Accidents Investigation Branch

Department of Trade

Report on the accident to Cessna Citation 500 G-BPCP at St Peters, Jersey, Channel Islands, on 1 October 1980

AIRCRAFT ACCIDENT REPORT 4/82
(ISBN 011 513508 1)

Corrections

Page 20 Paragraph 3. Second line.

G–BPCP would have experienced a 14.2°.
Numeral should read 14.6°.

DEPARTMENT OF TRADE October 1982
LONDON: HER MAJESTY'S STATIONERY OFFICE

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List of Aircraft Accident Reports issued by AIB in 1982

No	*Short Title*	*Date of Publication*
11/81	Piper PA 38–112 Tomahawk G–BGGH Wood Farm, Kiddington, Oxfordshire May 1980	February 1982
1/82	Pilatus PC–6/B2–H2 Turbo Porter G–BHCR Peterborough (Sibson) Aerodrome February 1981	April 1982
2/82	McDonnell Douglas DC10–30 N 83 NA London Heathrow Airport September 1980	September 1982
3/82	Maule M–5–235C G–LOVE Cranfield Aerodrome Beds September 1981	September 1982
4/82	Cessna Citation 500 G–BPCP St Peters Jersey Channel Islands October 1980	
5/82	Piper PA28 (Cherokee) G–AVBJ and G–AXZC Hamble Aerodrome Hants April 1981	

ISBN 0 11 513508 1

Department of Trade
Accidents Investigation Branch
Bramshot
Fleet
Aldershot
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24 August 1982

Sir Frank Ereaut
Bailiff of Jersey

Sir,

I have the honour to submit the report by Mr J S Owen, an Inspector of Accidents, on the circumstances of the accident to a Cessna Citation 500 G–BPCP which occurred at St Peters, Jersey, Channel Islands on 1 October 1980.

I have the honour to be
Sir
Your obedient Servant

G C Wilkinson
Chief Inspector of Accidents

Accidents Investigation Branch

Aircraft Accident Report 4/82
(EW/C718)

Registered Owner:		Penarth Commercial Properties Ltd
Operator:		Private
Aircraft:	*Type:*	Cessna Citation 500
	Nationality:	British
	Registration:	G–BPCP
Place of Accident:		St Peters, Jersey, Channel Islands Latitude: 49° 12′ 42″ N Longitude: 02° 11′ 12″ W
Date and Time:		1 October 1980 at 1902 hrs All times in this report are GMT

Synopsis

The accident was reported to the Department of Trade Accidents Investigation Branch at 1930 hrs on 1 October 1980 and the investigation commenced the following morning. The Bailiff of Jersey ordered an Inspectors investigation to be conducted under the Civil Aviation (Investigation of Accidents) (Jersey) Order 1975.

The aircraft, a twin engined turbo-fan jet, was engaged on a private flight from Cardiff to Jersey; the pilot being the sole occupant. During an instrument approach to land on runway 27, at night and in poor weather, the pilot discontinued the approach at a height of approximately 200 feet. During the ensuing missed approach 'go-around' manoeuvre, the aircraft struck the roof of a house situated about 190 metres to the right of the runway threshold and crashed. The pilot was killed and the occupants of the house sustained injuries as they escaped from the post impact fire.

The report concludes that the commander failed to execute correctly a missed approach 'go-around' manoeuvre in conditions of poor visibility and low cloud at night. He failed to fly an accurate procedure and allowed the aircraft to continue to descend and bank to the right and it is likely that this resulted from incorrect instrument flying technique. Physical incapacitation cannot be ruled out as a possible causal factor but it is probable that the commander suffered spatial disorientation during the attempted 'go-around.'

The report contains three Safety Recommendations.

1. Factual Information

1.1 History of the flight.

The pilot had completed three flights previous to the accident flight on the same day. He left Jersey at 0729 hrs to fly to Coventry via Cardiff for a day of business meetings in the Midlands and to return, again via Cardiff, to Jersey in the evening. Before leaving Coventry at 1729 hrs he had filed Air Traffic Control (ATC) Flight Plans for the sectors to Cardiff and to Jersey, he also checked the weather conditions at Jersey. The conditions shown in the forecast were of poor weather with low cloud and visibility intermittently falling to 400 metres in drizzle with 7 oktas of cloud below 100 feet. The 1650 hrs weather report for Jersey was noted on the top of his copy of the flight plan, this showed: surface wind 290° at 11 knots, visibility 6000 metres, cloud 4 oktas at 100 feet, 7 oktas at 200 feet, intermittently becoming 3000 metres visibility in drizzle with 6 oktas cloud at 100 feet.

Sufficient fuel for a return flight from Jersey was on-loaded at Cardiff, the pilot remarked, to the Customs Officer, that he might have to return because of the weather at Jersey.

The aircraft departed Cardiff for Jersey at 1821 hrs. It could not be established whether the pilot obtained the latest weather reports for Jersey, issued at 1720 hrs and 1750 hrs whilst at Cardiff; or if he availed himself of the in-flight weather broadcast service by London Volmet South, which transmitted the 1820 hrs Jersey weather report whilst *en route*. Had he done so, he would have been aware of deteriorating landing conditions because the 1820 hrs report for Jersey showed: visibility 300 metres, runway visual range (RVR) 800 metres in drizzle and 8 oktas of cloud below 200 feet.

By 1842 hrs the aircraft was descending towards Jersey. The pilot was in radio contact with 'Jersey Zone' ATC, he had received his inbound clearance and had been advised of the latest weather conditions at Jersey. Radar guidance was provided by Jersey Zone, then later, by Jersey Approach Control who also advised that the RVR had fallen to 850 metres and, later, to 650 metres. On receipt of this information the pilot asked for the Guernsey weather. He was informed that the weather at Guernsey had improved to 1800 metres visibility although the cloud base was still below 100 feet. At 1857 hrs, when at 7 miles on the approach to runway 27 at Jersey, the pilot reported that he was established on the Instrument Landing System (ILS). He then contacted Jersey Tower controller who cleared G–BPCP to land. During the final stages of the approach, about 45 seconds before the crash, the Tower controller advised that the RVR had improved to 850 metres. This message was not acknowledged. The approach controller continued to observe the progress of the aircraft towards the runway on his radar screen until it was about one mile from the threshold, at which point it appeared to be on the extended centre line of the runway. The approach controller then left the radar screen and went to the window to watch for the aircraft landing. When the

aircraft was half a mile from the runway, it was observed by an eyewitness to be on a normal approach path for runway 27. It was lost to view as it passed behind an adjacent house and almost immediately afterwards there was an increase in engine power. This increase was also heard by a professional pilot who was on the aerodrome, about 500 metres from the end of the runway; he said that the "engines started to spool-up as for an overshoot" and shortly afterwards he saw a flash and heard an explosion.

The aircraft struck the roof of a house situated 190 metres to the north of the runway threshold centre line. The house caught fire, the tail of the aircraft lodged in the blazing roof whilst the remaining structure fell into a courtyard where it was destroyed by fire. The four persons occupying the house at the time were able to escape with minor injuries although one, a young girl, was detained in hospital with serious burns. The pilot was killed.

1.2 Injuries to Persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	1	–	–
Serious	–	–	1
Minor	–	–	3

1.3 Damage to Aircraft

The aircraft was destroyed by impact damage and subsequent fire.

1.4 Other Damage

The house known as Sous L'Eglise, St Peters, Jersey, together with its contents was severely damaged by impact and fire and subsequently by the water used to extinguish the fire.

1.5 Personnel information

1.5.1 General

Commander: Male, aged 45

Licences: 1. United Kingdom

Permanent Private Pilot's Licence (PPL) issued by the Civil Aviation Authority (CAA) in May 1979; Night Rating and Instrument Meteorological Conditions (IMC) rating.

Licences (contd):	2. United States of America Airline Transport Pilot certificate, with type rating (Citation 500) issued in May 1980 and an Instrument Rating, first issued by the Federal Aviation Administration (FAA) in June 1978 *
Last medical examination:	27 June 1980, this included an electro-cardiograph test
Flying experience (Total):	1,787 hours on fixed and rotary wing aircraft
Experience on type:	132 hours
Duty time:	12 hours on the day of the accident
Flight time:	2 hours 30 minutes on the day of the accident.

1.5.2 *Flying training history*

The commander first qualified for a UK PPL on fixed wing aircraft in August 1968, and in October 1975 he qualified on helicopters which he then flew for 491 hours over a three year period.

In 1978, coincident with the purchase of a Piper PA23 Aztec, he attended an instrument flying course in the USA. This course, which lasted one month, consisted of approximately 40 hours of intense instrument flying training. He qualified for an American Instrument Rating in June 1978.

In April 1980 he purchased a Cessna Citation and as part of the purchasing agreement, a type certification course was included. This course was conducted on behalf of the manufacturer by Flight Safety International, Wichita, USA. Before commencing the Citation course he received approximately 15 hours of instrument flying training on the Cessna 310 and 172. Then followed the flight simulator course on the Citation which, it is understood, he initially failed but following further airborne instruction on the Citation (G–BPCP), he qualified for a type rating and an American Airline Transport Pilot Certificate. He then flew the aircraft to the UK and exercised the privileges of his FAA Instrument Rating, as private pilot licensed in the UK, on several private flights to and from Jersey.

