was maintained for 30 seconds, then approach flap was lowered at 4,100 feet and 202 kt IAS, and power was increased to 300 lb/hr/engine. Landing gear was lowered at 3,100 feet and 176 kt IAS, and the descent was continued at 300 lb/hr/engine. At 2,000 feet it was apparent that the rate of descent was less than that achieved by G–UESS, and idle power was again selected for 30 seconds before 300 lb/hr/engine was restored. The flight path achieved during this first trial descent had been similar to that of G–UESS until 3,600 feet but below that height, despite the low power settings used, the rate of descent of the trial aircraft was not as great as that of G–UESS.

Accordingly, a second descent was flown from 4,000 feet with approach flap and landing gear lowered. For this trial, the power levers were advanced just enough to give a reading on the fuel flow meters just above idle power. (Idle power in the test aircraft gave a fuel flow meter reading of 180 lb/hr/engine; with the power levers advanced ¼ inch, fuel flow indicated 220 lb/hr/engine.) Again, the achieved rate of descent was too low, and idle power was selected for 40 seconds as the trial aircraft descended from 2,800 to 1,900 feet; during this period the rate of descent equalled that of G–UESS. When power was restored to 220 lb/hr/engine, the achieved rate of descent was again slightly less than the 1,200 fpm achieved by G–UESS.

At the end of the second trial run, full power was applied on one engine only, with the other engine at idle power. At the accident weight, the aircraft was found to be capable of transition from a descent at 1,200 fpm at 124 kt, with approach flap and landing gear down, to climb in clean configuration on one engine with a height loss of no more than 50 feet.

A further flight was made by night to observe the lights of Stornoway from overhead the crash position. Although there was bright moonlight and no cloud, the sea could not be seen from 500 feet amsl. The only lights visible were those of Stornoway and the Eye Peninsular, which formed a near continuous line of lights that subtended a horizontal angle of approximately 40° at the pilot's eyes. Because some of the lighted areas north of the town and on the peninsular are on higher ground, the area of lights appeared to have depth, as if being observed from a higher altitude. Because of the combined effect of the width and apparent depth of the lights, all three pilots on board the test aircraft underestimated their distance from Stornoway and greatly overestimated their height over the sea. Two runs were made, one at 1,000 feet and one at 500 feet. The visual aspect of the lights was much the same at both heights. Even from 500 feet, the lights gave no visual cue to cause concern, and all three pilots experienced a false impression of being at a safe altitude.

Following the flight trials, data relating to the trial descents were extracted from radar recordings and compared with equivalent data relating to the final descent of G–UESS. The descent profiles are shown at Appendix 2. In summary, the results show that the profile achieved by the test aircraft flying with approach flap and landing gear selected at maximum permissible speeds was the same as the profile flown by G–UESS down to approximately 3,600 feet. In the last part of the descent, the rate of descent of the trial aircraft, using a power setting only marginally above idle, was slightly less than that of G–UESS.

1.17 Additional information

1.17.1 Research into night visual approaches

In 1968, Drs Kraft and Elworth of the Boeing Aerospace Company conducted a research programme to investigate the problems of night visual approaches.* Their results demonstrated that the visual cues available to a pilot approaching a lighted area at night over unlit terrain are misleading and inadequate. The most relevant visual cue was found to be the vertical angle subtended at the pilot's eye between the nearest and the farthest lights, ie the apparent depth of the light pattern. Extensive simulator tests disclosed a tendency, during a descent, for pilots to maintain this angle at a constant value, which resulted in their flying an

* The results of this research were first published in the USAF magazine Interceptor in October 1968.

approach path along the arc of a circle centred over the pattern of lights with its circumference intersecting the terrain short of the lights, ie to fly into the ground short of the target aerodrome. There was also a common tendency for pilots to grossly overestimate their height in these circumstances. Both of these tendencies were exaggerated if the plane of the lights was inclined slightly towards the approach path. The other significant visual cue came from the motion of the light pattern relative to the pilot's eye, but this motion must exceed a rate of change of approximately one minute of vertical angle per second before it can be perceived by most pilots. Thus, when flying an approach over a dark area at 1,000 feet and 120 kts, few pilots would be capable of perceiving the relative motion of the tilt in the plane of the lights that would alert them to an excessive rate of descent until within 3½ miles of the light pattern.

