

No. 10

Hawker-Siddeley HS-125, CF-CFL, accident at Churchill Falls, Canada, on 9 December 1977. Report No. H70003, not dated, released by the Ministry of Transport, Canada, in both English and French.

1.- Factual Information1.1 History of the flight

The corporate jet HS-125 aircraft departed Montreal at 2123Z (GMT),¹ 9 December 1977 with Churchill Falls as destination. The estimated time en route was 1 hour 45 minutes. The flight proceeded normally and was in contact with Air Traffic Services en route. When in range of Churchill Falls the flight received a clearance for the approach from Moncton ATC. At 2228Z the pilot acknowledged the clearance to the Churchill Falls airport and received the latest weather. The aircraft left cruising altitude shortly thereafter; the descent was normal to the minimum initial altitude for the instrument approach. The flight reported outbound to Churchill Falls advisory at approximately 2252Z. The final transmission from the crew was that they were two miles back on final with a confirmation that they could see the strobe lights and the VASIS.²

Moncton Centre was alerted shortly after 2300Z when it was evident that the aircraft had not landed. A local search was initiated with two helicopters from the airport but because of deteriorating weather, the search had to be discontinued and the aircraft was not found that night. Search and Rescue were alerted at 2314Z. Near blizzard conditions occurred that night and the next day, December 10. It wasn't until 11 December that the air search was resumed and the aircraft was located two miles short of the threshold of runway 14. There was no sign of life.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	2	6	
Serious			
Minor/None			

1.3 Damage to aircraft

The aircraft was destroyed on ground impact; wreckage was scattered along a trail of about 300 ft. (See figure 2.)

1.4 Other damage

Nil

1. All times in this report are in GMT.

2. For more complete details of events during the approach see Appendix A.

1.5 Personnel information

a) Pilot-in-Command (Captain)¹

The Captain was 53 years old and held a valid Airline Transport Pilot Licence. He started to fly in 1945 and acquired some 11 000 hours including 3 100 hours on the HS-125. In the past twelve months he had accumulated 520 hours on the HS-125. He was employed by the company in July 1970. His last medical was on 21 November 1977 and his profile was "S-1GA-1-1" (see 1.13-1). He had been on duty 9 hours before the accident, and had 16 hours off duty prior to the commencement of the flight.

b) Co-Pilot (First Officer)

The First Officer was 52 years old and held a valid Airline Transport Licence. He started to fly in 1959 and his total flying time was in excess of 15 000 hours. He had flown some 2 600 hours on the HS-125 including 450 hours flown in the past 12 months. His last medical was in October 1977 and his profile was "1-1GA-1-1". He had been on duty 9 hours before the accident and had several days off prior to commencement of the flight.

c) Check pilots who had administered their routine flight checks reported that during such checks the pilots performed well as a team and carried out all required altitude and other call-outs.

1.6 Company/aircraft information

The aircraft was owned and operated by a large private corporation, to provide transport for their executive personnel and high priority cargo. The corporation employed 3 pilots who rotated as a two-man crew on the one aircraft. The company aviation operations were well managed. The record keeping, training and flight operations activity was done in a professional manner. Maintenance, performed on a contract basis, was of a high standard.

The aircraft was a Hawker Siddeley HS-125 (403A(C)) manufactured in 1970 and powered by two Rolls Royce Viper Model 522 engines. The airworthiness and maintenance status of the aircraft was satisfactory and there were no known deficiencies prior to or during the flight.² Maximum authorized take-off weight was 23 600 lb. The weight and centre of gravity were within specified limits.

1.7 Meteorological information

An extensive area of light to moderate snow ahead of a low pressure system spread gradually into the Labrador area in the afternoon and evening of December 9 with light snow commencing at Churchill Falls at 2200Z. Between 2200Z December 9 and 0430Z December 10, light snow was reported in each observation from Churchill Falls with ice crystals starting at 0100Z. Visibilities during this period ranged from 3 to 10 NM in snow or ice crystals and the lowest reported ceilings were 3 500 ft.

The actual weather at Churchill Falls for the period of the accident was: ceilings 3 500 ft or higher, visibilities from 3 to 10 mi in light snow or ice crystals, surface winds light, less than 13 kt from an easterly to northeasterly direction. The 2300Z observation (after the accident) reported a partially obscured condition in light snow with a measured overcast ceiling of 3 800 ft, stratocumulus 4/10, stratus 6/10, visibility 3 mi, surface winds 090° at 7 kt, temperature -21°C, dew point -23°C, and the altimeter setting 29.85 in.