** At the time of the accident, the Instrument Rating granted by the FAA was deemed to be valid in the United Kingdom for the purposes of a private flight only. (Air Navigation Order 1976 Article 19.3). This ruling was subsequently revoked by the Air Navigation Amendment Order 1982.*

In May 1980, the commander applied to the CAA for an assessment of his experience and qualifications with a view to obtaining a UK Commercial Pilot's Licence. He was advised that he would be granted certain exemptions from the full CPL examination but would have to take the examination in Aviation Law, Flight Rules and Procedures, the Technical (General) examination, the Type (Citation) Technical examination and the Performance 'A' examination. He was also required to take a flight test on the Citation which he successfully completed. Of the other examinations which were attempted in August 1980, he was successful in only Performance 'A'. He was also required to take the Initial Instrument Rating flight test which he successfully completed on 29 August. The events preceding this latter test are relevant.

In June 1980 the commander commenced a course of instrument flying with a training organisation recognised by the CAA and he initially completed 14 hours 47 minutes of dual instruction on a PA23 Aztec over a 10 day period. He was then given a progress check on 3 July by the chief instructor with a view to him taking the Instrument Rating test with a CAA examiner. In the opinion of the chief instructor, he was not up to the required standard; the commander expressed his disappointment and did no further training for about seven weeks. The shortcomings noted by the chief instructor were: weakness in basic instrument flying ability, inconsistent performance in applied instrument flying, a non-professional use of the aircraft and its equipment, a low standard in checks and procedures and the mis-use of radio navigational aids. These characteristics were also confirmed by other pilots who had flown with the commander in both the Aztec and the Citation.

Three days prior to taking the Instrument Rating test on 29 August he resumed instrument flying training with the former establishment and completed a further 7 hours 24 minutes dual instruction before presenting himself for testing by the CAA examiner. He failed his first attempt but was re-tested on the same day on manoeuvres in which he failed; these included a missed approach procedure off an ILS, when he allowed the heading to wander by 60°. He demonstrated a satisfactory standard on his second attempt.

With regard to the commander's ability on the Citation, it is understood that he was a capable pilot in visual conditions but his apparent weakness in basic and applied instrument flying was attributed to poor instrument scan and a lack of procedural and cockpit discipline. It was customary for him, when making an ILS approach in instrument weather conditions, to use the autopilot coupled to the automatic flight guidance facility and "wait for the lights to appear" rather than monitor the progress of the approach with adequate cross-checks. He had been advised by a professional pilot who was aware of these shortcomings not to attempt low minima approaches on the Citation without the assistance of a monitoring co-pilot. This advice was repeated on the day of the Accident.

Study of the commander's personal flying log books showed that of a total fixed wing experience of 1,140 hours accumulated over a 12 year period, he had recorded 393 hours actual and 23 hours simulated instrument flight. Total recorded instrument flying instruction was approximately 110 hours. There is no requirement for a pilot to record a missed approach in his personal flying log book, but it was the habit of the commander to make notes of such an

occurrence. There was only one recorded instance of a go-around in the Citation, this was on 18 September 1980, the reason given being adverse winds over the runway.

1.6 Aircraft Information

1.6.1 General

The aircraft was a Citation 1 (500 Series), twin turbo fan engined executive jet, manufactured in March 1980 by the Cessna Aircraft Company, Wichita, Kansas, USA.

1.6.2 Leading Particulars

Registration:	G–BPCP
Type:	Citation 1 (500 series)
Certificate of Airworthiness:	Transport Category (Passenger) issued: 19 May 1980 valid to: 19 May 1981
Certificate of Maintenance:	issued: 22 August 1980 at 107.7 flying hours valid to: 23 November 1980 or until the completion of 100 flying hours, whichever was the sooner.
Total Airframe Hours:	138.6 (estimated)
Maximum Take-off Weight:	11,850 lb. (5375 Kg)
Maximum Landing Weight:	11,360 lb. (5152 Kg)
Weight at time of accident:	9,377 lb. (4253 Kg) (estimated)
C of G Range (at 9,377 lb):	247.9 ins to 255.9 ins aft of datum.
C of G at time of accident:	255.4 ins aft of datum

1.6.3 Certification and operating limitations

1.6.3.1 Certificate of Airworthiness

In the United States of America the Citation 1 Series 500 was certificated by the FAA to comply with Federal Aviation Regulations (FAR Part 25) in the Transport Category, Day, Night, VFR, IFR (including Category II) and flight into known icing conditions. With the Sperry SPZ–500 Flight Guidance

System fitted, the aircraft is technically capable of being operated to Category II ILS weather minima* with an autopilot disconnect height of 95 feet above runway threshold elevation (ARTE). The approval to operate to Category II minima would be conditional upon additional factors such as the carriage of two suitably trained and qualified pilots, and the equipment status of the landing airfield.

For United Kingdom operation, a Certificate of Airworthiness was issued by the CAA on 19 May 1980. An approved Flight Manual formed part of that certificate and the following extracts from the Manual are relevant:

1.6.3.2 *Operating limitations*

"1. Category:

This type of airplane is eligible for certification in the Transport Category (Passenger).

2. Operations authorised:

This aircraft is approved for Day and Night, VFR and IFR flight and flight into known icing conditions.

3. Minimum crew:

For flights conducted wholly or partially within controlled airspace: one pilot plus one other crew member who shall hold a Pilot's Licence or Flight Navigator's Licence together with a Radio Operator's Licence, however, if a serviceable autopilot with altitude and heading hold modes is available at the commencement of the flight, this second crew member need not be carried.

4. The Autopilot and Yaw Damper must be OFF when the aircraft is less than 1,000 feet above the terrain except that the autopilot may remain engaged down to 180 feet ARTE provided that it is coupled to an ILS Glide Slope and Localiser and that the Decision Height is not less than 200 feet ARTE.

5. The 'go-around' mode shall not be used as the sole means of reference."

1.6.3.3 *The 'Go-Around' mode*

One of the features of the Sperry SPZ–500 Flight Guidance System fitted to the aircraft was the 'go-around' (GA) mode, activated by a push button switch on the left hand throttle lever. When the autopilot is coupled to ILS on an approach and the 'GA' button is pressed as the throttles are advanced for a missed approach or 'go-around' manoeuvre, the following sequence of events would occur:

** Operational performance – Category II ILS weather minima Operation down to 30 metres (100 feet) Decision Height (DH) and with a Runway Visual Range (RVR) not less than a value of the order of 400 metres (1,200 feet) with a high probability of approach success.*

1. The autopilot disconnects and the audio disconnect warning sounds for one second.

2. All other modes to the Attitude Director would cancel except the 'GA' command information which would display a 'wings level' and a 7½° pitch-up demand.

3. The 'GA' annunciator would illuminate on the Attitude Director.

   If the ILS approach is being manually flown with ILS command information displayed on the Attitude Director, pressing the 'GA' button would cancel ILS command information and a wings level 7½° pitch-up demand would be displayed.

1.6.4 *Go-Around (Missed Approach) Procedure*

The following procedure is contained in the Flight Manual approved by the CAA:

1.	Throttles	Take-Off power
2.	Flaps	Take-Off and Approach (selected and set)
3.	Landing Gear	Up (when positive climb established)
4.	Flaps	Up
5.	Climb power	Set
6.	Ignition	Normal

1.6.5 *Autopilot Serviceability*

According to a passenger on the previous flight, the aircraft, including the autopilot, was fully serviceable..

1.7 **Meterological information**

1.7.1 *Synoptic situation*

A weak warm front moved eastwards across the Channel Islands during the morning and early afternoon. It was followed by a very moist west north-westerly airflow with extensive low stratus giving fog at times over the highest parts of the Channel Islands, particularly in association with outbreaks of drizzle.

1.7.2 *Forecast conditions*

Before the pilot departed from Coventry on his return journey he obtained the following forecast for Jersey; this forecast was issued at 1500 hrs and was valid for the period 1600 hrs to 0100 hrs the following morning:

Surface wind	:	280°/12 knots
Visibility	:	7000 metres in mist
Cloud	:	7 oktas stratus, base 200 feet

Intermittently becoming:
Visibility : 400 metres in drizzle
Cloud : 7 oktas below 100 feet.

1.7.3 *Reported conditions at Jersey 1650 hrs*

The pilot also obtained the following report of actual conditions at Jersey before leaving Coventry:

1650 hrs
Surface wind : 290°/11 knots
Visibility : 6000 metres in mist
Cloud : 4 oktas stratus at 100 feet
7 oktas stratus at 200 feet

Temperature : plus 16°C
Dew point : plus 16°C
Intermittently becoming:
Visibility : 3000 metres in drizzle
6 oktas stratus at 100 feet.

1.7.4 *Subsequent weather reports*

The following reports for Jersey Airport were available to the pilot before he left Cardiff:

1720 hrs: Surface wind 290/08 knots, visibility 3500 metres, mist, cloud 4 oktas stratus 100 feet, 7 oktas at 200 feet. Intermittently 1500 metres in drizzle, 4 oktas stratus below 100 feet, 7 oktas at 100 feet. Temperature and dew point 16°C.

1750 hrs: Surface wind 290/11 knots, visibility 3500 metres in mist, cloud 4 oktas stratus at 100 feet, 7 oktas stratus at 200 feet, temperature and dew point 15°C.

Intermittently becoming: visibility 1500 metres in drizzle, cloud 4 oktas stratus below 100 feet, 7 oktas stratus at 100 feet.