1.18 **New investigative techniques**

None.

2. Analysis

2.1 General

The investigation of the accident was hindered by the fact that no significant part of the aircraft was recovered from the sea bed. The evidence available was largely confined to that contained in the RTF transcripts, the radar recording of the aircraft's final flight path and the post mortem examination of the bodies that were recovered. Transponder returns from the aircraft indicated that electrical power was available from some source until the last measured transponder height of 400 feet, equivalent, when corrected for ambient pressure and limits of error, to between sea level and 175 feet above the sea. Power would therefore have been available to at least one VHF radio and it was seen as particularly significant that no radio transmission of a distress or emergency condition was made by the aircraft at any time. The flight trials undertaken during the investigation showed that the descent path of the aircraft was not abnormal in any respect except that the deceleration and descent to aerodrome traffic height took place early, and that the descent continued at an almost constant rate until the aircraft disappeared from radar virtually on the direct track to, and to within 10 nm of, the aerodrome. A principal part of the investigation, therefore, consisted of the reconstruction and analysis of the most likely pattern of events that took place during the final stages of the descent.

2.2 Evidence of the nature of the impact

Examination of the wreckage showed that the landing gear was locked down at the time of the accident and that the left forward passenger seat had been subjected to a high rearward load. That this seat and some pieces of interior trim were found floating on the surface after the accident appears to indicate that there was some disruption of the forward fuselage on impact. The major injuries suffered by the pilot support this supposition but, because no other person on board had suffered similarly serious injuries, there is no evidence to indicate who, if anyone, was occupying the right-hand cockpit seat. It is even possible that if, at this late stage of the flight, the pilot's assistant was clearing and preparing the passenger cabin for landing, this seat could have been empty.

The fact that no person other than the pilot suffered serious injury also indicates that there was no violent impact with the sea such as would have occurred if the aircraft had entered the water at its last measured groundspeed and rate of descent. It seems likely therefore that the pilot was able to reduce the rate of descent in the last few seconds before impact and that he thus had some control over the pitch attitude of the aircraft at that time. There is no evidence to indicate whether or not the aircraft remained on the surface for any length of time after impact but the discovery that night of the body of a female passenger wearing a life-jacket leads to the supposition that some time was probably available for escape from the aircraft before it sank. The life-jacket would not have been fitted in the way it was if it had been worn in the aircraft during flight, nor would it have been inflated. The fact that it had been inflated orally suggests that it may have been inflated after escape from the aircraft, either by the wearer or by another passenger, whose body was found nearby. The strong smell of what was described as "diesel" on the woman's clothing reported by the crew of the vessel which recovered the body indicates that at least one fuel line or fuel tank was ruptured when the aircraft hit the sea.

There must be a strong presumption therefore that the aircraft was under control at the time of the accident, that the pilot was not aware of the sea beneath him until seconds before the impact and that, although the impact was severe enough to disrupt the fuselage and some part of the fuel system, it was not severe anough to render all the passengers unconscious. After the impact, it was possible for at least the two passengers whose bodies were found on the surface that night to escape from the aircraft through an escape hatch or through some hole opened up in the pressure cabin by the impact. The absence of burn or fragmentation marks on the bodies of all the passengers recovered allows fire or explosion to be eliminated as a possible cause of the accident. Similarly, the nature of the impact rules out the possibilities of major structural failure or total loss of control.