1. Both pilots were fully qualified; the pilot in the left seat has been designated as Pilot-in-Command for report purposes.
2. Pilots reported that on this HS-125, as on others of the type, ADF indications became unreliable in conditions conducive to precipitation static. Such conditions existed in the Churchill Falls area at the time of the accident. According to the CVR record the crew experienced some unreliable indications during the latter part of the flight.

Upper air soundings taken at Goose Bay are believed to be most representative of conditions over Churchill Falls on the evening of December 9. This ascent shows a stable temperature profile with temperatures at -16° throughout the layer, surface to 500 mb; the ascent indicates the air was saturated between 4 000 and 16 000 ft, suggesting the presence of clouds throughout that layer. A combination of very cold air temperatures, a stable lapse rate and precipitation in the form of ice crystals and snow suggested that light rime might be expected in the cloud layer. The same conditions would contribute to the ice crystal condition at Churchill Falls which started to show up at 0100Z on the 10th.

Pilot reports in the vicinity of Churchill Falls immediately after the accident indicated extensive patches of ice crystals west of the field extending 600 to 800 ft above ground. Above that level visibilities ranged up to 20 mi.

The aftercast indicates that it was very unlikely that any low level turbulence was present in the vicinity of Churchill Falls.

The accident occurred during the hours of darkness.

1.8 Aids to navigation

The airport has one non-directional radio beacon "UM" on a frequency of 233 kHz. This is situated 4.5 NM from the end of runway 14 and was in operation at the time of the accident. The limits for the straight-in beacon approach to runway 14 are 718 ft and 1 mi.

1.9 Communications

The VHF communications with Churchill Falls on 122.2 MHz were satisfactory (see also Appendix A).

1.10 Aerodrome information

Churchill Falls airport, Newfoundland is operated under public licence by a private corporation. There is a paved runway 5 500 ft long by 150 wide, elevation 1 442 ft asl. On the approach end of runway 14 there is a VASIS set to a 3° glide path, and two strobe lights. (Figure 1* indicates a $2\ 1/2^{\circ}$ glide path; the angle was changed to 3° on 12 October 1977 and pilots were advised by NOTAM CYR 417/77.) The strobe lights and VASIS were in operation at the time of the accident. There is runway perimeter lighting, a rotating beacon, and low intensity centre row and runway identification lights - all of which were operating at the time of the accident.

1.11 Flight recorders

There was no flight data recorder on the aircraft, nor was there a requirement for one as this was a privately registered aircraft. It was, however, equipped with a cockpit voice recorder, a Fairchild A-100 CVR which was recovered in excellent condition. The recording was above average in quality due to the low cockpit noise and location of the cockpit area microphone on the instrument panel. The contents of the voice recorder were analysed and items with a bearing on the accident and with aviation safety implications are detailed elsewhere¹ in this report.

* ICAO Note. - Figure 1 not reproduced.

1. It is the policy of the Aviation Safety Bureau not to provide complete transcripts of CVR recordings, but to publish only those portions pertinent to an understanding of the accident circumstances, or to paraphrase the spoken words. This is to protect the rights of individuals, and out of consideration for next-of-kin.

1.12 Wreckage and impact information

The first contact was with the tops of several trees; the aircraft heading at the time was about 127° Magnetic. The heading had changed to about 143° Magnetic by the time of initial ground surface impact.

A distance of about 800 ft was covered between the first tree strike and the initial impact with the ground surface. A further 250 ft were covered before the main body of the wreckage came to rest (see Figure 2).

Examination of the wreckage and area showed: a) the engines were both producing power at impact; b) the landing gear was down; c) the flaps were in the landing position; d) hydraulic and electrical power were available; e) the aircraft was under control at the time it first entered the trees; f) adequate fuel was on board the aircraft; g) all failures were the result of impact forces; h) the impact attitude, decelerative forces and destruction of the forward sections of the aircraft indicated the accident was classed as essentially non-survivable; i) the only post-crash occupiable area was in the aft cabin.