1.7.5 *In-flight weather broadcasts*

Following are the actual weather conditions for Jersey Airport at 1820 hrs which were transmitted by London Volmet South whilst the aircraft was *en route* from Cardiff to Jersey.

Surface wind	:	290°/10 knots
Visibility	:	300 metres
*Runway visual range	:	800 metres in drizzle
Cloud	:	8 oktas below 100 feet
Temperature and dew point	:	15°C.

1.7.6 Pre-landing reports received by G–BPCP from Jersey when control of the aircraft was transferred from London Control to Jersey Zone the commander was informed at 1842 hrs of the latest weather conditions at Jersey; these showed a very slight improvement in RVR to above 1000 metres and of the cloud to 7 oktas below 100 feet (from the 8 oktas previously reported).

During the approach to land, visibility deteriorated again and RVR's of 850 metres and later, 650 metres were passed to the aircraft by Jersey. Shortly before the accident an improved RVR of 850 metres was passed by Jersey Tower controller but this was not acknowledged by the commander.

1.7.7 *Weather conditions at the time of the accident*

A special observation taken at 1906 hrs showed:

Surface wind	:	300°/13 knots
Visibility	:	500 metres in drizzle
RVR	:	850 metres
Cloud	:	8 oktas stratus below 100 feet
Temperature and dew point	:	15°C

QFE 1018, QNH 1029.

1.7.8 *Other reports*

Reports from pilots of other aircraft that had landed just before the approach of G–BPCP indicated that there was no wind shear or turbulence on the approach to the runway, but that the visibility was variable as banks of low cloud and drizzle drifted across the aerodrome.

Light conditions: It was dark and the accident occurred 1 hour and 13 minutes after sunset at Jersey.

1.8 Aids to navigation

1.8.1 *In the aircraft*

The aircraft was equipped with sufficient radio navigational aids for operation within controlled airspace; the scale of equipment included:

** Runway visual range (RVR)*

This is the range over which the pilot of an aircraft on the centre line of a runway can see the runway markings or the light delineating the runway or identifying its centre line. RVR is normally reported when visibility has fallen below 1500 metres.

Dual audio control panels
Dual VHF Nav-Comm VHF Transceivers
Dual RMIs
ADF, DME and Transponder
Autoflight system and weather radar
Radio altimeter
Servo altimeter with digital display

There were no recorded defects pertaining to the foregoing, but because of fire and impact damage very little or no useful information was obtained during post-crash inspection. All navigational maps, charts and logs were destroyed by the post-impact fire.

1.8.2 *On the ground*

The following radio navigational and instrument approach aids are published for Jersey Airport:

ILS:
Runway 27: Performance Category 1. Frequency 110.3 MHz
Runway 09: Uncategorised Frequency 110.9 MHz
MF Beacons:
'JW' 329 KHz
'JEY' 367 KHz
Surveillance radar

All the ground navigational aids listed above were serviceable and operating; both ILS installations for runways 09 and 27 were radiating simultaneously. The 27 ILS equipment was checked by the Senior Electronics Officer, Jersey Airport,immediately following the accident and no abnormalities were recorded; he then requested the UK CAA to carry out a full post-accident flight check.

1.8.2.1 *Instrument landing system (ILS)*

It had long been the practice at Jersey Airport to radiate the ILS signals for both runway directions (09 and 27) simultaneously because the geographical location, and the prevailing surface wind conditions on the island, led to frequent runway changes. This, it was felt, would be best facilitated by simultaneous transmissions from both ILS installations and had thus been the practice since the first installation of twin ILS using thermionic valves. Following the installation of more modern 'solid state' equipment in 1970 the practice had still continued. Early experience with the old equipment had been that most failures had occurred during the first moments after switching on from 'cold'. It was found that there were fewer failures if the equipment was left running continuously.

Only one ILS, that serving runway 27, has a Facility Performance Category: it is promulgated as conforming to Category 1 as defined in Annex 10 (Aeronautical Telecommunications), of the ICAO Convention. The other ILS serving runway 09 has no Facility Performance Category because it has no outer marker beacon, the approach path being over the sea.

1.8.2.2 *Runway 27 ILS Operational performance and periodic checks*

The following definition of a Performance Category 1 ILS is given in Annex 10 Aeronautical Telecommunications, Part 1:3.1.1: Standards and Recommended Practices:

> "An ILS which provides guidance information from the coverage limit of the ILS to the point at which the localiser courseline intersects the ILS glide path at a height of 60 metres (200 feet) or less above the horizontal plane containing the threshold. Note: This definition is not intended to preclude the use of Facility Performance Category 1 ILS below the height of 60 metres (200 feet) with visual reference where the quality of the guidance provided permits, and where satisfactory operational procedures have been established".

Part 1:3 .1.2.7

> "At those locations where two separate ILS facilities serve opposite ends of a single runway, an interlock shall ensure that only the localiser serving the approach direction in use shall radiate, except where the localiser in operational use is Facility Performance Category 1 ILS and no operationally harmful interference results".

Also included in Annex 10, Attachment C to Part 1 is the following paragraph which is relevant:

> "Information and material for guidance in the application of Standards and Recommended Practices in Annex 10.
>
> 2.1.9 Radiation by ILS Localisers not in operational use.
>
> > "Severe interference with operational ILS localiser signals has been experienced in aircraft carrying out approaches to low levels at runways equipped with localiser facilities serving the reciprocal direction to the approach. Interference in aircraft overflying this localiser antenna system is caused by cross modulation due to signals radiated from the reciprocal approach localiser. Such interference in the case of low level operations could seriously affect approach or landing and may prejudice safety".

1.8.2.3 In the case in question, because each ILS localiser transmitter is situated beyond the far end of its respective runway, an aircraft on final approach on runway 27 must fly over the localiser transmitter antenna for the opposite landing direction (09). If both localiser transmitters are radiating then cross modulation of the signals can occur at this point and severe interference can result to the localiser information being displayed to the pilot or being fed into

the aircraft's automatic flight control system. However, the point at which this interference would occur on the approach to runway 27 would be when the aircraft is below 200 feet and approaching the runway threshold.

Since this interference occurred at a late stage in the approach and affected accurate evaluation of the ILS equipment by the Navaid inspecting aircraft of the CAA Flying Unit (CAAFU), it had become customary for the non-operational ILS to be switched off when the active runway equipment was undergoing a flight check by a CAAFU aircraft. However, during a routine (four monthly) check in May 1972, cross interference was noticed when both ILS transmitters were radiating simultaneously; it was consequently recommended that steps be taken to ensure that only the ILS serving the runway in use is radiating.

Following the inspection in May 1972, a Notice to Airmen (NOTAM) was issued to inform pilots that "Slight fluctuations may be experienced when in the vicinity of the localiser installations serving the reciprocal runway direction". This NOTAM was cancelled three months later as it was considered that the 'bends' were no longer significant since they occurred below the minimum height for a Cat 1 ILS.

1.8.3 *Post-accident flight check*

Post-accident flight checks were carried out on 27 ILS by a CAAFU aircraft on 2–4 October and the Navigation Aid Inspector's report included the following details of irregularities found:

(a) *Glide path*

Slight deviation on all runs at approximately 600 feet above ground level. Acceptable.

(b) *Localiser (with 09 radiating)*

Steady down to 140 feet when the following occurred:

Run 1: Fly left demand which the aircraft followed and was displaced 10 feet to 15 feet left of the runway centre line at the threshold.

Run 2: Full fly right demand which the aircraft followed to just beyond the right hand extremity of the runway. The autopilot was manually disconnected and the aircraft manually flown to overshoot.

Run 3: Momentary full fly right which the aircraft started to follow, then returned towards extended runway centre line. The maximum displacement was short of the runway right hand edge. The autopilot remained coupled to 50 feet.

Run 4: Similar to run 3.

During these tests the aircraft's position was fixed by photography, visual observation and Decca Navigation.

Results

The Navigation Aid Inspector's report states, *inter alia* that:

The ILS facility conforms with the standards specified in the UK Flight Inspection Instructions as modified by any promulgated differences. The report drew attention to Annex 10 Vol 1 Para 3.1.2.7 and Attachment C to Part 1 Para 2.1.9 (referred to previously in Para 1.8.2.2).

1.9 Communications

Transcriptions of all radio telephony (RTF) communications between G–BPCP, Cardiff, London Control, Jersey Zone, Jersey approach, and Jersey Tower were obtained.

Communications were normal until 1900 hrs when G–BPCP acknowledged a final wind check prior to landing.

1.10 Aerodrome information

Runway 27 at Jersey Airport is 1706 x 46 metres; the airport elevation is 276 feet amsl and the elevation of the displaced threshold of runway 27 is 271 feet. The ILS localiser antenna for runway 09 is sited 462 metres (1,516 feet) before the displaced threshold of 27.

The runway threshold is displaced 91 metres (298 feet) from the commencement of the runway paving.

1.11 Flight recorders

None fitted or required to be fitted.

1.12 Wreckage and impact information

1.12.1 On-site examination

The aircraft had struck the south east facing wall of the main house "Sous L'Eglise" just above the level of the eaves, 18 ft 10 inches above ground level and then continued through the roof structure, which included 3 bedrooms, before demolishing the upper area of the northwest wall on the main house. This wall had fallen into the adjoining smaller "Dower" house, the roof and single dormi-bedroom of which were also destroyed.

The tail-section of the aircraft was found lodged inside the latter house and was badly damaged by the impact and ensuing fire.