2.3 Aircraft considerations

The aircraft had descended from FL 330 to below the freezing level, passing through only small amounts of cloud. The temperature at the top of the lowest cloud, which was reported to be not above 4,000 feet, was not less than +1°C. The preceding aircraft had followed a similar descent path and experienced no icing therefore the possibility of ice having affected the flying or control characteristics of the aircraft may be discounted. Similarly, the possibility of the engines having been affected by atmospheric icing is most improbable. Loss of power for other reasons merits consideration although there is no evidence that the engines were operating at either above or below idle power at any time during the last 4,000 feet of the descent. As demonstrated during the flight trials, the loss of power on only one engine would not have prevented the pilot from checking the descent; therefore, for engine failure to have been a possible cause of the accident, both engines would need to have either lost power or to have failed to respond to their power levers at the same time. However, a complete loss of power would have caused a significantly higher rate of descent than that recorded. Moreover, it is reasonable to suppose that the pilot would not knowingly have descended much below 1,000 feet so far from the aerodrome and therefore that he would have discovered any engine problem in time to transmit an emergency message if he had indeed experienced loss of power. The radar plot shows that the descent from 1,000 feet to sea level took at least 50 seconds, and the pilot would have been well aware of the vital importance of transmitting such a message – however brief – before ditching in the sea.

Nevertheless, possible reasons for double engine failure were examined. The JT15D engine has a good record of reliability in service and has no history of compressor stall or flame-out, nor were conditions conducive to either problem in that the aircraft was not executing any maneouvre and there was no severe turbulence reported. The probability of a simultaneous mechanical failure of both engines may also be discounted as extremely improbable. Fuel icing could, in extreme circumstances, have caused a near simultaneous failure but there is no evidence that this is likely to have occurred. The fuel sample taken at Liverpool was free of water contamination and the rest of the fuel in the aircraft's tanks had been used on the two previous flights that day without any reported problem. Moreover, normal precautions against fuel icing had been taken by the pilot at Liverpool during the last refuelling.

The fuel estimated to have been in the tanks at the time of the accident was not less than 405 kg (892 lb). Confirmation that some fuel was left in the aircraft came from the smell of "diesel" on one of the bodies recovered that night and from the search vessel, which found a smell of kerosene on the surface of the sea in the area of the accident five days later, after its nets had engaged and partially lifted a heavy object from the sea bed.

The possibility was also considered that a multiple bird strike might have caused simultaneous engine failure or such severe damage to the cockpit as to incapacitate the pilot. However, the likelihood of such a severe bird strike at night 5 miles from the nearest shore is extremely remote; it is known that sea birds rarely fly at night, except near fishing vessels, of which none were known to be in the area at the time. In any case, a multiple bird strike would be extremely unlikely to occur above 1,000 feet and would provide no explanation of why the aircraft should ever have descended to and below 1,000 feet when still 12 miles from its destination.

2.4 Pilot incapacitation

Incapacitation or fatigue were considered but discounted in view of the pathological evidence, the known fitness of the pilot and the fact that his flying duty time that day had been no more than 6 hours.

2.5 Operational considerations

2.5.1 The descent from 10,000 feet to 4,000 feet

From examination of the flight path of G–UESS it is apparent that the operation of the aircraft was influenced by the presence of the other aircraft 5 miles ahead.

During the 5 minutes that it took both aircraft to descend from 10,000 to 4,000 feet amsl, G–UESS altered heading to follow the track of N40GS as the latter navigated to Stornoway using its area navigation aid. As there was no navigational reference other than the lights of N40GS by which G–UESS could have followed this track, it is reasonable to suppose that the pilot of G–UESS had N40GS in sight throughout this time. The flight trials showed that he must have been using a fairly low power setting at this time and must have maintained a similarly low power setting until he passed through approximately 4,000 feet. As G–UESS reduced both speed and rate of descent at about 5,000 feet, it is possible that the pilot wished to increase his distance behind N40GS prior to arrival at Stornoway; this would have been a normal action for him to take at this stage.

