SERIOUS INCIDENT

Aircraft Type and Registration:	BAe ATP, G-BUUR	
No & Type of Engines:	2 Pratt & Whitney Canada PW126 turboprop engines	
Year of Manufacture:	1990 (Serial no: 2024)	
Date & Time (UTC):	26 January 2016 at 1950 hrs	
Location:	On approach to Guernsey Airport	
Type of Flight:	Commercial Air Transport (Cargo)	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	60 years	
Commander's Flying Experience:	6,843 hours (of which 1,512 were on type) Last 90 days - 74 hours Last 28 days - 23 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The crew reported that the autopilot would not disengage during the approach for a night landing at Guernsey in a strong crosswind. A manually flown go-around was initiated from low altitude and the newly-qualified co-pilot, who was Pilot Flying (PF), reported the aircraft then exhibited a strong pitch-up tendency. The commander also sensed excessive pitch-up and pushed forward on his control column to assist. Thereafter the crew were alerted to activation of the Standby Control System (SCS) with the left and right elevators operating in split control.

During the go-around, the elevator control system problems distracted the crew so they did not follow the standard go-around procedure resulting in late retraction of the gear and flaps. After levelling, the pilots realised the autopilot was not engaged and immediately re-engaged it. The appropriate drill for SCS engagement was then actioned and they diverted to Jersey.

On completion of the flight, the crew reported the problems encountered to the operator and their engineers began system checks. It was not understood by the crew or those working on the aircraft that the event was a reportable serious incident and consequently, the Cockpit Voice Recording (CVR) of the event was not preserved and certain autopilot components were removed from the aircraft prior to the AAIB being notified on the evening of 27 January 2016.

Recorded flight data indicated the autopilot disengaged during the approach to Guernsey and examination of the aircraft revealed no technical defects that would have caused the

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incident. As the CVR was unavailable, it was not possible to ascertain if an audio autopilot disengagement alert was generated. Some human factors were identified which may have contributed to the incident. The operator has made changes to its training policies and its guidance concerning post-incident or accident response.

History of the flight

The aircraft departed Jersey at 1940 hrs for a night cargo flight to Guernsey. The co-pilot, who was PF, had completed the operator's BAe ATP training course the previous month and this was his first commercial aircraft type. The forecast was for a strong southerly wind affecting both islands, with a possibility of severe turbulence and windshear. The PF believed he had experienced similar weather during training and was content to handle the aircraft in these conditions. Before departing for this short flight he briefed the commander, who was Pilot Not Flying (PNF), about the expected approach to Guernsey's Runway 27. He mentioned the required routing in the event of a missed approach but did not discuss the actions required of each pilot in the event of a go-around.

Following a normal take-off, autopilot system 2 (AP2) was engaged at approximately 1,000 ft aal and the aircraft was levelled at 2,000 ft amsl. No significant turbulence was experienced and Runway 27 was in view when the aircraft established on an ILS approach with AP2 still engaged. The visibility was good, the surface temperature was 11ºC, the reported surface wind was from 200º at 20 kt and the crosswind was within the operator's advisory limits (see *Crew guidance*). At 1,000 ft agl, the PNF stated the aircraft was stable; with the gear extended and flaps set to 20º. The estimated landing weight was 18,369 kg, so the calculated threshold speed (V_{AT}) was 103 kt. The approach speed would have been 113 kt (V_{AT}+10) but the crew added a 5 kt buffer and aimed to fly at 118 kt because of the gusty conditions and the forecast of possible windshear.

Approaching the decision altitude (200 ft aal), the PF attempted to disengage the autopilot, by pressing the red disengage switch on his control wheel, but he did not hear the expected audio disengagement alert. Unaware of this, the PNF suggested the autopilot be disengaged, as he was keen the PF had enough time before landing to become used to handling the aircraft in the windy conditions. The PF pressed the disengage switch once more but still neither pilot heard the disengagement alert. The decision altitude was then announced by the PNF and acknowledged by the PF, who pressed the autopilot disengage switch again. He also tried to make small control column inputs but he thought the controls felt extremely stiff.

Both pilots believed the autopilot was still engaged, as neither of them had heard the disengagement alert and the PNF was aware, in his peripheral vision, of the PF "frantically pressing" the disengage switch. The PNF asked what was happening and the PF told him "it won't disconnect", so the PNF pressed the disengage switch and the pitch trim switch on his control column, as either action should disengage the autopilot. He also recalled pressing the AP switch[1] on the autopilot controller, but still no disengagement alert was

Footnote

[1] See *Autopilot selection and engagement.* The AP switch's function is to engage the autopilot if pressed for 0.75 seconds. This switch does not have a disengagement function.

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heard. He could not recall checking the auto-flight mode annunciations on his Primary Flight Display (PFD). The PF thought he remembered seeing the relevant AP annunciator on his PFD at some stage after his first attempt to disengage the system.

The PNF asked the PF if he had control and the PF said he was not sure. The PF later stated that he tried moving the control column again, both laterally and fore and aft but it felt very stiff, "as if the autopilot was in". Both pilots were aware of the aircraft deviating above the glideslope and the PF recalled trying to pitch the nose down and possibly reducing power as well. Shortly after this the PNF instructed the PF to go-around, because he was unsure if sufficient control was available to land the aircraft in the crosswind conditions and he now assessed the approach to be unstable. He recalled making this decision when the aircraft was close to the runway.

The PF advanced the power levers and pressed the go-around button on the right power lever using his left hand. This should have caused the autopilot to disengage and the flight director bars on the PFD to move. He was not aware that either of these changes happened, so he pressed the go-around button a second time, but still sensed no response. However, he was now applying rearwards force on the control column with his right hand and the aircraft began to pitch nose-up. His recollection was that the controls felt stiff but he did not have to exert an unusual amount of force at this stage. He called for go-around power, for FLAP 15 and for HDG and PSA mode selections (see *Autopilot and flight director modes*).

The PNF concentrated on adjusting the power levers to the go-around setting and moving the flap lever. He could not recall looking at the flight director bars on the PFD or selecting HDG and PSA modes[2]. Neither pilot was sure if they employed IAS mode while climbing, but both of them did remember seeing a large decelerative speed trend on their PFD airspeed tapes during the go-around. Once the power had increased, the PF was aware of a strong pitch-up tendency and he responded with an unusually large amount of forward force on his control column.

The PNF also recalled the aircraft pitching up more than expected, possibly as much as 15-20º but he did not see this on the instruments. He instinctively assisted the PF by pressing forward on the left control column using the palms of his hands. He then heard the caution annunciation and was aware of a caution light on the Central Warning Panel (CWP).

The PF saw the STANDBY CONTROLS caution on the CWP. The pitch control forces now seemed lighter than normal and were similar to those he had experienced in the simulator when practising flight with split elevator control.

The crew later stated they felt the go-around now began to "normalise" and they retracted the flaps and levelled at 2,000 ft amsl, in response to ATC instructions. They then noticed an elevator SPLIT indicator on the overhead console. Both pilots now realised the autopilot was no longer engaged. They did not recall discussing the autopilot problem or its annunciations at this time and successfully re-engaged AP2.

Footnote

2 See ***Organisational information*** **-** *Go-arounds.*

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The drill in the Quick Reference Handbook (QRH) titled '*Standby Controls Warning (CWP)*' was actioned, during which the crew engaged AP1 for a short time, before re-engaging AP2. After completing the drill, AP2 was briefly disengaged again and then re-engaged.

The autopilot now disengaged and re-engaged normally and both pilots heard the audio autopilot disengagement alert clearly. They decided to divert to Jersey, where the runway is longer[3] and where the operator has a maintenance base. Owing to the unusual circumstances, with the elevators split, the commander elected to reverse the crew roles and, with the co-pilot's agreement, he became the PF for the approach to Jersey. The autopilot was switched from AP2 to AP1, without difficulty.