The main fuselage and both engines were found in the adjacent courtyard, the fuselage structure having been destroyed by impact and fire.

Numerous parts of the aircraft were found beyond the north west wall of the courtyard and associated out-buildings, including the outer area of the left wing (which still contained fuel), the tip-section of the right wing and nose wheel.

Both the cabin and emergency doors were found with their locking handles in the "closed" positions as were the 2 forward baggage compartment access doors.

The following readings/settings were found on the recovered instruments listed below;

(i) clock at 20.08 hrs

(ii) horizontal situation indicator at 300° heading

(iii) radio magnetic indicator (serial No 9711) at 290° heading

(iv) radio magnetic indicator (serial No 9756) at 293° heading

(v) attitude director indicator (pilot) at approximately 4° pitch-up, 7° right bank

(vi) artificial horizon (co-pilot) at 5–10° pitch-up, right bank

(vii) mach/air speed indicator (serial No 432) bug at "100 Kts."

(viii) mach/air speed indicator (no serial No) bug at "118 Kts."

(ix) Servo-Altimeter digital display showing "020 ft", sub-scale set at 1016 mb.

(x) Radio Altimeter 'bug' set at "200 ft".

1.12.2 *Subsequent examination*

Internal examination of the badly damaged main attitude reference gyro indicated an aircraft pitch-up angle of approximately 4° at impact, with some 5° of right bank.

Detailed examination of both Mach air speed indicators in conjunction with the associated manufacturer, showed one indicator to have jammed internally corresponding to an indicated air speed of between 160 and 180 Kts.

The Servo-Altimeter with the as-found pressure setting of 1016 mb was inspected since this setting was not consistent with the aerodrome pressure setting (QFE) at the time of the accident. An arc-shaped mark was found to the right of the sub-scale setting knob and when the latter, the associated spindle of which had bent on impact, was rotated to a position where the lower edge of the knob made contact with the arc-witness mark, the pressure-setting changed to 1018 mb – ie the correct QFE setting.

Comparison of the flap motor-actuator limit-switch cam position with corresponding cam positions at zero flap 15° and 40° on another Citation 1 aircraft indicated that G–BPCP had zero flap at impact. Inspection of their respective hydraulic actuating jacks indicated that all three landing gear legs and both speed brakes were retracted before impact.

Inspection of the four landing gear warning lamp filaments did not show any evidence of filament stretching associated with the green warning lamps. Both master warning "reset" lamps with four bulbs in each unit also did not show any evidence of illumination at impact.

Both turbo-fan engines showed evidence of high speed fan rotation at impact.

The evidence found indicated that the aircraft was structually complete just before impact. The degree of damage to the flying controls arising from the impact and ensuing fire was such that it was not possible to confirm the pre-crash integrity of the flying control systems.

1.13 Medical and pathological information

Post-mortem examination revealed that the commander was killed on impact. He had advanced coronary artery disease and there was evidence of a very definite degree of previous coronary insufficiency (myocardial fibrosis). Informed medical opinion states that iscaemic heart disease of this degree could lead to an attack of coronary insufficiency at any time which might result in incapacitation of the pilot. There was no direct pathological evidence of such an attack having occurred before the accident but this does not exclude the possibility. Any additional stress could precipitate such an event.

Tests for carbon monoxide, drugs and alcohol proved negative.

1.14 Fire

The Airport Fire Service (AFS) were alerted by ATC and informed that an aircraft had struck a house on the northern perimeter. The crash had also been seen by AFS personnel who manned four appliances and proceeded across the aerodrome. On arrival, they found that the aircraft had crashed through both gable walls of the house from east to west and had removed the roof. Fuel from the aircraft had set fire to the house, outbuildings and garage. The garden was on fire with blazing debris from the roof and the wreckage of the aircraft. A gate from the aerodrome led into a narrow lane beside the house and the two Range Rover appliances used this access to the house to apply Light Water Concentrate (foam) as it was feared that there were occupants still inside. The two larger appliances, a Nubian Major and a Jetranger, stayed inside the aerodrome boundary and used their Monitor equipment to apply foam.

Units of the States of Jersey Fire Service also attended the scene and applied water to the blazing house, and, using breathing apparatus, firemen were able to inspect premises and confirm that all known persons were accounted for except the pilot.

Fire extinguishing medium used:

AFS Units : 1360 litres of Light Water Concentrate (Fluorochemical foam)

Jersey Fire Service : Water.

1.15 Survival aspects

The accident was not survivable. The body of the pilot was thrown from the aircraft at impact and fell through the roof of an outbuilding. Pathological evidence suggests that the lap safety belt had been fastened. As the cabin area was almost totally destroyed by the intense magnesium fire, it was not possible to assess the integrity of the seat or seatbelt anchorages.

1.16 Tests and research

1.16.1 Early in the investigation it became apparent that incorrect demands could be fed to the aircraft's autopilot system if the ILS coupled mode was retained below the recommended decision height or below the minimum height stipulated for a Category 1 ILS. A similar aircraft to the one that crashed, a Cessna Citation with identical avionic equipment, was used to fly a series of approaches to the runway threshold to assess the effects of the interference being caused by the simultaneous radiation of the ILS localiser for the opposite runway (09). Five ILS approaches were flown and on each occasion when overflying the reciprocal runway localiser, the ILS display showed a "fly right" demand. The magnitude of this demand varied from half scale to full scale deflection of the localiser pointer. While the autopilot was engaged this resulted in a turn to starboard being initiated, with a maximum bank application rate of 5° per second and the angle of bank being limited to 12° in the localiser tracking mode. If the autopilot remained engaged, however, the aircraft would attempt to regain the ILS centre line after the interference was passed at about 80 feet aircraft height.

1.17 Additional information

1.17.1 *Aerodrome operating minima*

The law requires all pilots to consider weather reports and forecasts before take-off and satisfy themselves that the flight can be safely made. Public Transport operators are also required to include Aerodrome Operating Minima in their Operations Manuals to which their pilots are required to conform. In the case of non-public transport flights, there is no statutory requirement under UK and States of Jersey air law to observe Aerodrome Operating Minima. A private pilot, therefore has no legal obligation to observe a Decision Height or a minimum RVR during an approach to land in bad weather. In the case of such operations, the UK Air Pilot (Vol 1 RAC 4–6) "Recommended aerodrome operating minima: Non-Public Transport flights" contains the following guidance:

> Jersey, Runway 27, ILS, Recommended Decision Height 250 feet, Recommended RVR 600 metres.

These recommended minima assume that the pilot has a valid Instrument Rating and is in current instrument flying practice.

Decision Height

A specified altitude or height in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

Note 1. Decision altitude is referenced to mean sea level (MSL) and Decision Height is referenced to the threshold elevation.

Note 2. The required visual reference means that section of the visual aids or of the approach area which would have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path.

1.17.2 *Air Traffic Control Instructions*

Jersey Air Traffic Control Instructions contain a requirement that the Approach Controller should include the Recommended Weather Minima when passing the initial approach instructions to inbound non-public transport aircraft when the cloud base is at or below 850 feet or the meteorological visibility is 1500 metres or less. For the purpose of this instruction it was to be assumed that any aircraft not having a company prefix to its callsign was to be regarded as a "non-public transport aircraft".

Examination of the RTF recording shows that this information was not passed to the pilot of G–BPCP on his approach to Jersey prior to the accident. The approach controller knew the pilot to be a resident on Jersey and a frequent user of the airport and assumed that the pilot was aware of the Recommended Minima.

1.17.3 *Recommended minima – non-public transport aircraft*

Reference has been made in para 1.17.1 to the Recommended Minima of 250 feet decision height and 600 metres RVR for non-public transport aircraft using 27 ILS at Jersey. It should be noted that the decision height minimum was increased in January 1981 to 260 feet following a change in the Obstacle Clearance Limit, and that these recommended minima now specifically apply to piston engined aircraft below 5700 kg weight. Pilots of heavier aircraft and/or those with turbine engines (such as the Citation) are now invited to consult with the CAA in order to establish their operating minima.

At the same time the following note was added to the Air Pilot.

RAC 4–6–4

"WARNING – Commencing an instrument approach.

Pilots should never commence or continue an approach when the cloud ceiling is reported to be at or below the value required for the decision height or the reported RVR/Visibility is below the value required for the decision height. Therefore a flight should not be planned to terminate in conditions below the relevant minima. Should the destination weather deteriorate below minima after departure a diversion to a suitable planned alternate should be made forthwith".

1.17.4 *Aircraft performance*

The following information was supplied by the Cessna Aircraft Company:

1. Acceleration data

A Citation aircraft flying at the same weight as G–BPCP and under the same meteorological conditions as on the evening of 1 October 80 would be expected to accelerate at 8.427 ft/sec^2 (0.26g) following the application take-off power if the aircraft were in the landing configuration, and at 10.735 ft/sec^2 (0.33g) with the flaps and landing gear retracted.

2. Pitch attitude

Similarly, when established on a glide slope of 3.1° angle, the pitch achieved attitudes would be:

+0.6° with full flap (40°) set
+2.6° with approach flap (15°) set
+4.6° with flaps fully raised and landing gear 'up'.

3. Flight path

If a 'go-around' were to be initiated at 200 feet ARTE, the power increased to take-off, flaps fully raised and the landing gear retracted but the pitch attitude left unchanged at the approach setting, then the aircraft would, on a descending flight path, collide with a 20 feet high object approximately 2,800 feet (853 metres) from the start of the 'go-around' procedure.