2.5.2 The descent through cloud

Shortly after 1742 hrs N40GS descended through 4,000 feet amsl. G–UESS at this time was only 500 feet higher and decelerating quite quickly. The flight trials showed that between 4,000 and 3,000 feet, G–UESS must have used only idle power and must have extended both approach flap and landing gear at close to the maximum permissible speeds. At 1743 hrs and a height of 3,800 feet amsl, the track of G–UESS began to diverge from that of N40GS, turning slowly to the right towards the Stornoway VOR. This suggests the probability that G–UESS lost sight of N40GS at about this time as both aircraft descended into cloud.

It was only at this stage of the flight that the operation of G–UESS began to differ from a fairly typical descent to a destination airfield. Even then, it would not have been unusual if the same flight path had been flown in visual conditions and closer to the destination. However, from the evidence available, the rapid descent of G–UESS between 3,000 and 1,000 feet was flown in cloud between 15 nm and 12 nm from Stornoway. It is necessary, therefore, to consider possible reasons why the pilot of G–UESS should have descended below the minimum sector safe altitude of 2,100 feet at this time. He would have known that the lowest cloud reported at Stornoway was one okta at 1,200 feet, that he was 5nm behind N40GS and that both he and the other aircraft were cleared for visual approaches to runway 01. He would probably have expected N40GS to fly a straight-in approach and shortly to reduce to approach speed. Having temporarily lost sight of this aircraft, he had two choices: to level-off and maintain safe height separation from it, or to anticipate its speed reduction, descend quickly below the cloud and re-establish visual contact with it. He could well have thought that, if he chose to level-off, he might arrive over Stornoway in or over cloud and so have to fly an instrument let-down pattern before landing. On the other hand, he would probably have wished to land as soon as possible behind the other aircraft so as not to delay the occupants of that aircraft.. It seems likely that, accordingly, he chose to slow down early and keep a safe distance behind the aircraft ahead. He was familiar with Stornoway and, from his DME range and VOR bearing, he would have known that he was over the sea and might well have considered it not imprudent to continue his descent to visual conditions below cloud.

There remains some doubt about his altimeter setting because, when he reported to Stornoway that he had copied the weather information, he did not read back the QNH, as would have been standard practice. It was then that he should have set the aerodrome QNH of 1001 on his altimeter sub-scale if he had not already done so but, if he did in fact continue his descent on the standard setting of 1013, his altimeter would have been over-reading by approximately 350 ft.

2.5.3 *The descent below cloud*

The radar plot shows that N40GS levelled off at approximately 1,400 feet amsl and appears to have been in cloud until just after 1745 hrs, when its pilot reported breaking cloud at 4 miles from Stornoway. By this time, because of the early speed reduction of G–UESS, the distance between the two aircraft had increased to 5¾ nm. The base of the cloud over the sea is not known precisely. N40GS reported breaking cloud at 1,400 feet close to Stornoway but, away from the influence of the land, the cloud base in the area where G–UESS was descending could have been lower. However, with a difference of 2°C between the sea temperature and the dew point, it is unlikely that the cloud base over the sea would have been lower than 1,000 feet. G–UESS reached 1,000 feet amsl at approximately 1744½ hrs, still decelerating and, on the evidence of the flight trials, using no more and no less than idle power. It is now appropriate to examine why the aircraft should have continued to descend with no apparent change of power until it disappeared from radar 50 seconds later.

As described in sub-paragraphs 2.2 and 2.3, a malfunction of the aircraft seems extremely improbable. The only other possible explanation is that the pilot was not monitoring the flight instruments. In the circumstances, some credence can be given to this supposition. Having had N40GS in sight for most of the descent, he had probably not seen it for two minutes since it entered the cloud layer. Although he had reduced to little more than his final approach speed, he might have thought it likely that N40GS had also slowed down and might even have been manoeuvring across his track whilst lining up for the approach to the runway. Thus, when he broke cloud, he would probably have wished to confirm as quickly as possible that he still had safe separation from N40GS and was far enough behind it to land without flying an additional orbit. It seems a reasonable hypothesis that, once clear of cloud, he was, in fact, looking ahead for the lights of N40GS against the background of the lights of Stornoway, a task that would have been difficult even if the other aircraft had been clear of the cloud, which, at that time, it was not.