1.13 Medical and pathological information

1.13.1 Pilot-in-Command (Captain)

The pilot-in-command held an Airline Transport Licence. Because of recurrent urinary calculi (kidney stones) he had been issued a special licence medically valid provided no change in this condition was noted on annual follow-up examinations. Autopsy findings revealed that kidney stones were not a contributory factor in the accident. The injury pattern is consistent with this pilot flying the aircraft from the left-hand seat.

Numerous tablets in partially emptied containers were found in his pockets; these were identified as Contac C (an antihistamine), Tuinal (a barbiturate), Anacin, ASA, (analgesics), Rolaid, Gelusil (antacids) and Hydrozide (a diuretic for kidney stones).

No carbon monoxide or alcohol were found in the tissues. Lactate determinations indicated that he was subjected to an acute stress reaction of 6 to 7 seconds. Tissue analysis showed the presence of metabolic products of acetylsalicylic acid.¹

The Captain was considered by his peers to be a meticulous, highly-qualified pilot, very knowledgeable about his aircraft, but who would not readily admit to making an error. He took pride in being able to do an approach with minimum power adjustments.

1.13.2 First Officer

Medical information on this pilot shows no evidence of disease which might have impaired his flying ability. The injury pattern suggests that he was sitting on the right-hand side but not flying the aircraft. His peers assessed him as competent and knowledgeable, and probably less aggressive than the other pilot.

No alcohol or carbon monoxide was detected. Lactate determinations indicate that he was subjected to an acute stress reaction of approximately 15 seconds.

1. No other of the compounds mentioned could be detected in the tissue analysis.

1.13.3 Possible illusions affecting the pilots^{1,2}

There were no lights on the approach side of the airport and the lights of the town of Churchill Falls were 2 or 3 mi farther away from the airport on the right side of the flight path, with no lights in between. The lights of the airport would therefore be surrounded by a dark area (black hole effect).

The prevailing weather conditions during the approach included ice crystals and light snow. Viewing the lights on the ground under such conditions could lead a pilot to believe that the airport's lights were larger and farther away than normal. He might then judge himself to be higher than he actually was and fly a lower path.

Another condition which has been known to falsify a pilot's visual cues is the illusion which occurs when flying into gradually thickening fog on approach. The pilot feels he is climbing and to compensate descends too low. The absence of lights around the airport, especially on the approach side, would amplify the effects of such illusions.

The Captain had a history of mild hypothyroidism; this condition may have produced a slowing of his mental activities. Also, since he had taken some ASA tablets he may have been suffering from some discomfort such as a headache, a cold, a toothache or other pain. The Contac C in his pocket would suggest that he was suffering from a cold. Any of these discomfort factors could reduce his attention and alertness during the approach, especially under the prevailing circumstances.

1.13.4 Passengers

Alcohol determinations revealed that some of the passengers were drinking during the flight; alcohol levels in various tissues of one passenger, who according to the CVR was in the cockpit area until after beacon passage on final, show a recent ingestion of alcohol. This suggests that he was drinking while in the cockpit talking to the pilots since the CVR reveals his presence there for at least part of the last 30 minutes recorded. It is noteworthy that biochemical determinations showed that this passenger, who was also a pilot, had an acute stress reaction of 4 seconds.

Autopsy findings reveal that all passengers were wearing seat belts and that all but 2 died at impact. Most of the injuries were more prevalent in the upper parts of their bodies and on their left sides. This confirms that the final aircraft impact was nearly inverted and toward its left side. All passengers had seat belt imprints. One passenger had two such imprints indicating that there were two major impacts of approximately equal force.

The seat belts of two passengers who had been in the rear of the cabin on a bench type seat had been undone; their bodies were found outside the aircraft near the main part of the fuselage. The autopsy findings indicate that both these passengers had survived the impact. When the aircraft finally stopped they evidently undid their seat belts and in a probable state of confusion, hastily evacuated the aircraft, fell out of the wreckage and further injured themselves. They died of exposure to cold.

1.14 Fire

There was no fire.

1. Donald G. Pitts, Major U.S.A.F., B.S.C.
Visual Illusions and Aircraft Accidents
2. The Boeing Company, Renton, Washington
Document D6-22996
Flight Deck Load and Night Visual Approach Performance

1.15 Survival aspects

See 1.13.

1.16 Tests and research

1.16.1 Instrument examination

The cockpit instruments recovered from the wreckage were subjected to laboratory study. Pertinent results included the determinations that both the Captain's and the First Officer's altimeters were operating and showed no gross errors, and that the radio altimeter had been operating properly. (Report LP 303/77 refers.)