During the approach to Jersey the commander disengaged the autopilot earlier than normal. At approximately 600 ft aal the Enhanced Ground Proximity Warning System (EGPWS) annunciated a 'TERRAIN' audio alert but the crew disregarded this as they were visual with the runway, the approach was stable and because, according to the commander, "terrain warnings are not uncommon at Jersey and Guernsey".

After landing the crew noticed the elevator ENGAGED caption was illuminated on the overhead panel. They did not recall seeing this during the flight. The commander told the engineering staff what had happened and made an entry in the Technical Log. This stated the autopilot failed to disconnect on approach and that the elevators split and the standby controls engaged during the go-around.

The following day (27 January 2016) the commander forwarded an incident report to the operator and that evening the AAIB was notified. In the intervening period, the aircraft was electrically powered and the Cockpit Voice Recorder (CVR) recording of the incident flight was overwritten during maintenance activity.

Recorded information

Cockpit Voice Recorder

The aircraft was fitted with a CVR which was successfully downloaded. However, the 30 minute recording was of poor quality; a 400 Hz tone was continually audible and prevented comprehension of the whole recording, but it was evident that the recording did not cover the event. Instead, it recorded a period of on-ground troubleshooting during which the event was discussed and, at times, the aural autopilot disengagement alert could be heard to function.

Data Recorders

G-BUUR was also fitted with a 25-hour Flight Data Recorder (FDR) and a Quick Access Recorder (QAR), both of which were successfully downloaded. The data on the QAR replicated the data on the FDR so the QAR data, which was available first to the investigating team, was used.

Footnote

3 The LDA of Runway 27 at Guernsey is 1,463 m and the LDA of Runway 27 at Jersey is 1,554 m. The QRH drill states the aircraft should be landed at the nearest suitable airfield and does not specify any adjustment to the required landing distance.

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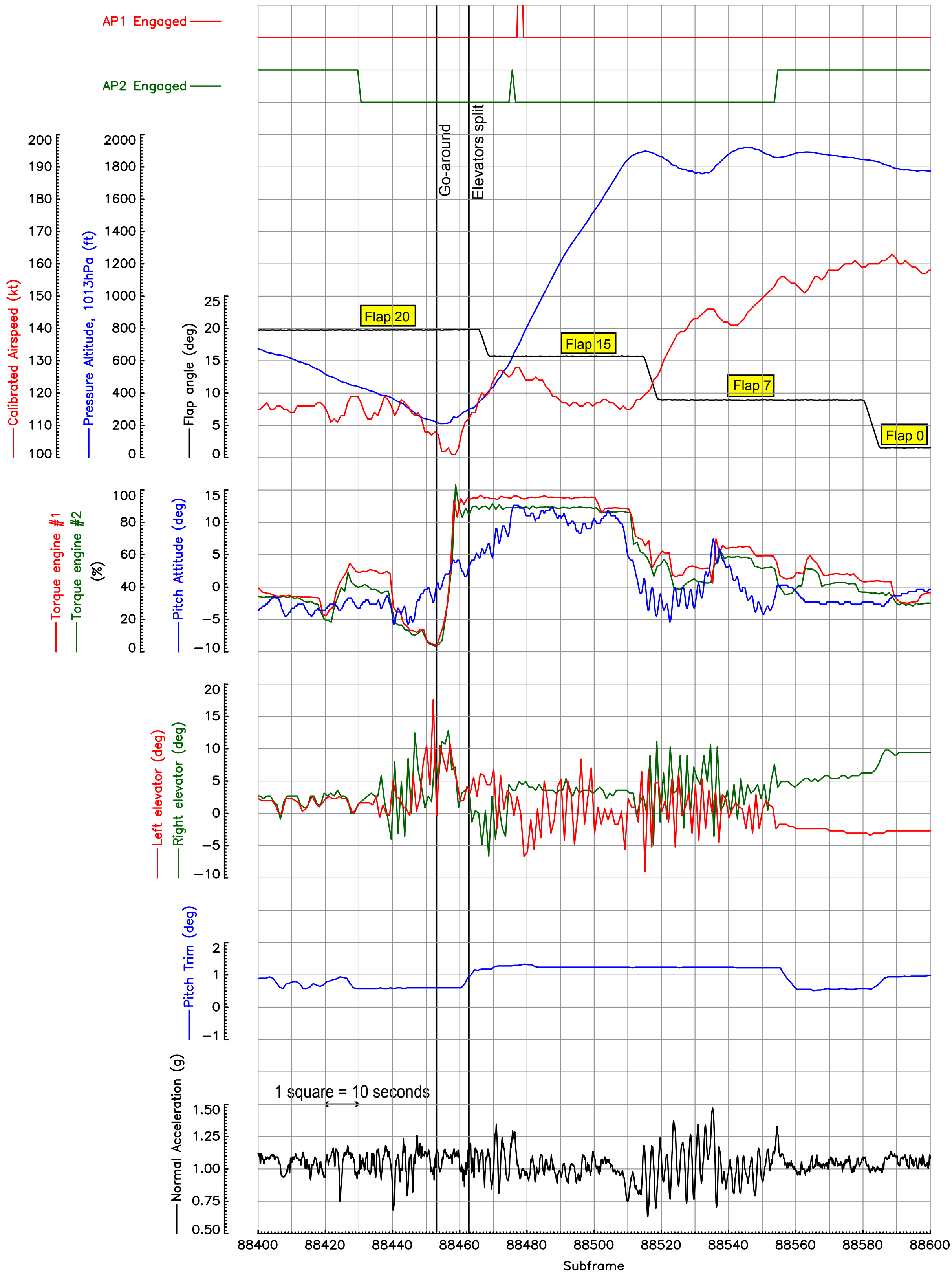

Figure 1

QAR data showing the approach and go-around at Guernsey

The QAR data has been divided into 3 phases; *the approach to autopilot disengagement*, *the go-around* and *the level-off to final autopilot re-engagement*. These phases are described under their respective headings below.

The approach to autopilot disengagement

The data showed that AP2 was engaged as the aircraft descended through 685 ft pressure altitude[4], equivalent to 470 ft above aerodrome level (aal)[5], 20º of flap was selected and the aircraft's pitch attitude, although varying, averaged -3º. The aircraft's airspeed was generally steady, with only minor fluctuations, around 115 kt[6] and engine torques were well matched at 34%. However, 19 seconds later, a reduction in torque to 22% on engine No 1 and to 20% on engine No 2 occurred as the aircraft passed through 550 ft pressure altitude (335 ft aal). At the same time the aircraft's airspeed reduced to 111 kt and an application of power was then made. This was slightly asymmetric in nature with engine No 1 leading engine No 2, torque values settled at 50% for engine No 1 and approximately 40% for engine No 2. The aircraft's airspeed increased to 119 kt. At this point, the aircraft was descending through 435 ft pressure altitude (220 ft aal[7]) and the data showed that AP2 disengaged. Prior to AP2 disengaging, the left and right elevators moved together in unison and the pitch trim was observed to modulate[8].

The go-around

After disengagement of AP2, for a period of 10 seconds, the aircraft's airspeed continued to vary between 112 kt and 119 kt but engine torques fluctuated by no more than 3%. The aircraft's pitch attitude was approximately -2º. Engine torques then reduced over 4 seconds to 15%, the initial reduction coincident with a change in pitch attitude of the aircraft to -5.7º, but thereafter pitch attitude settled at around -5º. The aircraft's airspeed, which had reduced to 113 kt, recovered back to 119 kt. Following autopilot disengagement, the activity on the elevators increased but because both elevators were sampled at different points in time and, due to a low sample rate, the precise position of the elevators, especially in relation to each other, could not be deduced. However, the trend of both elevators began to show a nose-up demand. The aircraft's pitch attitude changed, from -5º to +2º over 6 seconds, and during this time both engine torques decreased to 4%, whilst the aircraft's airspeed decayed to 102 kt. A minimum pressure altitude of 211 ft, approximately equivalent to the elevation of Guernsey's runway, was recorded before a rapid increase of torque, over 3 seconds, from 4% to a value of 95% for engine No 1 and 90% for engine No 2. The power settled at these values as the aircraft passed 250 ft pressure altitude (370 ft amsl). At 300 ft pressure altitude (420 ft amsl), a nose-down demand on both elevators was recorded and a nose-up

Footnote

4 Using 1013 hPa as the pressure reference.

5 The METAR for Guernsey at 1950 hrs UTC gave the regional pressure setting as 1017 hPa, meaning altitudes measured with reference to 1013 hPa required correction by +4 hPa, or +120 ft, to read above mean sea level. Taking into account the elevation of Guernsey (336 ft), as listed in the UK's Integrated Aeronautical Information Package, all aal heights were calculated by taking the 1013 hPa pressure altitude values, adding 120 ft and then subtracting 336 ft.