1.17.5 *Somatogravic Illusion*

It has been established in previous accident investigations and by experiment that the human being can suffer from illusions when an aircraft accelerates or decelerates.* The degree to which any individual pilot is affected by this

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** Report on accident to Vanguard G–APEE at Heathrow on 27 October 1965*

somatogravic illusion can vary widely but the illusion is likely to be intensified under conditions of poor visibility and at night when other senses cannot be relied upon to dispel the illusion. Tiredness is also a factor which can and has, led experienced instrument pilots into the trap.

Linear acceleration, for example on take-off or during a missed approach go-round, forces the pilot back in his seat and if external visual cues are insufficient or absent, may be interpreted as a shift in the vertical axis. The pilot will then experience the sensation that the aircraft has pitched nose-up and may respond by pushing the control column forward, thus causing the aircraft to pitch downwards. This in turn creates a radial acceleration which intensifies the illusion. The same illusion could also inhibit a pilot from applying sufficient nose-up pitch in order to rotate the aircraft into a climbing attitude during a 'go-round.'

Using the acceleration figures provided by the manufacturer, the pilot of G–BPCP would have experienced a 14.2° displacement of the gravitational vertical from the true vertical while the aircraft was accelerating during the 'go-round' in the landing configuration. Displacement of the gravitational vertical would increase to 18.3° when accelerating 'clean', ie with flaps and landing gear fully retracted. This would have created the illusion that the aircraft was pitching nose-up by 14.6° and 18.3° in each case. Such an illusion could only be overcome or dispelled by total reliance on the flight instruments.

1.17.6 *Effects of reducing slant visual range*

During the visual phase of an approach to land in poor visibility, the pilot is dependent on adequate slant range visibility to assist in his orientation; the number of lights or visual cues that are within his field of vision or the "visual segment" provide a basis on which to make corrections about all three axes. If the mist or fog is homogeneous, the visual segment ahead of the pilot increases as the aircraft follows a descending glide slope towards the runway, until, at the threshold, the visual segment approximates to the RVR. However, if a thicker patch of fog or reduced visibility is encountered during this final phase, both the slant visual range and visual segment will decrease. Unless the pilot is trained to guard against this, he will almost certainly experience the illusion that the aircraft has inadvertently pitched nose-up. If the pilot does not instantly revert to instrument flight (rather difficult under the circumstances) and ignore the sensation, the natural reaction would be to attempt to regain the "former attitude" by easing forwards on the elevator control with a consequent danger of increasing the rate of descent, landing heavily or undershooting the runway. The same effects could also occur during an attempted 'go-around' following a loss of visual reference below decision height.

An example of a similar illusion is related in CAP 166, a report on the accident to Viscount G–AOHU which crashed on landing at Heathrow on 7 January 1960. Reference is also made to the illusion in "Pilot Error" by Granada Publishing Ltd.

1.17.7 *Missed approach procedure Jersey 27 ILS*

The procedure published on the Jersey Instrument Approach and Landing Chart requires, in the event of a missed approach, the aircraft overshoot and climb straight ahead to 1,900 feet. The 27 ILS Chart may be seen at Appendix 2.

1.17.8 *Final flight path*

From the observations of eyewitnesses located along the approach path to the runway, it was possible to obtain a reasonable assessment of the position of the aircraft during the final stages of its approach and the point at which engine power was increased. These observations were then compared with the approach paths followed by the CAAFU Navaid aircraft during its post-accident test runs on the ILS.

The aircraft was last sighted when correctly lined up with the runway when it was 2,880 feet (878 metres) from the displaced threshold. At this point its height would have been about 200 feet ARTE if it had been following a 3.1° glide slope on a stabilised ILS approach path. The point at which engine power was applied was assessed by reference to this last observation and witness recollection; this point was assessed at 2,666 feet (812 metres) from the threshold. The aircraft was last seen at about 1,875 feet (572 metres) from the threshold when it had apparently already diverged from the approach path. A diagram illustrating the foregoing may be seen at Appendix 1.

It may be noted that the ILS localiser antenna for runway 09 ILS is 1,516 feet (462 metres) from the displaced threshold of runway 27. The first point at which ILS localiser cross interference was identified on the sensitive test equipment of the CAAFU Navaid test aircraft was 1,750 feet (533 metres) from the threshold.

1.17.9 *Landing gear and flap retraction times*

The landing gear, which is hydraulically actuated, should fully retract to the 'up' position in less than 6 seconds. Wing flaps, which are electrically actuated, will move from the 40° fully 'down' position to 0° fully 'up' in 3 to 4 seconds. Flaps can be preselected to any intermediate angle but there are detents in the selection quadrant for the 40° ("landing") and 15° ("approach") settings. When flaps are selected fully 'up' the resulting trim change is nose-down but the control forces are low and can be easily contained.

2. Analysis

2.1 General

The commander, being properly licensed, and exercising the privileges of his FAA instrument rating as a private pilot, made an instrument approach to land in poor visibility and low cloud in an aircraft which was suitably equipped for the task.

No evidence was found in the wreckage to suggest there was any defect which could have caused or contributed to the accident. The evidence of the retracted landing gear and flaps, and the high thrust indications on both engines at impact clearly show that the commander was attempting to carry out a 'go-around' missed approach manoeuvre.

2.2 The weather

2.2.1 Weather conditions at Jersey before the accident were very poor and many commercial operators had cancelled their flights to Jersey. The Channel Islands were under the influence of a very moist air stream and only a change in the air mass or a rise in temperature could bring an improvement. No improvement was expected within the forecast period and as temperature fell with the onset of night, the condition could become worse.

2.2.2 The commander was aware, even before he left Coventry for Cardiff on his return journey, of the Jersey forecast together with the report of actual conditions existing at 1650 hrs. The cloud base was low, the visibility was poor and worse conditions were forecast. In these circumstances it would have been advisable for the pilot to have checked the latest weather report from Jersey before leaving Cardiff. Had he done so and this could not be established, he would have been aware that the weather had already deteriorated. In these conditions and with no forecast improvement, a prudent airman would have considered it unwise to proceed. Having started the flight from Cardiff, prudence would again dictate the need to monitor the latest weather reports for Jersey, which were being transmitted by the London in-flight weather service, before the aircraft commenced its descent from cruising altitude. The 1820 hrs report for Jersey, broadcast by London Volmet South during this phase of the flight, indicated a further deterioration with the visibility down to 300 metres and total cloud cover below 100 feet. Shortly after starting his descent towards Jersey the commander received the 1830 hrs weather report direct from Jersey Zone ATC; there had been a slight improvement in RVR to above 1000 metres as the drizzle had temporarily ceased, but the cloud cover still remained 7 oktas below 100 feet.

2.2.3 Because it could not be established whether the commander sought any meteorological information at Cardiff, nor whether he listened to London Volmet whilst *en route*, it is possible only to speculate that the reported condition he received from Jersey Zone ATC, whilst descending, was the first

knowledge he had that the weather had deteriorated. If this were so, it might explain why he decided to continue possibly on the basis that, having come so far, he might as well attempt an approach before diverting to a more favourable aerodrome. Certainly under these conditions, a high standard of instrument flying would be demanded, all the more so because he was operating as a single crew without the assistance of a monitoring co-pilot. In the light of the foregoing and since the weather conditions had, throughout, been significantly below the Recommended Minima for an ILS approach and landing at Jersey, he should not have attempted the approach.

2.3 Weather Minima

2.3.1 There were no statutory weather minima that had to be observed because this was a non-public transport flight. It is clear, however, that the conditions were considerably below those allowed for in the Recommended Decision Height of 250 feet for an ILS approach at Jersey as given in the UK Air Pilot at that time. The commander was under no legal obligation to observe the recommended minima although it would have been wise to do so notwithstanding a natural inclination to land at his home aerodrome rather than divert elsewhere with resulting administrative inconvenience. This situation has, unfortunately, resulted in several accidents in the past.

2.3.2 Contrary to ATC instructions for Jersey, he was not informed of the Recommended Minima (600 metres RVR and Decision Height 250 feet) before he commenced the approach because the controller was under the impression that the commander, as a regular user and resident on Jersey, would have been aware of this. It is not considered likely in the circumstances that such information would have necessarily deterred the commander from making the attempt since he was under no legal constraint. Such is the undesirable but nonetheless legal situation which permits relatively inexperienced pilots to attempt a single pilot operation in weather conditions which would preclude public transport operations by experienced crews. The conditions actually obtaining at the time of the accident would not necessarily have precluded such operations but they were indeed marginal. In this respect, attention is drawn to previous accidents in poor weather when light twin engine private aircraft crashed whilst approaching to land in fog at Elstree (Report No 14/76) and at Birmingham (Report No 18/76). Although steps were taken by the CAA to try and prevent such recurrences by publishing Recommended Weather Minima in the UK Air Pilot and, more recently, advising non-public transport pilots of private turbo-jet aircraft of what they should observe, it is still possible for a private pilot legally to attempt an operation in weather conditions which can only be described as dangerous.

2.4 Final flight path

The approach to the runway appears to have been steady and correctly flown. The localiser was intercepted at seven miles from the runway and the approach was continued with no apparent problem. The approach was also observed in azimuth on surveillance radar by the Jersey Approach Controller until it was within a mile of the runway threshold at which stage it was on the centre-line

of the approach path. Qualified eyewitness evidence also confirms that the aircraft was correctly positioned to complete the approach when it had descended to approximately 200 feet ARTE when it was half a mile from the runway threshold. Engine power was substantially increased shortly afterwards.