1.16.2 Light bulb analysis

Evidence obtained from the condition of the recovered light bulb filaments generally confirmed the expected operating conditions at impact. Of interest was the fact that the two bulbs of the "dome light" were illuminated at the time of impact. (Report LP 304/77 refers.)

1.16.3 Flight and simulator tests

The flight path was studied by means of a helicopter equipped with a video camera. Subsequently tests were carried out in a HS-125 flight simulator and in a HS-125 aircraft. The simulator was set up for Churchill Falls airport; the procedure in the aircraft was flown on another beacon, but using the Churchill Falls headings and altitudes.

The test programmes were planned to duplicate the accident flight as closely as possible, using standard operating procedures and incorporating the timing and other information obtained from the cockpit voice recorder tape. The power settings were those determined from analysis of sounds on the CVR tape. Experienced HS-125 pilots were at the controls.

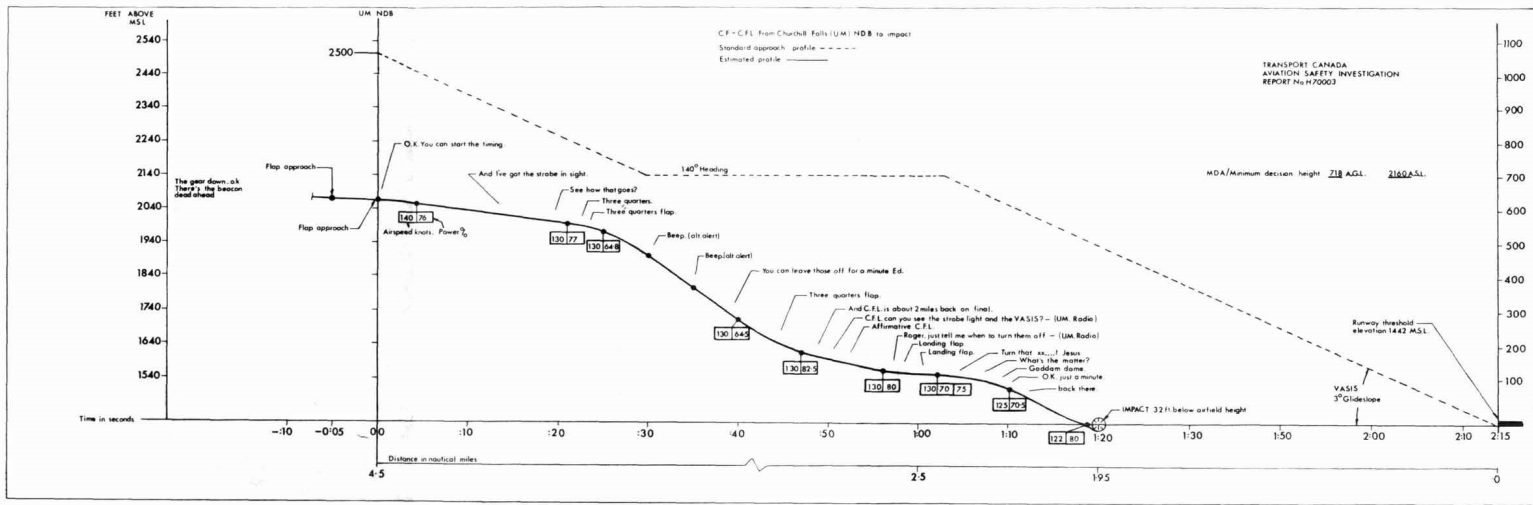
The pattern of "beeps" from the altitude alert system on the CVR tape was studied in flight.

The conclusions of the series of tests were as follows:

- a) The aircraft must have crossed the Churchill Falls NDB on final approach about 400 ft below the published altitude;¹
- b) The frequent power adjustments during the final approach indicate that the pilot was unsure of his distance, proper altitude and approach angle in relation to the runway threshold environment lights;
- c) The aircraft was never on a stabilized approach path;
- d) It is unlikely that the VASIS and strobe lights were visible throughout the final approach;

1. This conclusion was reached because in repeated simulations it was found necessary to cross the NDB 400 ft below the published altitude in order to duplicate the final flight profile.

FIGURE 3



- e) No excessive sink rate or airspeeds developed during the approach.
- f) The crew had used the altitude alert system for the approach.