The pilot may also have considered that the lights of Stornoway gave him a good reference for visual flight. However, it is a known aeronautical phenomenon that an area of lights viewed in the distance from over unlit terrain gives a poor indication of true height. The research conducted by the Boeing Aerospace Company showed that, when making a visual approach to such an area of lights, most pilots would over-estimate their height; a situation the pilots who flew the trials after this accident found to be true for the lights of Stornoway when approached from the south-east. Although the pilot of G–UESS had flown into Stornoway on many occasions, both by day and night, he would not normally have descended as low as he did on the night of the accident whilst so far out from the aerodrome.

2.5.4 *The altitude alerting systems*

It is also a matter of conjecture as to why neither the altitude pre-select audio warning nor the radio altimeter warnings installed in G–UESS did not alert the pilot to his low altitude. It is possible that he had engaged the auto-pilot, set a safe altitude on the altitude selector, and was expecting the auto-pilot to level the aircraft at the selected altitude. If this was the case, and he then adjusted the rate of descent with the pitch wheel at a critical time, he could have overridden the altitude capture mode of the auto-pilot. It is more likely, however, that at this stage of the flight he was flying the aircraft manually. In either case, the altitude warnings would have operated if set. It may be, however, that, not knowing the height of the cloud base, he had not changed the previous setting on the altitude selector from, say, 8,500 feet, which was his last cleared flight level, and it would then have given its last warning as the aircraft descended through 8,250 feet. Also, because he intended to fly a visual approach, he may not have selected any decision height on the radio altimeter, the bug of which might have been wound to over 2,500 feet to avoid unwanted warnings. Finally, it is even possible that the warnings were armed and did indeed operate but were not noticed because the cockpit speakers were in use and the pilot was talking to someone in the aircraft as he searched ahead for sight of N40GS. Whatever the true reason for the lack of effectiveness of these audio warnings, it seems clear that the pilot remained unaware of his low height until only moments before the aircraft hit the sea.

2.6 The balance of the evidence

In summary, although the aircraft wreckage was not recovered, there are three predominant factors which strongly indicate that the aircraft was serviceable when it hit the sea. The aircraft maintained a steady flight path throughout the latter part of the descent, the pilot made no distress call, and the evidence suggests that he had sufficient control of the aircraft to reduce the severity of the impact. Thus, the balance of the evidence indicates that the pilot was distracted from his aircraft instruments, probably by the need to re-establish visual contact with the aircraft ahead, that he had a false impression that he was at a safe height, and that he failed to check the aircraft's descent until too late.

2.7 Air traffic control

In considering the air traffic control aspects of the accident, the action of the Stornoway controller in permitting the pilot of G–UESS to continue descent at his own discretion was examined. With only one okta of cloud at 1,200 feet and visibility of 20 km, it was reasonable for him to expect both aircraft to see the airfield from some distance away. Moreover, because the pilot of G–UESS had reported that he had N40GS in sight, it was also reasonable for him to suppose that not only did the pilot wish to follow N40GS but, in the prevailing conditions, it was possible for him to do so safely. Knowing from their reported DME ranges that the aircraft were separated by 5 nm horizontally, the controller had no reason to advise an additional vertical separation, and he accepted the reduced separation standard applicable in the vicinity of an airfield to aircraft in visual contact, as he was permitted to do. The 4½ minute period after 1740 hrs, when the controller made no transmissions was also reasonable, as he had no reason to suppose that operations were other than normal, and the next call expected was from N40GS reporting the airfield in sight. The controller had no reason to suppose that G–UESS might have lost visual contact with N40GS during this period.