At the time of the impact the landing gear and flaps were fully retracted, whereas, if the correct missed approach procedure was being followed, flaps should have been selected only to 15°, at least until a safe climb out had been established. Following the initiation of the 'go-around' procedure, the aircraft also deviated to the right of the approach path; this was a considerable lateral displacement in the distance covered from the point the 'go-around' was initiated, the magnitude of which could not be reconciled with the displacement which might have occurred if the autopilot remained coupled to the flight guidance system and was being subjected to a full 'fly right' command due to cross modulation interference of the ILS. Flight tests have shown that a significant deviation on the autopilot was unlikely since the bank angle would have been limited to 12°; this would not have taken the aircraft so far to the right of the centre line if the divergence commenced at the earliest point at which aberrant ILS signals would have been detectable. Calculations show that if the aircraft deviated to the right in a constant turn from the point at which 'go-around' power was applied (812 metres from the threshold), to have arrived at the point of impact at an average true airspeed of 150 knots over the distance travelled, an angle of bank of at least 18° to 20° would have been required. Had the turn to the right commenced from the point at which aberrant ILS signals were detectable (533 metres from the threshold), the bank angle would have had to be greater. Moreover, if, as the evidence of two eyewitnesses indicate, there was a considerable deviation to the right immediately after 'go-around' power was applied, the initial bank angle would have been greater still. The evidence therefore strongly suggests that the autopilot was disconnected when the 'go-around' was commenced, if indeed it had been used during the ILS approach, but the steadiness of approach as observed on radar and the manner in which the commander was known to operate the aircraft on ILS, seems to indicate that the approach was made with the autopilot coupled to the ILS. However, it is considered more than probable that the turn to the right and subsequent descent were made with the autopilot disconnected and were pilot induced. The commander had on previous occasions demonstrated a tendency, to allow the aircraft to turn or to involuntary initiate a turn to the right as he commenced a 'go-around' manoeuvre. There may have been other reasons why bank was applied as well as the aircraft not being rotated into a safe climbing attitude during the 'go-around.' These will be discussed in turn with other aspects which might be relevant.

The 4° pitch attitude at impact, was consistent with the approximate attitude of the aircraft had it continued to follow a 3.1° downwards flight path in a clean configuration after 'go-around' power was applied. If, however, the 'go-around' manoeuvre was being correctly flown the pitch-up attitude should have been about 10°, certainly more than 7°.

2.5 Competency testing and the 'go-around' manoeuvre

2.5.1 The commander had recently demonstrated his ability to operate in controlled airspace on instruments as part of the tests he was required to take in order to qualify for a UK Instrument Rating, albeit on a light twin piston engined type, with which he was quite familiar, as opposed to the more sophisticated turbo-fan jet he was flying at the time of the accident. The practice of awarding an instrument rating on a significantly less demanding type of aircraft although legal, is questionable especially in cases such as this when the pilot intends exercising his privileges on a more advanced type.

2.5.2 The handling characteristics, speed and altitude ranges, of a jet powered aircraft, even a light executive jet, are different from piston propeller types. Although modern flight guidance systems relieve a competent pilot of a considerable work load, there is one phase of flight which is more critical than is the case of a slower piston engined type. This is the 'go-around' or missed approach manoeuvre, particularly when it is performed on instruments from a decision height. Application of 'go-around' power on many types of piston propeller aircraft will normally result in a natural pitch-up and they require a less steep attitude to climb away, they do however have to be flown accurately and at the correct speed in order to maintain the initial climb. Jet aircraft, including the Citation, have to be positively rotated into a steeper attitude in order to achieve a safe climb out. This is well recognised by flight instructors in airline operations and is thoroughly emphasised during conversion training. It is a manoeuvre that is carried out only infrequently in practice, yet because it may be initiated close to the ground and without the benefit of external visual cues, it must be carried out correctly, with precision and with the minimum loss of height. According to the commander's flying log book, he had experienced only one 'go-around' on the Citation since completing his course in the USA; this last occasion, three weeks before the accident, was due to adverse winds on the runway rather than low cloud or poor visibility.

2.5.3 Manufacturers data shows that if 'go-around' power is applied at 200 feet above the ground, and the landing gear and flaps are retracted without altering the pitch attitude, the aircraft would strike a 20 feet high object approximately 2,800 feet (853 metres) from where the 'go-around' was initiated. The point at which 'go-around' power was applied was assessed from eyewitness evidence as being approximately 2,880 feet (878 metres) from the house which the aircraft struck about 19 feet above ground level. The evidence therefore strongly suggests that the aircraft was not rotated sufficiently, if at all, during the 'go-around' manoeuvre. Although selection of flaps from fully down to fully up will result in a nose-down change of trim, the resultant stick force should have been easily contained by the pilot. On the other hand, the resultant nose-up change of trim which would accompany an application of engine power is comparatively small. This latter aspect is thought to be of greater significance and emphasises the need to positively rotate this type of aircraft into a climbing attitude.

2.5.4 In the absence of any mechanical or systems defect and on the assumption that the autopilot was disconnected on the attempted 'go-around', three possible

reasons are considered which could have caused or contributed to the apparent failure of the commander to complete a safe missed approach. They are: mishandling under instrument conditions, spatial disorientation and physical incapacitation.

2.6 Mishandling under instrument conditions

Although the commander held an FAA Instrument Rating it should be noted that no further tests are required for its renewal or validation; log book proof of recent practice is all that is necessary. This is not the case in the UK when an Instrument Rating is due for renewal. Although the commander succeeded in meeting the requisite flight test requirements for both USA and UK Instrument Ratings, it is patently obvious that he had to work very hard to achieve the necessary standards. This he did through a considerable amount of dual instruction just prior to the event. Unfortunately, such an expedient is no guarantee that the necessary skills and standards are retained after overcoming the hurdle of the flight test.

The commander's recorded instrument flying amounted to approximately one third of his total hours on fixed wing aircraft; this is a very high proportion even by airline standards and could perhaps be questioned as to its credibility. What is probably more remarkable is the large number of hours of recorded dual instruction in instrument flying, over 100 hours or approximately ten per cent of his total fixed wing experience. The evidence clearly shows that this facet of flying was a weak point which he made considerable effort to overcome for the purpose of passing a qualifying test. Nonetheless, his inconsistent performance and shortcomings in applied and basic instrument flying techniques indicate that his lack of natural aptitude and ability as an instrument pilot could well have resulted in a loss of control in a critical situation.

2.7 Spatial disorientation

2.7.1 Somatogravic illusion

In failing to carry out a safe missed approach and achieve a safe angle of climb it is necessary to consider the illusory effects when accelerating an aircraft in conditions of poor visibility or whilst flying on instruments.

The combined effects of longitudinal and normal gravitational acceleration can engender a physical sensation that the aircraft has pitched nose-up. The figures given for acceleration were, initially 0.26g increasing to 0.33g as flaps and landing gear were retracted. This could have made the pilot believe that the aircraft had already pitched up by between 14° and 18°, indeed it might have induced a sensation that the aircraft had already over-rotated into the climb and could have tempted the pilot to decrease the angle or, at the least, prevented it from getting any steeper. In other words, he would have refrained from making any positive effort to rotate the aircraft into the correct climb attitude. If therefore his attention to his instruments had been distracted whilst retracting the flaps and landing gear, (having also apparently made an

incorrect flap selection) his senses would convey the impression that the aircraft was pitching nose-up into a climbing attitude. Only by close attention to his flight instruments and consciously ignoring physical sensations would he become aware of the true situation. The circumstances in which the 'go-around' was attempted were strongly conducive to this kind of illusion; the cloud base was below 100 feet, possibly down to 50 feet, visibility at 200 feet would have been poor or even worse as the aircraft diverged from the approach lights and the accelerative effects in the 12 second period before impact were more than sufficient to promote the illusion. The effects of somatogravic illusion are considered to have been significant in the circumstances and probably contributed to the apparent failure to achieve a safe climb attitude.

2.7.2 *Loss of visual reference*

Other aircraft which landed at Jersey before the accident reported patches of fog which drifted across the aerodrome. Runway visual range also varied considerably as the Citation was approaching to land. The approach was made in circumstances that were highly conducive to the effects described in para 1.17.6 but there is, however, no evidence to show that the commander had in fact achieved visual reference at 200 feet although the aircraft was seen illuminated in the glare of the approach lights. It is nonetheless possible that the commander may have been aware of the lights but that he encountered a patch of fog which reduced or obliterated his visual cues. The illusory effect of such a situation could have led him to believe that the aircraft had inadvertently pitched nose-up. Again, unless the commander reverted immediately and totally to instrument flight, ignoring the sensation, he could have been prompted into following a descending flight path.