1.16.4 Appropriate computer searches were made of aviation safety and medical literature, and information from these sources is incorporated in this report. A number of HS-125 undershoot-type accidents were studied; these revealed no pattern indicating operating problems or the need for special techniques for landing approaches with the HS-125.

1.17 Additional information

1.17.1 Although the accident occurred only two miles out on the extended centre line of the runway, the wreckage was not located for two days due to extreme weather conditions. A searching helicopter had flown over the site within 15 minutes of the crash with a receiver tuned to a distress frequency. The two aircraft emergency locator transmitters had been removed in compliance with an Airworthiness Directive (CF-77-11) issued because of malfunctioning (exploding) lithium batteries experienced in other aircraft.

1.17.2 The "dome" referred to by the Captain in his exclamation about 12 seconds before impact is considered to be the dome light which is in the entrance way behind the pilots. There is only one switch to this light, and it is not accessible to the pilots when they are at their posts. There had been reports of radar "domes" coming off in flight on other HS-125 aircraft; this possibility was considered but rejected following examination of the intact radar dome found in the wreckage.

1.18 New investigation techniques

A video camera was used to record details and actions at the site and also to study the flight path from the air. This simplified later briefings and analysis.

1.19 Witnesses

There were no witnesses to the crash. Information was obtained from various persons concerning departure details, communications, training and flight checks of the pilots, and the aircraft status; this has been incorporated in this report.

2.- Analysis

2.1 The approach

From study of the flight plan, the timing of the flight and the crew conversations during the descent phase, it was apparent that the descent was well planned from the point of view of fuel economy and that the crew had adequate weather and other information to conduct the approach. Contrary to accepted good practice, however, there was no approach briefing given by the Captain to the First Officer; a passenger was allowed in the cockpit area until the approach was well in progress; there were no altitude calls during the approach; the flight instruments were not adequately monitored.

Following a procedure turn the aircraft was flown toward the non-directional beacon for the final approach. The simulator and flight studies concluded that crossing the beacon was done about 400 ft below the published altitude. This could have been because the pilots made the station passage visually rather than on indications from their ADF equipment and reverted to a visual approach; they could have been unsure of exact station passage due to poor ADF indications caused by precipitation static (see 1.6); perhaps they were depending on their altitude alert system, which, according to the

analysis of the "beeps", may have been set incorrectly. As can be seen on the simulated flight profile, Figure 3, and in the cockpit voice recorder report, Appendix A, the altitude alert system was being used during the approach. It is possible that the pilots were placing undue reliance on this system, normally intended to be used before the final approach phase is entered. The analysis provided by flight test duplication indicates that the altitude alert system may have been used as low as the MDA (minimum descent altitude).

Although the Captain had a reputation for precision and particularly prided himself on being able to make an approach with a single power setting, in this case he made a number of power adjustments, and the approach could not be called a stabilized one. This might be a confirmation that on the day of the accident the Captain was below par, as indicated by the medical evidence. At the same time it is apparent that the First Officer was distracted at least twice during the approach; first when the passenger left the cockpit, and second when the Captain made an exclamation and complained about the dome light. It appears to be significant that when the matter of the dome light upset the rhythm of the flight the First Officer became quite concerned, as indicated by his lactate profile revealed by aeromedical studies. Whether this dome light had been on for some time or was simply switched on at the time the Captain complained (see Appendix A), could not be determined. If it had been on for some time, it is possible that it only became bothersome to the pilot when he was attempting to see the runway lights in the latter stage of the approach. The First Officer may have attempted to draw the cockpit curtain to alleviate this problem. Shortly after this distraction the aircraft was allowed to descend to the point where the approach lights would not be visible because of intervening terrain.

It appears probable the Captain was subjected to an illusion. However there are recommended flight crew co-ordination procedures designed to counteract the effects of such illusions; these include altitude cross-checks, and proper monitoring of the flight instruments until touchdown. Evidence indicates that three serviceable altimeters were available (one servo electric, one pressure, and one radio altimeter), yet no altitude calls were made by either pilot.

The aeromedical report indicated that the Captain experienced 6 seconds of extreme anxiety; this is consistent with the period when the aircraft was striking trees just prior to the final impact. It is interesting that the passenger who was in the cockpit area, but had returned to the cabin, was the only one among the passengers who showed an extreme stress reaction (4 seconds) - he was aware that the aircraft was on final approach and he himself was a pilot.