2.8 The search for the aircraft

The delay of approximately 1½ hours between the initial report that radio contact with G–UESS had been lost and the establishment of the last known radar position of the aircraft might appear to indicate some lack of urgency on the part of those whose duty it was to determine the likely location of the aircraft. However, the last known radar position is not normally the most up-to-date information available regarding a missing aircraft. In most cases, the best indication of position is likely to come from the air traffic service unit (ATSU) that last had radio contact with the aircraft; in the subject case those responsible did contact the ATSU at Stornoway, whose information was that the last communication with G–UESS, and the last visual sighting, had been at 30 nm to the south-east of Stornoway. In the stress of the moment, neither the Stornoway controller nor the two pilots in N40GS remembered the 25 nm call made by the pilot of G–UESS. However, in this particular instance, the best information available was the last radar position of the aircraft. Whilst accepting that the recording equipment at ScATCC was still under evaluation, it is disappointing that the initiative taken by the ATC watch supervisor in calling for playbacks of the radar picture was blunted by lack of liaison within ScATCC. Since the accident, written procedures have been introduced at ScATCC to ensure that playbacks are available to the controllers with the minimum of delay.

It is worth noting that, although the initial search datum was in error by some 20 nm, this situation is by no means unusual when an aircraft is missing. Although it did cause the needless call-out of some HM Coastguard coast rescue companies, it appears to have had no significant effect on the efficiency of the overall search operation. When the last known radar position of G–UESS was notified to the RCC, the rescue helicopter had been in the search area for only 10 minutes. At that time also, the Stornoway lifeboat was passing this same position in transit to the original search area. Therefore it seems unlikely that any lives would have been saved had the search been concentrated in the correct area from the start.

3. Conclusions

(a) Findings

(i) The pilot was properly licensed and well experienced for the flight. Although the pilot's assistant was not qualified to fly fixed-wing aircraft, there was no requirement for such an assistant.

(iii) The aircraft's documentation was in order and it had been maintained in accordance with an approved maintenance schedule.

(ii) The aircraft had been properly loaded and its centre of gravity was within the prescribed limits.

(iv) The aircraft's normal descent flight path towards Stornoway was continued below a minimum safe altitude and was only partially checked before it contacted the sea.

(v) Communications throughout the descent were normal and there was no indication of any emergency or in-flight difficulty.

(vi) There was no evidence of fire, explosion or major structural or mechanical failure, and there was fuel in the aircraft at the time of impact.

(vii) There was no evidence of pre-impact incapacitation of the crew.

(viii) There is circumstantial evidence that the pilot was distracted from his aircraft instruments, probably by the need to establish visual contact with another aircraft ahead, and was misled as to his estimation of his altitude by false visual cues from lights on the ground ahead of him.

(ix) The search and rescue forces responded promptly but there was some delay in ascertaining the correct datum point for the search. However, it is unlikely that any lives could have been saved had this delay not occurred.

(b) Probable cause

The accident was probably caused by the pilot's lack of awareness of his true altitude, which resulted in his allowing his aircraft to descend until it struck the sea.

Likely contributory factors were that he was distracted by the need to establish visual contact with another aircraft and that he was misled by false cues from lights on the ground ahead of him.