2.8 Medical aspects – physical incapacitation

2.8.1 The commander had been medically examined for the renewal of his licence three months prior to the accident and this had included an electro-cardiograph test which showed him to be within "normal limits", however, post-mortem examination revealed the presence of advanced coronary disease and evidence of previous coronary insufficiency. Medical opinion states that heart disease of this degree could lead to an attack of coronary insufficiency at any time, particularly under conditions of stress. It is quite certain that the commander would have been operating under some degree of stress during the approach to Jersey: the weather was bad and he was operating as a single pilot; it was at the end of a long duty period of twelve hours during which he had been involved in business matters as well as driving a car between appointments on the ground. He then found himself in a situation of making an instrument approach in poor weather with a low probability of success for landing at his home base and he was forced into a situation of having to make a missed approach from a low height with little alternative but return to Cardiff. Had he been subjected to an attack of coronary insufficiency at that time, or for that matter during the approach to land, the effects could vary from discomfort and pain to total incapacitation; the first two effects would at the very least prove distracting at a crucial stage of the flight or as he carried out a demanding manoeuvre.

2.8.2 It might be significant that the commander did not acknowledge the last message from Jersey Tower about 45 seconds before impact; this was when the aircraft was about 1.5 nm from the runway. Although there was no requirement to acknowledge this message since it was advisory, he had, up to this moment, acknowledged and dealt with all RTF calls in a prompt and decisive manner.

2.8.3 There is no pathological evidence to show that the commander suffered some degree of incapacitation before the crash; unfortunately, such a condition when followed shortly by death due to multiple injuries rarely leaves any evidence that such a condition existed. However, total incapacitation was unlikely because he applied power and retracted the landing gear and flaps in the 12 seconds which elapsed before impact, but the possibility of some degree of incapacitation and the ensuing distraction from a vital task cannot be discounted. Had he been so distracted, the illusory effects described earlier would only have exacerbated the situation.

2.9 Flight Manual

The information contained in the approved Flight Manual for Citation aircraft on the UK Register did not emphasise the need, or even state the need, to change the attitude of the aircraft during the 'go-around' manoeuvre; however, the instructional notes issued by Flight Safety International to the commander of G–BPCP did emphasise this point. While it would be reasonable to suppose that the need to rotate the aircraft into the 'go-around' attitude is part of basic airmanship, and need not be repeated or emphasised in the Flight Manual, this supposition may not be valid in the case of a pilot who has had no previous experience or formal training in jet aircraft operation. It is therefore important that such pilots should be able to refer to and rely on the Flight Manual for guidance and for vital matters of aircraft handling. In the case of the Citation, the missed approach 'go-around' is a vital manoeuvre but the Flight Manual for UK registered Citation aircraft makes no reference to the need to change the attitude of the aircraft and to adhere strictly to the published drill for a missed approach in order to avoid serious loss of height and to establish the correct climb-out attitude.

2.10 The Jersey ILS installation

2.10.1 Since the aircraft crashed following an ILS approach and deviated to the right of the approach centre line in the process, it is appropriate to consider whether the ILS installation and its known irregularities were factors which might have contributed to the accident. Simultaneous transmissions of two ILS installations can cause cross modulation interference at the point where an approaching aircraft flies across the reciprocal runway ILS antenna. At Jersey, this interference in the form of 'bends' in the localiser had been commented upon by the CAAFU Navaid inspector on two separate occasions. There is no doubt that Jersey Airport authorities were aware of the interference, but, since it occurred at a point below the lowest height to which the 27 ILS had been certificated, 200 feet, it was not considered to be 'operationally harmful' and that the

airport was therefore acting within the spirit of Annex 10 to the ICAO Convention. The Navaid inspector's report also stated that the ILS facility at Jersey conforms with the standards specified for a Category I installation, notwithstanding the irregularities which were found below the height to which the equipment was certificated.

2.10.2 Recent years has seen a rapid development in the design of avionic equipment and it is not unusual to find General Aviation aircraft equipped to a high standard with radio navigation aids and sophisticated automatic flight guidance systems. When such an aircraft is fitted with equipment that has a minimum disconnect height for the autopilot below the relevant decision height for an approach, there are sound reasons for leaving the autopilot engaged down to this lower height provided, of course, the pilot has adequate visual reference at decision height. The advantage of this is that physical control of the aircraft is left to the autopilot while the pilot is gaining improved visual reference and is evaluating the final approach path to the runway. Such a practice is condoned by Annex 10 in the Note to the Definition of a Category 1 ILS where it is qualified by the words 'where the quality of the guidance system permits and when satisfactory operational procedures have been established'. It is, nonetheless, undesirable in the light of continued development of avionics, and changing procedures, that dual radiation of Category 1 ILS transmitters should continue when it is known that cross modulation interference can occur, albeit at a low altitude with the pilot in visual contact with the runway, but with the autopilot still coupled to the facility. With the foregoing in mind, it is felt that the appropriate parts of Annex 10 should be reviewed.

2.10.3 Since the evidence discussed in the preceding paragraph 2.4 leads to the belief that the autopilot was disconnected at the time the 'go-around' was initiated at about 200 feet, it follows, therefore, that the irregularities due to cross modulation were unlikely to have caused the aircraft to diverge off the approach centre line, or for that matter, to follow the glide slope down to the point of impact.

2.10.4 *Flight checking procedures for radio aids*

When the ILS systems at Jersey were undergoing periodic checks by the CAAFU Navaid inspection aircraft, it was customary practice to switch off the non-operational runway ILS because cross modulation affected the assessment of the operational ILS at low heights on the approach. Whilst this was a sensible thing to do, the flight checks were nonetheless being conducted with aerodrome equipment operating in other than its usual manner. There is no doubt that runway 27 ILS did in fact conform to Category 1 ILS standards, even with dual radiation, but it is also true to say that the radio aids at Jersey were being normally operated in a manner that was different from the conditions under which they had been checked.

3. Conclusions

(a) *Findings*

(i) The commander was correctly licensed for the flight.

(ii) The aircraft was serviceable and correctly documented.

(iii) The commander commenced an ILS approach to runway 27 at Jersey in weather conditions which were significantly below the Recommended Weather Minima for that approach.

(iv) The approach was correctly flown and the aircraft was on the ILS centre line and the glide slope when it was half a mile from touch down.

(v) The commander initiated a 'go-around' missed approach manoeuvre from a height of approximately 200 feet ARTE.

(vi) The aircraft continued to descend at increasing speed, turning to the right of the approach centre line and struck a house 190 metres to the right of the 27 runway threshold.

(vii) At the time of the impact the landing gear and the wing flaps were fully retracted and both engines were at a high thrust setting.

(viii) The aircraft's attitude at impact was 4° nose-up and banked slightly to the right. Its speed at impact was approximately 160 to 180 knots.

(ix) No pre-crash defects were found in the aircraft, its engines or its equipment.

(x) The ILS installation on runway 27 was correctly certificated as conforming to performance Category 1.

(xi) Bends were known to exist in the localiser during simultaneous transmissions of the reciprocal runway ILS; these bends occurred at a glide slope height of approximately 100 feet ARTE.

(xii) Both ILS transmitters were radiating at the time of the accident.

(xiii) The known irregularities due to simultaneous ILS transmissions were not contributory to the accident.

(xiv) The autopilot was disconnected during the 'go-around'.

(xv) Although legally entitled to operate in IFR in a controlled airspace, the commander was not consistent in his abilities as an instrument pilot and had repeatedly demonstrated faulty instrument flying techniques.

(xvi) It is highly probable in the circumstances that the commander lost control, in a critical situation, due to faulty or inadequate instrument flying technique.

(xvii) The circumstances of the approach to land and the ensuing 'go-around' were highly conducive to pilot disorientation due to illusions that could be caused by the effects of accelerated flight or by loss of visual reference.

(xviii) The commander had been on duty for 12 hours and would have been tired.

(xix) The commander was suffering from advanced heart disease and had suffered previous coronary insufficiency. Some degree of physical incapacitation prior to the accident cannot be ruled out.

(xx) The 'go-around' procedure published in the approved Flight Manual did not state the need to establish a pitch-up attitude during the 'go-around' manoeuvre.

(b) *Cause*

The accident was caused by the commander failing to execute correctly a missed approach 'go-around' manoeuvre in conditions of poor visibility and low cloud at night. He failed to fly an accurate procedure and allowed the aircraft to continue to descend and turn to the right. It is probable that this resulted from incorrect instrument flying technique but partial physical incapacitation cannot be ruled out. It is also probable that spatial disorientation was a causal factor to the accident.

4. Safety Recommendations

It is recommended that:

(i) The UK approved Flight Manual for the Citation be appropriately amended to reflect the importance of rotating the aircraft into a positive nose-up climbing attitude during the 'go-around' procedure.

(ii) Simultaneous radiation of reciprocal runway ILS transmissions should not be permitted with Category 1 installations, and that the appropriate parts of the ICAO Annex 10, (3.1.2.7) should be re-appraised.

(iii) Serious consideration should be given to prohibiting instrument approaches by non-public transport aircraft when reported conditions are worse than those published as Recommended Minima.