6 The target approach speed was 118 kt (see *History of the flight*).

7 Decision height for the approach was 200 ft aal.

8 When the autopilot is engaged it controls the pitch trim but, when it is not engaged, the pilots can adjust the pitch trim, either electrically or manually.

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deflection in pitch trim then occurred. The elevator surface deflections now changed in character, with different absolute values for both elevators recorded even during periods of elevator inactivity, consistent with the elevators having split. At 355 ft pressure altitude (475 ft amsl) the flaps were retracted to 15º, the aircraft's airspeed settled at between 125 kt and 130 kt and the pitch attitude reached the maximum recorded of 12.6º. Around this point, AP2 and then AP1 both momentarily showed as engaged. The aircraft reached 1,500 ft pressure altitude (1,620 ft amsl) 24 seconds later with the pitch attitude in the climb being between 8 and 12º and the airspeed averaging 118 kt.

The level-off to final autopilot re-engagement

Both engines now reduced to 87% torque, the pitch attitude reduced to +4º, which was accompanied by a further power change on both engines to around 70% torque. After the aircraft reached 1,900 ft pressure altitude (2,020 ft amsl), with an airspeed of 120 kt, the flaps were retracted to 7º. Further reductions in engine power were then made to 48% torque on engine No 1 and 40% torque on engine No 2 and the aircraft descended back to 1,750 ft pressure altitude (1,870 ft amsl) with a pitch attitude of -2.5º. The aircraft's pitch attitude was then increased to +7º, along with a power increase to approximately 60% torque, the aircraft climbed to 1,920 ft pressure altitude (2,040 ft amsl) with the flightpath becoming more stable although the aircraft continued to accelerate. During this whole period of time, the QAR data showed significant elevator activity, but this then settled with the re-engagement of AP2, and at the same time the pitch trim surface moved nose-down. Over the next 20 seconds, the aircraft levelled at 1,775 ft pressure altitude (1,895 ft amsl) the airspeed settled at 160 kt and the flaps retracted to 0º.

Aircraft description

The British Aerospace[9] Advanced Turbo Prop (ATP) was derived from the Hawker Siddeley 748. The aircraft is a low-wing turboprop transport with a conventional tail configuration and two Pratt and Whitney PW126 engines, mounted above the wings, driving six bladed propellers (Figure 2). The aircraft was produced in passenger and cargo configurations.

Figure 2

British Aerospace ATP G-BUUR

Footnote

[9] BAE Systems (Operations) Ltd is the design Type Certificate holder.

System descriptions

Autopilot

Automatic flight control is provided by two independent autopilots, flight directors and SCS. Each autopilot system has its own computer / amplifier. Only one autopilot can be engaged at any time.

Autopilot selection and engagement

An autopilot controller, common to both systems, is located on the console between the two pilots. It provides control of the autopilot functions and selection of system 1 or 2 (Figure 3). Operating the system selection switch will alternately select either system 1 or system 2 with each successive operation. The selected system is displayed above the selection switch. The autopilot is engaged by depressing the AP switch for a minimum period of 0.75 seconds. The autopilot will engage provided a safety circuit does not detect any errors and successful engagement will be indicated on the autopilot controller by a cyan AP caption on the autopilot controller.

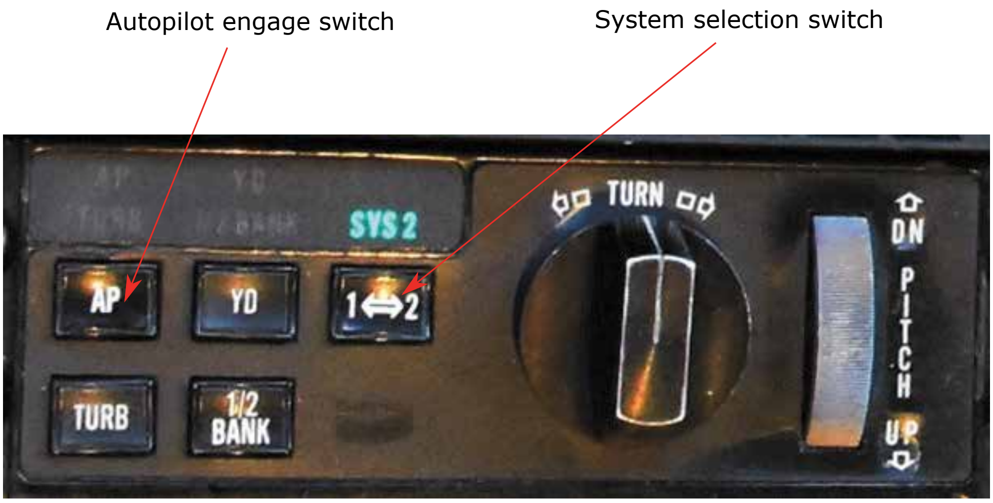

Figure 3

Autopilot controller

Autopilot and flight director modes

There are two identical mode selectors, one for each system. Each selector has two rows of switches and two rows of annunciator lamps to indicate armed and engaged modes. These modes are also annunciated on the PFDs, to either side of the autopilot annunciator. The mode selectors can be used independently to provide inputs to the flight directors and autopilots. During a coupled ILS approach the lateral engaged mode is APP (localiser captured) and the vertical mode is GS (Glideslope captured). GA (Go-Around) mode is a flight director only mode that is initiated when the go-around button is pressed and which demands wings level and 6º pitch-up on the PFDs. HDG is a lateral mode that directs the aircraft to follow the heading index as selected on the PNDs. The PSA (Pre-Selected Altitude) mode is used to capture a pre-selected barometric altitude and can be used in conjunction

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with another vertical mode, such as IAS (Indicated Airspeed) which maintains the airspeed indicated at the time the mode is engaged. Following the selection of GA mode the flight directors will demand wings level until the lateral mode is changed (eg HDG mode engaged) and 6º pitch-up will be demanded until the vertical mode is changed (eg IAS mode engaged).

Autopilot status on Primary Flight Display

The autopilot engaged annunciation (AP1 or AP2) is presented above the roll scale datum position on each PFD. If the system 1 autopilot is engaged, AP1 is coloured green on the commander's PFD and white on the co-pilot's PFD. When the system 2 autopilot is engaged, the co-pilot's indication is coloured green and the commander's PFD indication is coloured white. Lateral and vertical navigation modes, as selected or armed on the mode selector, are displayed to the left and right, respectively, of the autopilot engagement status (Figure 4).

Figure 4

Autopilot and mode indications on PFD
(Note photo taken of a PFD under test conditions and not in flight)

Autopilot manual disengagement

When the autopilot is manually disengaged the AP annunciation on the autopilot controller and the AP1 / AP2 annunciations on the PFDs are extinguished. To confirm disengagement a one second audio 'cavalry charge' alert is passed to the pilots' headsets and the cockpit loudspeaker.

The autopilot can be disengaged by pressing the red instinctive autopilot disengage switch on either of the pilots' control wheels. The autopilot will normally autotrim the elevators using the trim servomotor but, if necessary, electric trim switches on the pilots' control wheels can be used to adjust pitch trim manually. Activation of either switch will disengage the autopilot first (Figure 5).