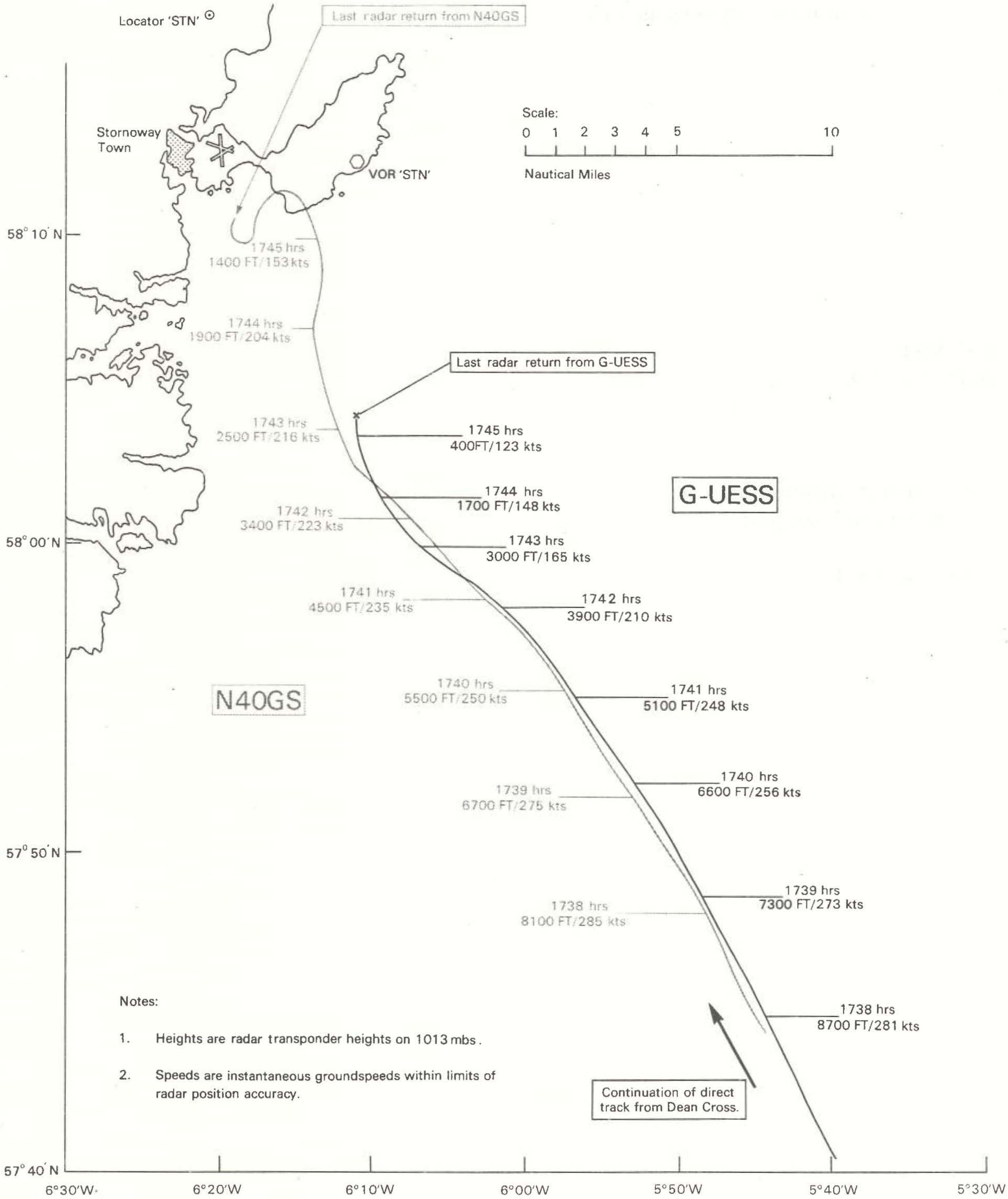
4. Safety Recommendations

4.1 It is recommended that, whenever air traffic control radar recording equipment is available, whether in operational use or on trial, procedures should exist for the rapid recovery of information from these recordings when relevant to the likely position of a missing aircraft.

C C Allen
Inspector of Accidents

Accidents Investigation Branch
Department of Transport

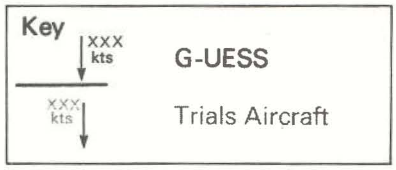
November 1984



Notes:

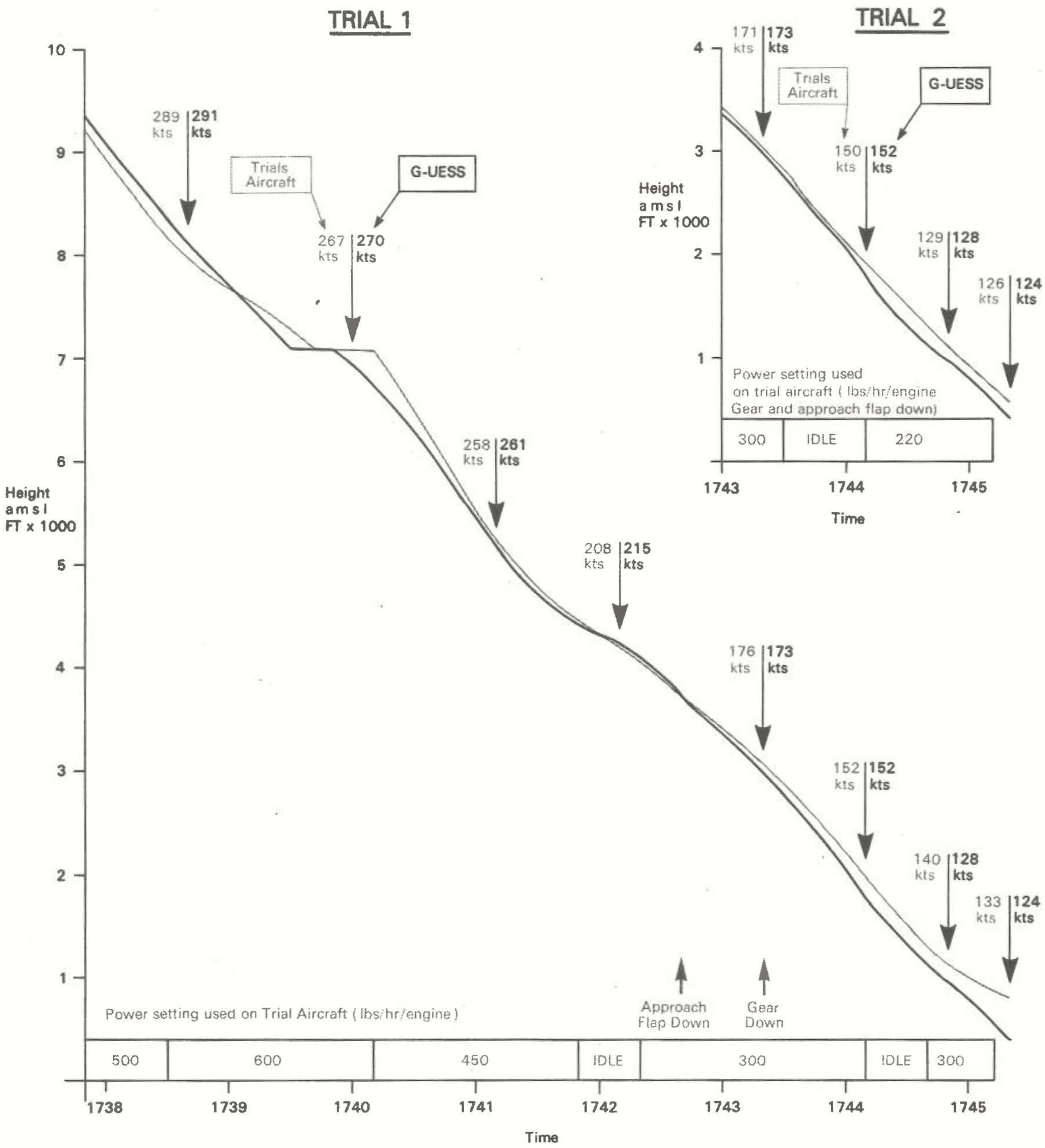
1. Heights are radar transponder heights on 1013 mbs.
2. Speeds are instantaneous groundspeeds within limits of radar position accuracy.

Radar tracks of G-UESS and N4OGS



Notes:-

1. Height is radar height from Mode C SSR. (1013 mbs datum)
2. Time is related to descent of G-UESS
3. Speeds are true airspeeds computed from radar plot and reported wind velocities.
   These speeds are accurate only to ± 10 knots.



Flight trials simulation of descent (paragraph 1.16.3)