Even though this night approach was conducted in what might be termed visual conditions, standard operating procedures require an instrument monitored approach regardless of the existing weather. The company training, equipment and other facilities provided to the pilots were of high quality; instrument flight check reports showed that the two pilots carried out acceptable procedures during their check flights; nevertheless, on the accident flight there was poor crew co-ordination and poor communication between the pilots during the approach stage of the flight. This may have been due to complacency brought on by familiarity with the route and the operation, and by medical factors affecting the Captain.

3.- Conclusions

3.1 Findings

- 3.1.1 Cockpit discipline was inadequate as the approach entered the final phase.
- 3.1.2 Distractions in the cockpit degraded crew performance.
- 3.1.3 The pilots deprived themselves of essential altitude information by not effectively monitoring the flight instruments during the final approach.

3.1.4 The Captain, by relying on visual cues from the runway environment lighting in conditions where those cues were degraded, became exposed to visual illusions.

3.1.5 The pilots permitted the aircraft to deviate below the safe approach profile until it struck the terrain.

3.1.6 On the assumptions that there had been at least one serviceable ELT on board, that it had been activated as a result of the impact or by other means, and that there was the capability at Churchill Falls of homing to the point of origin of the ELT signal, the rescue activity may have been expedited.

ICAO Note: Only Appendix A and Figures 2 and 3 to the report are reproduced.

ICAO Ref.: AIG/434/77

APPENDIX A

Cockpit Voice Recorder Information

The aircraft was equipped with a Fairchild A-100 CVR, Serial No. 4082. The recorder was in excellent condition and the recording was above average in quality, due to low cockpit noise and to the location of the Cockpit Area Microphone on the panel in front of the right seat. It was not difficult to transcribe most of the speech on the cockpit area microphone track. The speech recorded on the Captain's and First Officer's audio tracks was also of good quality, and it seemed that most of the time the two crew members were wearing boom microphones which picked up cockpit conversations.

The tape's duration was 31 minutes, 4 seconds.

Engine Power Determination

By analysing the sound frequency spectrum it was possible to derive the % N2 RPM during the last 4 minutes of the flight. Once the physical characteristics of the Rolls-Royce Viper powerplants were determined, it was possible to develop the relationship between frequency and RPM and a graph of % N2 RPM versus CVR elapsed time. This is incorporated in Figure 3.

Analysis of Other Recorded Sounds

During the first 1 minute 30 seconds of the recording, the crew members were talking with a passenger. At about 1:50* CFL was cleared to the Churchill Falls airport for an approach by Moncton Centre. The weather was given by Moncton as "special, aircraft ceiling 3 500 overcast, visibility 10 mi in light snow, temperature -21, dewpoint -24, surface wind 090 true at 10, altimeter 29.87". At this time the Captain contacted Churchill Falls advisory to arrange refuelling and to file a flight plan on to St. John's.

After these radio transmissions the crew again talked with a passenger until 4:57 when Churchill Falls Advisory called to confirm the flight plan details. Conversation with the passenger resumed, and it was apparent that they were identifying surface details such as power lines, using radar. At 5:54 the Captain gave their range as 110 mi, and at 6:58 as 100 mi. At 7:32 the First Officer called Moncton "out of 330 on a descent for the approach". Immediately before this call the pressure altimeter warning tone sounded. Moncton Centre told the flight to call Churchill Falls Radio on 122.2 at 7:40. At 8:25 the Captain called for the "descent check" and the First Officer responded "coming up". The weather was given by Churchill Falls Advisory as "partially obscured, estimated 3 500 overcast, visibility 4 mi in light snow, wind 110 at 8 kt, altimeter 29.85. At 9:11 the First Officer, who handled all subsequent radio transmissions, asked that the VASIS's, strobes and approach lights be turned up, and that the (approach) lights should be on bright until he asked them to be turned down. The radio operator asked to be told if the VASIS worked, and mentioned that the switch sometimes did not work.