J S Owen
Inspector of Accidents

Accidents Investigation Branch
Department of Trade

July 1982

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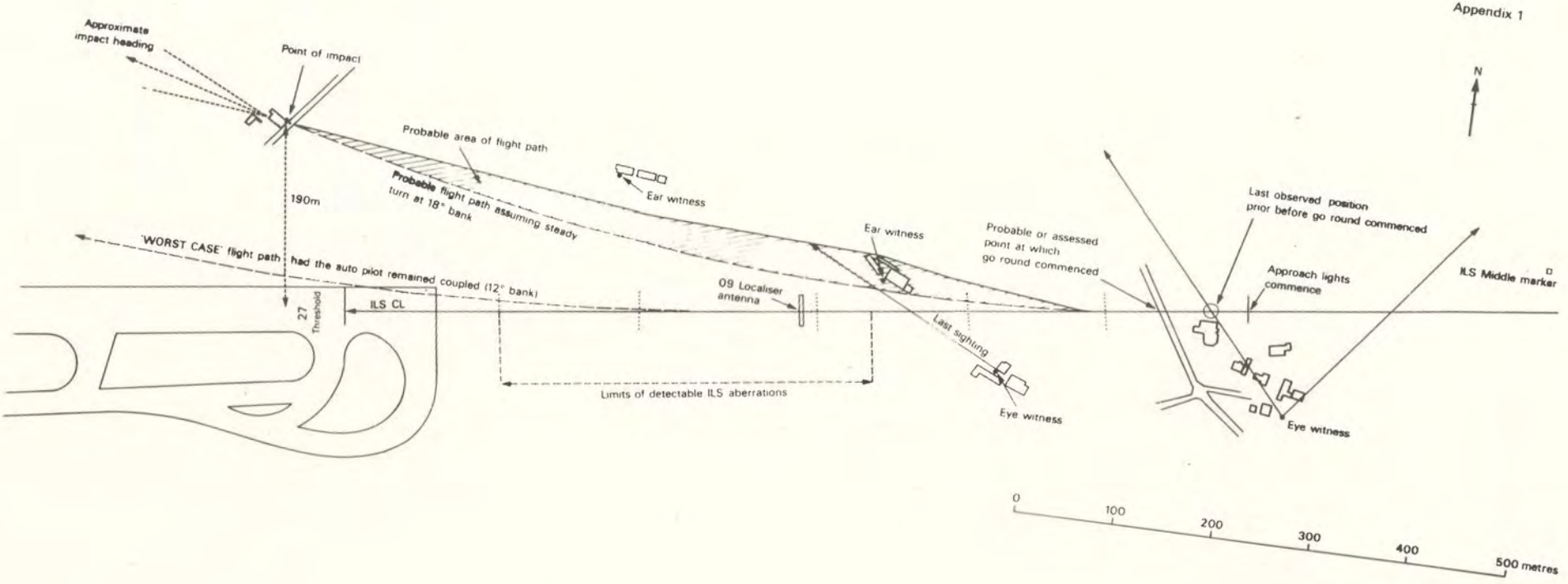
Bas 92749/R151 C8 9/82 TP

Appendix 1



APPENDIX 1

INSTRUMENT APPROACH AND LANDING CHART I C A O

BEARINGS ARE MAGNETIC
ELEVATIONS IN FEET A.M.S.L. 810
HEIGHTS IN FEET ABOVE THRESHOLD
ELEVATION OF RUNWAY 27 ..... (539)

ELEV. 276. FT.

CONTOURS COMMENCE 300 FEET ABOVE AERODROME

MANDATORY PROCEDURE

Jersey
CAT I ILS R/W 27

AERODROME OPERATING MINIMA			
TAKE OFF	DAY		NIGHT
LANDING	DAY		NIGHT

DISTANCE BETWEEN MARKERS	90 KTS	120 KTS	140 KTS	160 KTS	180 KTS	195 KTS
O.M. to M.M. 3·12 nm.	2m 05s	1m 34s	1m 20s	1m 10s	1m 02s	58s
M.M. to R/W threshold 0·64 nm.	26s	19s	16s	14s	13s	12s

RADIO

Service	Frequency	Call Sign
ATC	125·2 120·45	JERSEY ZONE
APP	120·3 121·5 (Emergency)	JERSEY APPROACH
TWR	119·45	JERSEY TOWER
GMC	121·9	JERSEY GROUND
RADAR	118·55 125·2 120·3 120·45	JERSEY RADAR

LIGHTING

APP LTG

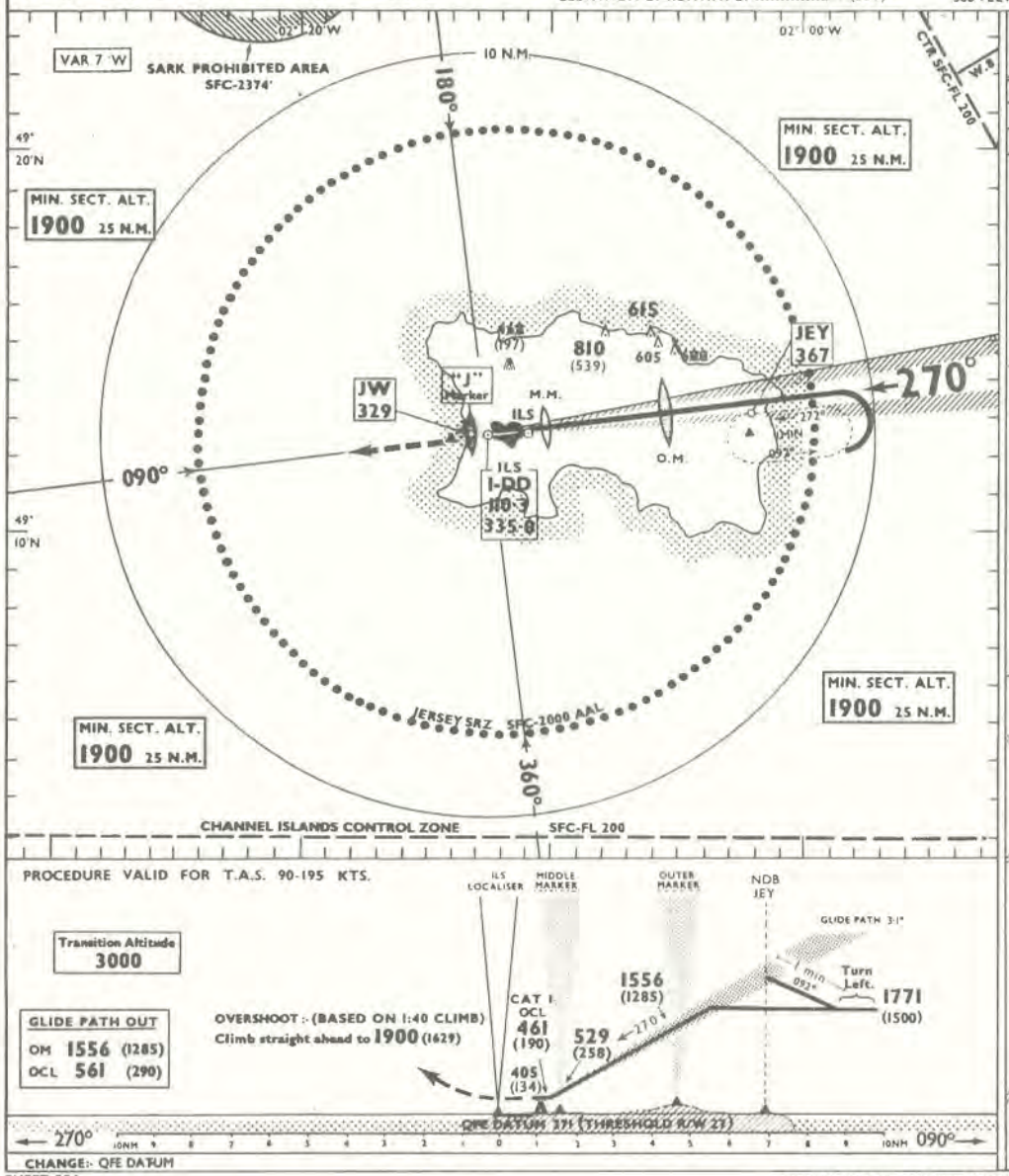
27 899m. HI C/L 2 bars. 899m. LI red C/L 2 bars. VASIS (3°)

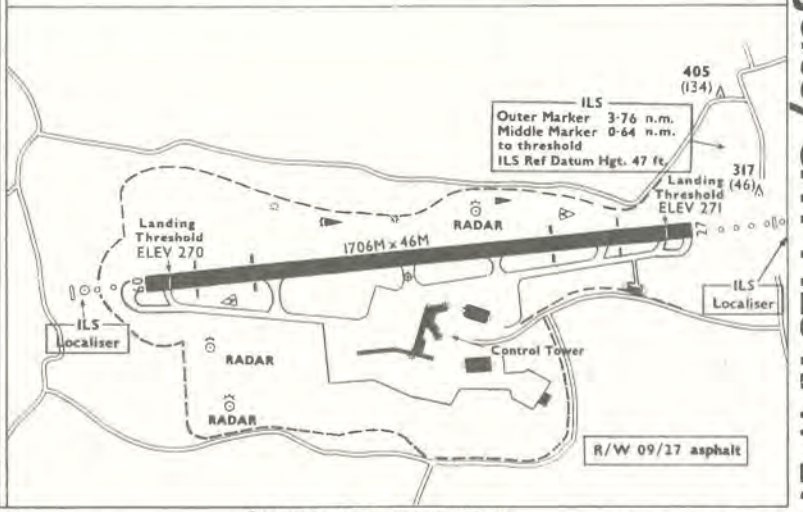
RNWY LTG

27 HI elev. bi-d with LI elev. omni-d component. Threshold HI green with HI elev. green W bars. End lights red.

OTHER LTG

Taxiways green C/L to R/W's, others blue edge. Obstructions.





SHEET 58A

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AERO.INF.DATE 27.10.78

49°13'N 02°12'W

Jersey CAT I ILS R/W 27

APPENDIX 2