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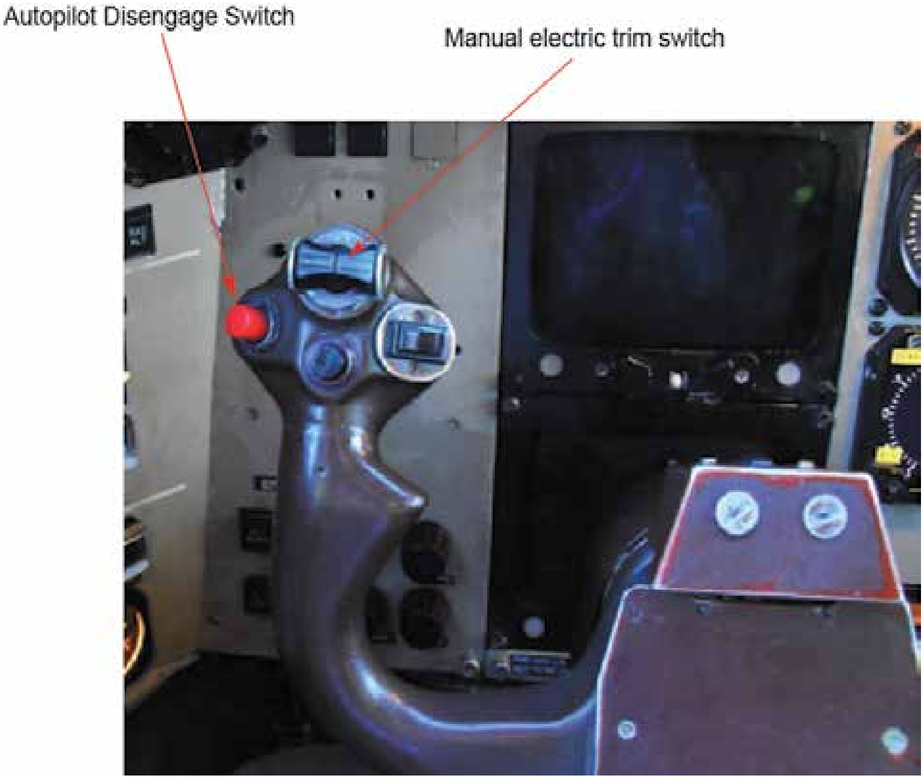

Figure 5
Autopilot and manual trim switches

Elevator primary flying controls

The elevators are operated directly from the control columns through a system of cables, rods and levers (Figure 6). These pass under the floor, down the left side of the fuselage then via push / pull rods and bell cranks to the control surfaces. A solenoid-operated elevator release unit is fitted between the two elevators. Under normal circumstances the release unit functions as a fixed length control rod but when the solenoid is energised the unit allows the elevators to operate independently. The elevator release unit cannot be reset in flight.

Under normal operating conditions the two control columns are interconnected by a torque tube and detent mechanism. The detent mechanism consists of a spring-loaded roller on the right control column and a cam on the torque tube. Spring pressure between the roller and cam ensures that the control columns remain aligned during normal operation but provides a means of breaking the interconnection in the event of a jam; this requires a differential of 100 lb between the control columns. If necessary, the pilots can physically separate the control columns at the detent unit by pulling a force relief handle in the cockpit. The force relief handle cannot be reset in flight.

A servomotor in the right tailplane drives the elevators in response to autopilot demands. The servomotor has a common gearbox driven by two independent motors; one associated with each of the autopilot systems. An electromagnetic clutch is energised when the

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autopilot is engaged and a slipping clutch at the servomotor output allows the autopilot to be overpowered if the force applied at the control column exceeds 50 lb. Overpowering the autopilot will not automatically disengage it.

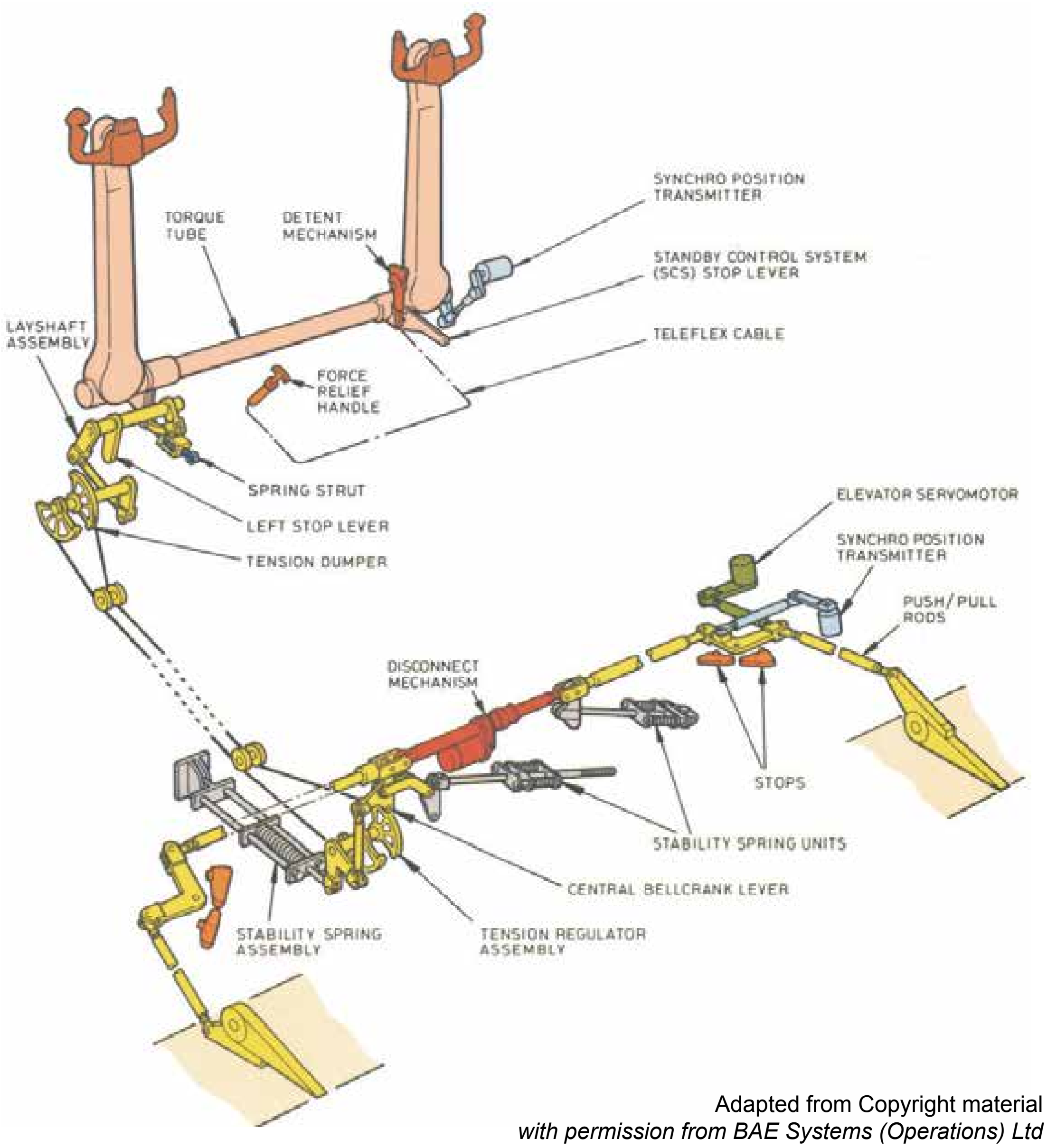

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Figure 6

Elevator flying controls

Elevator Standby Control System (SCS)

The Standby Control System (SCS) is designed to ensure safe, continued operation in the event of either control cable severance or a jam in the control system.

The SCS control circuitry resides within the autopilot computers. It operates independently of the autopilot and continuously monitors the position of the flying controls. The autopilot has priority over the SCS.

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Control cable severance

If the elevator control cable breaks, the direct (mechanical) connection between the control columns and the elevators will be lost.