There was no passenger speech detected between the start of the descent at 7:32 and 9:55, when a different passenger's voice can be heard in conversation with the crew. At 10:40 a range of "75 miles out" is mentioned by the Captain, and starting at about 10:45 the "UM" morse ident is heard. At 10:54 advisory asked for an ETA, "because they're clearing the runway", and the First Officer estimated 56. A discussion followed

* This is flight data recorder running time, an arbitrary time covering the last 31 minutes, 4 seconds of the flight.

with the Captain, who felt they would be in sooner than that, and he asked the First Officer to ensure that "they're off by 50". At 12:40 the maximum speed warning horn sounded three times (282 kt). At 12:48 the Captain mentioned that they would be there in 12 minutes, and at 13:27 the First Officer gave advisory a range of 50 mi, and an ETA of 54. At about 14:00 the altimeter setting of 2984 is mentioned and at 14:37 the First Officer gives the weight and reference speed as 19 000 and 112 respectively. At 14:54 the Captain mentions a range of 45 mi.

At 16:04 the Captain called for the "field approach" check and the First Officer responded "is done", and again stated the reference speed of 112 kt. At 17:10 the Captain mentioned that the snow was adversely affecting the ADF. At 18:42 the First Officer asked "you going to do the whole approach?" and the Captain responded in the affirmative "unless we see it".

At 19:24 Advisory gave the visibility as 3 mi with very light snow drifting across the runway. The First Officer gave their range as 10 mi and told advisory that he would call outbound and inbound on the let-down. At 20:03 the Captain stated "go down to 32 turn outbound". At 20:18 a passenger asked "how's the beacon, good?" and the Captain responded "it's fairly steady". At 22:09 the altitude warning sounded. At 23:30 the Captain said "that looks like it over there about 4 or 5 miles", and at 24:37 "that'll be the airport there, yeah we'll do our approach". The First Officer and passenger also mentioned seeing the strobes.

At 25:41 the First Officer called Advisory "by the beacon outbound" and was given the wind 120 at 10, altimeter 29.84. At 26:03 the Captain asked for "flap 15" and at 26:31 two altitude warnings sounded, five seconds apart. At about 26:30 the First Officer mentioned the procedure turn headings two seven five and zero nine five.

At 27:19 the Captain stated "it'll be about 2 minutes and 15 seconds there but we should be able to see it anyway." This timing implies a groundspeed of 120 kt. At 27:29 Advisory called CFL about fuel requirements and the radio conversation was interspersed with comments by the Captain to the effect that he had given their requirements earlier, and that there was no need for this call.

At 28:00 the power increased from 75 per cent to 85 per cent at 28:10. At 28:03, 28:08 and 28:14 the pressure altimeter warning sounded. At 28:18 the Captain said "OK get the gear down", and shortly thereafter the increased wind noise indicated that the gear was extended. The First Officer stated that the "gear's down and locked" at 28:26, and then the power decreased to 65 per cent at 28:45.

At 28:59 the pilot stated "there's the beacon dead ahead ay", as if he saw the beacon. The power started increasing at 29:05 to 75 per cent at 29:15, and at 29:36 the Captain asked for approach flap, and the First Officer acknowledged. The power varied from 75 per cent to 77 per cent until 30:05. At 29:43 the Captain said "OK you can start the timing", indicating beacon passage, and at 29:47 the First Officer indicated that he had "the strobes in sight". At 30:03 the Captain asked for three quarters flap, and shortly after this the power dropped to 64 per cent at 30:15. At 30:13 and 30:18 the altitude alert warning sounded, and at 30:19 the Captain said "you can leave those off for a minute", probably referring to the landing lights. At 30:24 the power began to increase and the First Officer said "three quarters flap". At 30:27 the First Officer called Advisory "about two miles back on final" and when asked if he could "see the strobe light and the VASIS", he replied "affirmative CFL". The power increased to 83 per cent at 30:30, falling to 80 per cent at 30:35. At 30:39 the Captain asked for "landing flap" and the First Officer echoed the request at 30:42. From 30:39 to 30:43 the power on the two engines fell to 75 per cent and 71 per cent, remaining at these levels until 30:50. At 30:43 the Captain said "turn that f... , Jesus" as if he was angry. At 30:46 the First Officer asked "what's the matter?", and at 30:47 the Captain said "goddamn dome". At 30:49 the First Officer said "OK just a (minute)" while the Captain said "back there". At 30:50 to 30:54 the power increased rapidly to 83 per cent, and then more slowly to 88 per cent at 31:04 when the tape ends. Between 30:49 and 31:00 neither crew member spoke, but the sound of passengers' conversation in the cabin can be heard until 31:00. From 31:00 to 31:04 crashing sounds can be heard.