The output of a synchro transmitter (position sensor) that is connected to the right control column is continuously compared against the output of a synchro transmitter that monitors the right elevator control surface. If the difference between the two outputs exceeds 25%, and the autopilot is not engaged, SCS will engage. The elevators will be electrically driven, via the elevator servomotor, to a position where there is no difference between the two synchro transmitters. Both pilots will retain control of the elevators via their respective control column.

Elevator jam

If there is a jam in the elevator system, the pilots will experience a resistance to movement at the control columns.

When the pilots exert a force exceeding 100 lb they will overcome the detent mechanism and the control column that is not on the jammed side will 'break out'. Overcoming the detent mechanism energises a solenoid on the elevator release unit, thereby separating the elevators. An amber STANDBY CONTROLS caption illuminates on the CWP, an audible warning will be heard and the attention getters flash. The amber elevator release unit SPLIT caption illuminates on the STANDBY CONTROLS panel on the overhead panel in the flight deck.

Continued operation of the elevators is dependent on the location of the jam. If the jam is forward of the elevator release unit and the difference between the two synchro transmitters exceeds 25%, the SCS will engage and the right elevator will be controlled by the right control column through the elevator servomotor. The amber ENGAGED caption will illuminate on the overhead panel (Figure 7).

Figure 7

STANDBY CONTROLS panel

If the jam is aft of the release unit, the left elevator will respond normally to primary control system inputs. If the control column detent mechanism has operated, the pilots should establish the forces required to operate the elevators and, if necessary, the force relief handle should be operated to separate the control columns.

Autopilot fails to disengage

If the autopilot does not disengage when selected, the servomotor can be overpowered by the pilot applying a force in excess of 50 lb. The autopilot will continue to try and fly the aircraft but the pilot's inputs will overcome the slipping clutch. If the aircraft is being controlled from the left seat, this situation will continue until the autopilot is disengaged. If the aircraft is being controlled from the right seat, the same conditions will exist unless the pilot applies a force in excess of 100 lb, which will overcome the control column detent, thereby operating the elevator release unit. An amber STANDBY CONTROLS caption will illuminate on the CWP and the SPLIT caption will illuminate on the STANDBY CONTROLS panel. The right elevator will remain under autopilot control until the autopilot is disengaged. The left elevator can be driven by the left control column and the right control column, provided the detent mechanism is not overcome.

If the autopilot were to subsequently disengage, the right elevator would cease to be driven and its position would be dependent on the airflow over the control surface. This situation will continue until the difference between the two synchro transmitters exceeds 25%, at which point the SCS will engage and the right elevator will be controlled by the right control column through the elevator servomotor. The amber ENGAGED caption will illuminate on the overhead panel.

If the force relief handle has not been pulled, both control columns will be held together by the detent mechanism which allows the cables and autopilot SCS to drive both elevators.

Enhanced Ground Proximity Warning System (EGPWS)

The EGPWS fitted to the aircraft provides look-ahead terrain awareness warning and display functions. System warnings are provided by red PULL UP, amber TERR and white GLIDE SLOPE annunciators above the PFDs. Aural alerts are passed to the pilots' headsets and a flight deck loudspeaker.

The EGPWS incorporates the basic GPWS modes 1 to 4, producing aural warnings of possible terrain conflict. Mode 5 monitors for excessive deviation below the ILS glideslope and mode 6 provides aural altitude alerts as a function of radio altitude and decision height.

Mode 2B is active when the flaps are in the landing configuration or during an ILS approach with less than two dots deviation on the glideslope and localiser. When the warning envelope is penetrated and the landing gear is in the down position, a mode 2B warning generates a repeated aural "TERRAIN, TERRAIN" alert and red PULL UP captions are illuminated until the warning envelope is exited.

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Maintenance and aircraft history

The aircraft was manufactured in 1990 and had accrued 21,554 hours and 23,181 cycles. It was originally configured for passenger transportation but was converted for cargo operations in 2006.

According to the operator, the aircraft did not have a recent history of autopilot or flying control problems.

Aircraft examination

Prior to AAIB notification

Prior to the AAIB being notified of the occurrence, the operator initiated its own investigation and downloaded the QAR. A functional check of the autopilot disengage logic and electrical continuity checks that required disconnection of the autopilot computers were performed. No failures were identified.

The autopilot controller and elevator servomotor were removed and replacement units were installed. The units that were removed had been quarantined locally pending further investigation.

Investigation under AAIB control

Visual examination of the elevators, horizontal stabilisers and rear fuselage showed no abnormalities. The floor and appropriate panels were removed to allow access to the elevator flying control system. There was no evidence of damage or restriction. The SCS synchro transmitters and associated wiring were checked and no faults were identified.

Functional testing of the autopilot disengage logic, elevator SCS and control column detent identified no failures. The incident autopilot controller and elevator servomotor were refitted and the tests were successfully repeated.

The aircraft was released to the operator. Since then and up to the end of April 2016, it had completed an additional 79 flying hours and 110 cycles without recurrence.

Component testing

The following components were removed from the aircraft and sent to an approved overhaul facility for testing and strip examination as appropriate.

- Autopilot computer No 1 (Serial Number 242)
- Autopilot computer No 2 (Serial Number 121)
- Autopilot controller (Serial Number 195)
- Audio summing amplifier (Serial Number 1542)
- No 1 static inverter (Serial Number F503)
- Elevator servomotor (Serial Number 449)

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- Right control column pitch position synchro (Serial Number AL903)
- Elevator trim servomotor (Serial Number 130)
- Tone Generator (Serial Number 99)

Extensive testing identified no failures that were associated with the reported occurrence.

Weight and balance

The aircraft's dry operating mass was 13,721 kg and it departed Jersey with a recorded cargo load of 2,157 kg and with 2,750 kg of fuel. The calculated takeoff mass was 18,628 kg and the calculated landing mass at Guernsey was 18,369 kg; both weights were significantly less than the regulated figures recorded on the load sheet. A load plan, signed by a member of the loading team, stated the cargo was loaded in accordance with the load sheet. The Centre of Gravity (CG) was calculated to be well within the allowable range for both takeoff and landing. During the takeoff the PF reported that control forces felt normal, with no indication that the CG was different from that calculated.

Organisational information

Crew guidance

The Operator's Manual (OM) advises that the maximum demonstrated crosswind for ATP landings is 34 kt. The operator recommends a crosswind limit of 25 kt when landing on wet runways with a width of 40 m or more and good braking action. The operator did not specify a crosswind landing limit for newly qualified pilots.

A section of the OM Part B relating to flight director and autopilot selection procedures states, '*When selecting a mode or autopilot on the selected mode shall be crosschecked on PFD by both pilots.*' Thus both pilots are to check their PFD when a flight guidance mode is selected or when the autopilot is engaged, but autopilot disengagement is not mentioned.

The Part A to the OM lists the commander's responsibilities, one of which is to ensure the immediate deactivation of flight recorders in the event of an incident or accident that is subject to mandatory reporting. However, the Part A contained no guidance to crews regarding the reporting of accidents, serious incidents or the mandatory occurrence reporting scheme. This information had previously been in the Part A but had been moved to the operator's Management System Manual. No specific guidance was offered in the OM on how the FDR or CVR should be deactivated.

Go-arounds

The OM lists several items '*which may be considered*' for inclusion in an approach briefing and one of these is '*Review the go-around procedure'.* The Standard Operating Procedure (SOP) for the go-around procedure is:

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'If the PF, PNF, ATC or the EGPWS calls for a go-around the PF will call "go-around". He/she shall then simultaneously:

- *Press either or both go-around buttons on the power levers*
- *Advance the power levers close to the rated torque setting*
- *Rotate the aircraft to maintain speed VAT +10*

When pressing the go-around button(s) the autopilot will disengage and flight director mode GA will engage, demanding 6° nose up attitude and the heading at go-around selection. As soon as practicable, HDG and PSA shall be inserted and confirmed. When the correct speed (VAT +10) is achieved, it is recommended to engage IAS mode.

The PF shall, after having set the approximate power, call "set power – flaps 15" (flap 20 landing).The PNF shall set power and call "power set" retract the flaps to 15 degrees and make the appropriate call outs. As soon as positive rate of climb is achieved, the PNF shall call "positive rate" and gear up selection shall be made.

…Upon reaching 400 feet AAL, and providing that speed is above V2 flap 7°, retract the flaps to 7°.Continue as a normal take off in regards to acceleration, configuration and speed…'

EGPWS

The OM includes instruction for pilots to adjust the aircraft's flight path positively and immediately in response to all EGPWS alerts and warnings. The commander is permitted to modify the response only in day, VMC conditions when it is immediately obvious the terrain does not pose a danger. All alerts and warnings are to be reported to the operator.

The operator was aware of nuisance alerts and warnings being generated by the ATP on approach to certain airports, including Jersey and Guernsey. Trials by the operator, in collaboration with the aircraft manufacturer, indicated that on Runway 26 at Jersey there was a tendency for a nuisance 'TERRAIN' alert to be generated if the aircraft deviated very slightly below the glideslope at a certain position on approach. An email was sent to pilots in July 2015 which asked them to have the autopilot engaged during ILS approaches at Guernsey and Jersey. This procedure was not incorporated in the OM, because it was only intended as a short-term trial to assist in identifying spurious alerts, but the duration of the trial was not specified. The OM Part C stated an EGPWS '*callout*' was possible on approach to the eastern runway at Jersey but made no mention of the Runway 26 approach. The commander stated he regarded nuisance 'TERRAIN' alerts as being normal at Guernsey and Jersey and that the operator was aware.

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Crew comments

The commander considered that, by the time he appreciated the difficulty the co-pilot was having trying to disengage the autopilot, it was not appropriate for him to take control and check if the aircraft could be flown normally from the left seat. His reasoning was that the aircraft was close to the ground and there was a strong crosswind, so it was more appropriate to go around and then re-assess the control problem.

During discussions after the event, neither pilot thought they had been trying to move the elevator in opposing directions when the control split occurred. The PF's recollection was the STANDBY CONTROLS caution illuminated at approximately 600 ft amsl.

Both pilots reported they had been distracted from following the standard go-around procedure and the gear was raised later than normal. They were unsure exactly when the gear was raised because their focus had been on achieving a safe flight path. The PF was sure he made no pitch trim inputs during the initial part of the go-around and neither pilot recalled trying to change the autopilot status while the aircraft was climbing.

BEA go-around study

Un-anticipated go-arounds with all engines operating have previously led to numerous serious incidents and accidents. In August 2013 the French Bureau d'Enquetes et d'Analyses (BEA) published a '*Study on Aeroplane State Awareness during Go Around*' ie a study of situations in which there was a loss of control of the flight path at some stage during a go-around. It concluded that such events could be due to one or more of a list of factors, including:

' • *Time pressure and a high workload.*
• *The inadequate monitoring of primary flight parameters during go-arounds, especially with a startle effect*[10]*.*
• *The difficulty in applying Crew Resource Management (CRM) principles in a startle effect situation.*
• *Inadequate monitoring by the PNF.*
• *The low number of go-arounds with all engines operating performed by crews, both in flight and in the simulator.*
• *Inadequate fidelity on flight simulators.*
• *The non-detection of the position of nose-up trim by the crew during go-arounds.*
• *Aircrew learning teamwork on unrepresentative aeroplanes before a first CS 25 TR*[11]*.*

Footnote

10 The sudden onset of critical events can create a '*startle*' or '*surprise*' effect which can cause cognitive impairment for up to 30 seconds.
11 'first CS 25 TR' refers to a pilot's first type rating on a Certification Standard 25 aeroplane ie a large aeroplane on which all or most of the go-around training required is achieved in a simulator.

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- *Somatogravic illusions[12] related to excessive thrust on aeroplanes. The lack of evaluation of visual scan during the go-around.*
- *The channelized attention of a crew member.*
- *The difficulty of reading and understanding Flight Mode Annunciator (FMA) modes.*
- *Excessive time spent by the PNF on manipulating the Flight Control Unit/ Main Control Panel.'*

Human factors

Pre-flight rest

The co-pilot was off duty on 23 January 2016 (3 days before the incident) while the commander operated a night flight on 22/23 January which ended at 0415 hrs on 23 January. Both pilots were off duty on 24 January with rest days on 25 January. They reported for duty at Coventry Airport, their crew base, at 0230 hrs on 26 January before positioning by ground transport to Luton Airport. At 0525 hrs they departed Luton in G-BUUR for a cargo flight and arrived at Guernsey at 0640 hrs, where they remained for 30 minutes before leaving for Jersey. They landed at 0730 hrs and went to a hotel where they were rostered to commence their rest period at 0750 hrs. However, there were no rooms available and they had to transfer to an alternative hotel. They did not arrive at the second hotel until 0900 hrs or perhaps later; the pilots' recollections of the timing differed. The operator was not informed of the delayed start to the rest period.

At 1845 hrs, after spending a maximum of 9 hours 15 minutes at the hotel, the pilots reported for duty at Jersey Airport. The operator's flight time limitation scheme specified that the crew required a minimum rest period of 11 hours and that the hotel room allocated to each crew member had to be available for occupation for a minimum of 10 hours.

The co-pilot stated he achieved over six hours sleep but the commander estimated that he only slept for four or five hours due to noise. However, neither of the pilots believed they were fatigued or tired at the start of the duty.

Commander's experience

The commander had logged 1,300 hours as an ATP co-pilot and had considerable experience instructing in light aircraft when he began his command training in March 2015. Following the simulator element of this training course, it was stated that he had been overly reliant on his PNF in pressurised situations.

Since completion of command training, the commander had logged a further 207 hours on-type and had carried out recurrent training in the simulator in September 2015. The

Footnote

[12] When an aircraft accelerates during a go-around, hairs in the utricle of the vestibular system bend backwards, creating the same sensation as when the head tilts back. The acceleration force is therefore perceived by the brain as a strong pitch-up sensation and is known as a somatogravic illusion.

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simulator instructor's report indicated the commander demonstrated good Crew Resource Management (CRM) skills during this training detail.

Co-pilot's experience

The co-pilot had 380 hours flying experience before this flight, including 74 hours on the ATP. This was his first commercial aircraft type and the first type he had flown using Electronic Flight Instrument System (EFIS) screens. He could not recall having been taught to check for autopilot disengagement on the PFD during his training, which was completed the previous month. The operator's records state he progressed well through training and demonstrated good qualities as PF and as PNF. He was complimented for his ability to think ahead and also for his crosswind landing technique.

CRM

The operator provided CRM training to its pilots in accordance with EASA specifications. The commander completed an approved course of CRM training during his command course, 9 months prior to the flight, and further CRM training and a skills assessment as part of his recurrent simulator training in September 2015. The co-pilot received CRM training during his initial type conversion in the latter part of 2015.

CRM involves non-technical skills, such as communication, problem solving, decision making and workload management. When unusual circumstances are encountered, effective CRM training should ensure the crew, particularly the PF and PNF (monitoring pilot), share information efficiently and succinctly and co-ordinate their actions.

This operator advocates the mnemonic '*DODAR*' as a template for pilots to use when managing stressful events. The first '*D*' is for Diagnosis; the use of all available senses and resources to understand the symptoms of a problem. The '*O*' is for Options; consider if more than one option is available, what the consequence of each is and what time is available. The second '*D*' is for Decision, this being mutually agreed after considering the options and risks. The '*A*' is for Allocate; with crew members allocated tasks based on the decision made and other agencies, such as ATC, informed of any assistance required. Finally the '*R*' is for Review; has the event changed, does the diagnosis require updating? The aim is to re-evaluate the situation continuously and manage the time available efficiently.

Sensory awareness

Visual inputs tend to take precedence over aural inputs when the brain is working at high capacity leading to inattentional deafness. Consequently a person may hear a sound but the aural input does not register and the person is unaware of it[13]. Most aircraft alerts

Footnote

[13] Evidence of inattentional deafness by pilots in a high workload environment is offered by Dehais, Frédéric and Causse, Mickael and Vachon, François and Regis, Nicolas and Menant, Eric and Tremblay, Sébastien in their paper '*Failure to Detect Critical Auditory Alerts in the Cockpit: Evidence for Inattentional Deafness',* published 2014 in The Journal of the Human Factors and Ergonomics Society, vol. 56 (n° 4). pp. 631-644. ISSN 0018-7208. The paper can be accessed via the following link: http://oatao.univ-toulouse.fr/11613/1/Dehais_11613.pdf

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and warnings are presented aurally and visually but sole reliance on an aural input as confirmation of an action or change of status may cause it to be missed during periods of high workload.

Subsequent research

Three weeks after the incident the co-pilot practised go-around manoeuvres in the ATP training simulator with the operator's fleet manager. The simulator was configured for landing with the autopilot engaged and the co-pilot attempted to move the control column. He experienced feedback forces which he likened to those he felt on G-BUUR before the go-around. He then initiated several go-arounds by pulling back on the control column to overcome the autopilot, without pressing the go-around button, which would have disengaged the autopilot. He needed to use both hands on the control column to pitch the nose up and the STANDBY CONTROLS caution on the CWP and the elevator SPLIT indicator on the overhead panel illuminated before the aircraft began to climb.

After rotation the co-pilot sometimes had to overcome a pitch-up tendency by pushing forwards. On some occasions the pitch-up force exerted by the simulator seemed as strong as that experienced in G-BUUR and the assistance of the other pilot was required to resist this force. While overcoming the autopilot, the green AP2 annunciator remained lit on the co-pilot's PFD until the autopilot was deliberately disengaged during the climb. When the autopilot was disengaged, the SCS ENGAGED indicator on the overhead panel illuminated (as well as the SPLIT indication).

The crew tried to follow the standard go-around procedure in each practice, using HDG and PSA modes before the IAS vertical mode was engaged, after selecting FLAP 15. A video recording of one go-around showed the engaged vertical mode change to IAS, when the IAS switch was pressed, and a nose-up attitude of 13-15º was evident while the airspeed was maintained at VAT+10.

In these simulator trials, because the autopilot was kept engaged, it subsequently had to be disengaged but on the incident flight the pilots reported that they did not have to disengage the autopilot before re-engaging it. It therefore should be noted that the simulator trials by the operator differ from the incident flight. The co-pilot reported during the simulator trials that he had to overcome differing amounts of pitch-up after power was set. This could be a consequence of engaging the IAS mode while the autopilot was being over-powered. If IAS mode was engaged while accelerating, the autopilot would make a pitch-up input to try to maintain the speed at mode engagement. However, if the IAS mode was engaged at a stable speed (eg VAT+10) the autopilot would not input such a pitch-up demand.

Go-around handling

It is SOP for go-arounds in the ATP to be flown with the autopilot disengaged. The operator's fleet manager stated the aircraft does not tend to pitch nose-up during go-arounds, either with a single engine or with both engines operating. A nose-up attitude of 10º or greater is needed to achieve a stable airspeed during a two-engine go-around, even for an aircraft at maximum mass.

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The manufacturer concurred with these observations but noted that application of power can create some pitch-up tendency. During certification testing this equated to a control column force of less than 40 lb in the most extreme case.

Other relevant ATP incidents

27 May 1991. The commander of an ATP, G-BTPJ, stated that in the early stages of an approach the autopilot failed to disengage using any of the usual means. The crew eventually disengaged the system by pulling the autopilot circuit breaker. A fault was later found on the co-pilot's electric trim switch and there is no record of the problem recurring. No recorded flight data remains available.

Reporting of serious incidents

The UK Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996 state that when an accident or serious incident occurs in the UK, or to a UK registered aircraft, the commander is responsible for informing the AAIB. If the commander is killed or incapacitated the operator becomes responsible for notification, although operators sometimes assume such responsibility once they are advised of a relevant accident or serious incident.

A serious incident is defined by the Regulations as '*involving circumstances indicating that an accident nearly occurred.*' Greater clarity is added by EU Commission Regulation No 996/2010 which provides a list of examples of serious incidents and this includes '*occurrences which could have caused difficulties controlling the aircraft'.*

EU Commission Regulation No 965/2012 (Air Operations Regulations section CAT.GEN.MPA.105 'Responsibilities of the commander' section 10) states that the commander shall:

> *(10) ensure that flight recorders:*
>
> *(i) are not disabled or switched off during flight; and*
>
> *(ii) in the event of an accident or an incident that is subject to mandatory reporting:*
>
> *(A) are not intentionally erased;*
>
> *(B) are deactivated immediately after the flight is completed; and*
>
> *(C) are reactivated only with the agreement of the investigating authority;*

Analysis

Extensive examination and functional testing of the aircraft systems and components identified no technical failure that could be associated to the reported events during the incident flight. The available data indicated the autopilot disengaged on command during the approach. However, the crew report that the autopilot remained engaged. The lack of a cockpit voice recording of the event has meant it was not possible to verify if the autopilot disengagement alert sounded.

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Prior to go-around

The approach to Guernsey was at night in a strong crosswind, with turbulence and possible windshear reported. This would have made the approach and landing potentially challenging and would have increased the cognitive workload, especially for a newly trained pilot. However, the reported wind was within the applicable limits, the co-pilot was confident of his own ability and had coped well with similar conditions during training.

In view of the conditions and his own experience level, the co-pilot decided to disengage the autopilot approaching decision altitude. He could see the runway when he pressed the disengagement switch, so was likely to be using both external and internal cues during the latter part of the approach. The flight data shows airspeed changes and power adjustments being made just above decision altitude. It is likely the speed changed due to the windy conditions and the co-pilot responded by making power changes. This suggests his workload was high when he pressed the switch to disengage the autopilot.

His primary indication of autopilot disengagement would be an audible alert, but he did not hear this and so believed the autopilot was still engaged. It is possible the alert did sound but was not registered by either crew member because of the high workload. Neither pilot looked to the PFD for confirmation of autopilot status. The operator, in its OM and during training, does not prescribe referring to the PFD to verify the autopilot has disengaged. The co-pilot pressed the disengage switch again, before trying to move the controls and felt resistance, as if the autopilot was still engaged.

The flight data indicates the autopilot disengaged at 220 ft aal, at about the point at which the co-pilot reports first pressing the autopilot disengagement switch. With the autopilot disengaged the co-pilot should not have experienced unusual resistance when he tried to move the control column. It cannot be entirely excluded that there was some intermittent fault within the autopilot system that resulted in the pilot experiencing resistance to his inputs, but subsequent tests have not revealed any defect with the system or with the flight controls.

The commander did not recall hearing the autopilot disengagement alert. The aircraft was below decision altitude before he realised the co-pilot was having difficulty disengaging the autopilot. When the commander attempted to disengage the autopilot, from his control column, he did not take control to check if the aircraft could be flown normally from his position. He later stated that, with the aircraft close to the ground and a strong crosswind, it was more appropriate to go around and then re-assess the control problem.

The target approach speed was 118 kt but below decision altitude it decayed steadily in response to a power reduction, while the pitch attitude increased from approximately -5º to +2º. The pilots recalled the aircraft deviating above the glidepath and the co-pilot thought he tried to lower the nose in response. The flight data indicates the airspeed decayed to 102 kt prior to initiation of the go-around. The pilots were not aware of the speed reduction at this stage, possibly because they were both looking out and distracted by the autopilot issue.

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Go-around initiation

The aircraft was close to the runway when the commander called for the go-around. Approximately 25 seconds had elapsed since the initial attempt to disengage the autopilot. The co-pilot stated he pressed the go-around button, which is a further means of disengaging the autopilot, but still no disengagement alert was heard[14] and apparently the flight director bars did not command a pitch-up as they should have done. The commander did not recall looking at the flight director bars or at the auto-flight modes and these indications are not recorded. The go-around button later functioned normally so there is no verification of a malfunction. It is possible the flight director bars did move but the aircraft's proximity to the ground and the confusing situation distracted the pilots from absorbing all the data presented on their PFDs.

The co-pilot was able to initiate the pitch-up using one hand, although he considered the controls to be stiffer than he would have expected if the autopilot was disengaged. The pilots later remembered a large decelerating speed trend and this may have been displayed on the PFD as the aircraft started to pitch up before it responded to the power increase. The data shows the power was increased quickly and the pitch attitude increased to a little less than 5º by the time power was set. This is close to the 6º the flight director should have commanded and yet the commander had the impression of a pitch attitude of 15-20º. This might have been a somatogravic illusion as the aircraft was accelerating quickly and the effect may have been particularly alarming because of the observed low speed indications. In view of this and because the co-pilot was apparently struggling, the commander pushed on the control column.

A nose-up attitude of 15º can be normal during a two-engine operating go-around. This is substantially greater than that required for a single engine go-around, which is the manoeuvre the crew were more familiar practising in the simulator.

The co-pilot's recollection was that once power was set he had to overcome a strong pitch-up force. The ATP does not normally exhibit a strong pitch-up tendency during go-arounds (see *Go-around handling*) and the CG was within the normal range. The force experienced might be partly attributable to the dynamic changes to engine power, pitch attitude and airspeed which occurred while the pitch trim remained stationary. Alternatively it may be the strong force was felt after the pitch trim moved nose-up (see *Recorded information*). The co-pilot does not recall making such a selection but it is possible he inadvertently pressed the electric pitch trim switch and then had to push forward to overcome the resulting pitch-up force.

The nose-up pitch trim input would have increased control column loading so, when the co-pilot pushed forwards on the right column, he may have had to exert more than 100 lb force, causing the detent mechanism to operate and the elevators to split. It is also possible the pilots applied opposing forces to their control columns for a short time and this caused the columns to separate and the elevators to split. This does not conform to the pilots'

Footnote

[14] The disengagement alert should only have sounded at this point if the autopilot had not disengaged earlier and then responded normally when the go-around button was pressed.

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recollections but they were experiencing a high workload and a potentially disorientating situation. The BEA study underlines the difficulties associated with monitoring an unexpected go-around due to startle effect and particularly the challenges faced by the monitoring pilot, who is trying to manipulate gear, engine controls and flap controls while monitoring the instruments and PF's actions. These difficulties were compounded during this event by the suspected flight control problem.

Another possibility that may have led to the elevator split mechanism initiating would be if the co-pilot was having to oppose an input from some part of the autopilot system. The flight data does record brief, unexplained, engagement and disengagement of each autopilot channel in turn during the climb. However, subsequent examination of the aircraft has not revealed any technical defects that would have caused the autopilot to oppose the crew's inputs.

Approximately 40 seconds after levelling at 2,000 ft amsl, AP2 was re-engaged, without any discussion of the potential complications this might cause. There was no acknowledgement that it must have disengaged during the go-around or that it might not disengage again. After a further 25 seconds the last stage of flaps were retracted.

Response to abnormal situation

The go-around was successful but did not follow standard practice. The likely reason for this was the distracting effect of the control problems encountered but the lack of a detailed go-around brief may have contributed to the actions taken. The BEA study was initiated as a result of problems encountered during all-engine operating go-arounds and this event highlights some of the factors mentioned in the BEA conclusion. Crews should prepare as well as they can to cope with such factors and pre-briefing of individual actions during a go-around is one preparation which can aid this process.

The DODAR philosophy does not appear to have been followed after the go-around. This may have assisted the crew with their diagnosis and further options before re-engaging the autopilot. They did complete the QRH drill and agreed on the decision to divert but continued to use the autopilot, although they then disconnected it at an early stage of the approach to Jersey. When stress levels are high, there is a natural desire to make things as normal as possible as quickly as possible and in this case the outcome was successful. However, the potential threats from re-introducing a faulty system were not considered before AP2 was re-engaged.

Fatigue

The operator's flight time limitation scheme specified that the crew required a minimum rest period of 11 hours and that the hotel room allocated to each crew member had to be available for occupation for a minimum of 10 hours. Owing to problems with the hotel rooms they only spent a maximum of 9 hours 15 minutes at the hotel. Neither crew member thought they were fatigued either before or during the flight, but fatigue can be a contributory factor that might lead to individual underperformance.

In this case the rest period was shorter than required by the operator and the commander's rest was disturbed by daytime noises in the hotel.

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Terrain alert

The crew were aware the EGPWS on the ATP sometimes generated nuisance 'TERRAIN' alerts, especially at Guernsey and Jersey and decided to continue this night approach as they were visual with the runway, stable and confident they had good terrain separation. The operator requires crews to make immediate, positive manoeuvres in response to any EGPWS alerts or warnings at night but also promulgates certain places where nuisance alerts may be expected. The possibility of nuisance 'TERRAIN' alerts being triggered on final approach to Runway 26 at Jersey was known about but was not mentioned in the OM. Alerting and warning systems can be ineffective when false alarms become the norm.

Serious incident response

Operators are required to provide sufficient training and guidance to ensure serious incidents are correctly recognised and reported by their staff and the correct actions taken to notify and preserve evidence. If it is suspected that the occurrence is a serious incident then the recorders should be isolated and engineering work delayed until the AAIB has been notified. In this serious incident the CVR was overwritten and critical evidence concerning the flight was lost, despite an instruction in the OM Part A for flight recorders to be de-activated following any reportable incident. Engineering work prevented the AAIB from being able to analyse the systems in the state they were in at the end of the flight.

Inclusion of the list of examples of serious incidents from EU 996/2010 in an OM can help employees understand what may constitute a serious incident. This operator had moved guidance concerning accidents and incidents from its OM Part A to the Management Safety Manual, and this might be one reason there was a delay reporting the event.

Safety actions

This serious incident occurred when the operator was in the process of transferring all ATP aircraft and crews to a related company, with an air operator's certificate from another European country. Several Safety Actions were taken by the operator;

- An internal review was carried out and the pilots received further training.
- Changes were made to ATP procedures before the fleet transfer was completed. This included a requirement to check autopilot disengagement switches before each flight.
- The entry for Jersey in the OM Part C was amended to include note of the potential for spurious EGPWS alerts in certain circumstances.
- The procedures required after accidents or incidents are now detailed in the OM Part A.
- Pilots and engineers have been given guidance on deactivation of flight recorders and CVRs.
- Changes were made to pilot training procedures and certain wind limitations for newly qualified pilots have been reduced.

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Conclusion

Extensive examination and functional testing of the aircraft systems and components identified no failures that were associated with the reported occurrence. The available data indicated the autopilot disengaged on command although the pilots believed otherwise. As the operator had not isolated the recorders following the incident, a cockpit voice recording of the event was not available. It was therefore not possible to ascertain if the autopilot disengagement alert sounded at the moment the FDR recorded autopilot disengagement during the approach.

During the resultant go-around, the co-pilot recalled having to overcome a strong pitch-up force after power was set, which he then struggled to overcome. The data indicated the aircraft was trimmed nose-up after power was set, so this may have been the cause of the pitch-up force and the co-pilot's opposition to this force may have led to the elevator control split. It is also possible the pilots briefly made opposing inputs on the control column and this caused the elevator split and activation of the SCS.

However, it was not possible to exclude the possibility that there was an intermittent fault within the autopilot system that then caused the system to oppose the co-pilot's inputs and lead to the control split. The recorded data shows two brief recordings of autopilot engagement during the event which the investigation could not explain.

Once the elevators had split the pilots completed the go-around but deviated from SOPs while struggling with a stressful and disorientating situation. They re-engaged the autopilot without discussing any potential threats from this action and they did not use CRM principles designed to help deal with problem solving and decision making. The operator has since reviewed and updated its training of crews as a result of the findings from this incident.

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