Australian Government
Australian Transport Safety Bureau

# Flight path management occurrence involving Boeing 737-838, VH-VYE

213 km SSE of Brisbane Airport, Queensland | 25 February 2013


Investigation

**ATSB Transport Safety Report**
Aviation Occurrence Investigation
AO-2013-049
Final – 27 April 2015

Cover photo: Aircraft captain

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

**Publishing information**

**Published by:** Australian Transport Safety Bureau
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**Addendum**

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# Safety summary


## What happened

**Mode control panel**

**Source: Aircraft captain**

On the evening of 25 February 2013, a Boeing 737-838 aircraft, registered VH-VYE and operated by Qantas Airways Limited, was conducting a scheduled passenger service from Canberra Airport, Australian Capital Territory to Brisbane Airport, Queensland.

At 2110 Eastern Daylight-saving Time, about 115 NM (213 km) from Brisbane, and as the aircraft approached the descent point for Brisbane Airport, the aircraft's autopilot unexpectedly commenced climbing the aircraft. The crew disconnected the autopilot and descended the aircraft.

During the descent to an air traffic control-cleared level the aircraft rolled left and deviated laterally from the flight plan track. The autopilot was subsequently re-engaged and the aircraft was manoeuvred to re-intercept the flight-planned track. The remainder of the flight was uneventful and the aircraft landed on runway 01 at Brisbane Airport.

## What the ATSB found

The ATSB found that the auto-flight system allowed the capture of the Brisbane Airport runway 01 instrument landing system (ILS) glideslope and the aircraft unexpectedly climbed to intercept the signal, which had itself been affected by atmospheric refraction. The preconditions for the occurrence were that the Canberra and Brisbane ILS frequencies were the same, this frequency remained active in the aircraft's navigation system and, shortly after reaching top of climb out of Canberra, the auto-flight system's approach mode was inadvertently armed. This meant that when the aircraft was within range of the Brisbane ILS signal, the glideslope would become the active vertical flight mode. The configuration of the auto-flight system logic on the operator's Boeing 737 fleet allowed the aircraft to capture and follow a glideslope signal despite not being on the localiser.

The ATSB also found that contrary to the flight crew's intent, after dis-engaging the autopilot, it was not re-engaged, resulting in a lateral deviation from the planned flight path.

## Safety message

This occurrence highlights the human performance limitations with respect to monitoring and detecting mode reversions and flight mode annunciator (FMA) changes in automated aircraft. Flight crew are reminded of the importance of regularly identifying and confirming the flight modes displayed on the FMA.

# Contents

# The occurrence

## Departure and climb to flight level 410

On the evening of 25 February 2013, a Boeing 737-838 aircraft, registered VH-VYE and operated by Qantas Airways Limited (Qantas), was conducting a scheduled passenger service from Canberra Airport, Australian Capital Territory to Brisbane Airport, Queensland. The captain was the pilot flying.

As part of the Qantas normal pre-flight procedures the flight crew elected to use the head-up guidance system (HGS) for the departure. To enable runway guidance for the departure, the Canberra runway 35 instrument landing system (ILS)[1] frequency of 109.5 MHz was entered into the aircraft's systems. This also ensured the correct frequency was available for the ILS should a return to the airport be operationally required.

Following an uneventful departure from Canberra at 2007 Eastern Daylight-saving Time,[2] the aircraft was climbed to the planned altitude of FL 410.[3] During the climb, the crew engaged the autopilot and selected an auto-flight mode that commanded the autopilot to fly a pre-programmed lateral navigation (LNAV) route and a vertical navigation (VNAV) profile for the majority of the climb. The Canberra ILS frequency remained as the active ILS frequency on the navigation control panel.

## Arming of approach modes

At 2026:19, shortly after the aircraft reached FL 410, the mode control panel (MCP) approach (APP) push-button was manually selected by the crew, which illuminated a green dashed light on the APP push-button. Simultaneously, the glideslope (G/S) and very high frequency omni-directional radio range/localiser (VOR/LOC) annunciations appeared in white text on the flight mode annunciator (FMA), which was located on the crew's primary flight displays (PFD). These annunciations indicated that the G/S and VOR/LOC modes were armed and would become the active modes when the aircraft met the capture requirements[4] for the glideslope and/or localiser.

At about the same time the APP push-button was selected, some minor changes were made by the flight crew to the aircraft's selected heading using the heading select knob located nearby (see *Mode control panel*). The flight crew reported that they could not remember making the heading changes or the APP selection at that time and that they did not observe either the MCP APP push-button annunciation or the G/S and VOR/LOC mode annunciations on the FMA. They also remarked that selecting the APP push-button at that time would not have been appropriate or intended.

The captain reported that it was their normal practice to indicate to the first officer (FO) that an assigned level-off altitude had been captured by tapping their finger on the selected altitude display window on the MCP. The captain also noted that the APP push-button may have been inadvertently selected at this time.

Recorded flight data indicated that, while at FL 410, the aircraft encountered some light turbulence. At about 2032, in response to a request from the flight crew, air traffic control (ATC) cleared the

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[1] A standard ground aid to landing, comprising two directional radio transmitters: the localizer, which provides direction in the horizontal plane; and the glideslope, for vertical plane direction, usually at an inclination of 3°. Distance measuring equipment or marker beacons along the approach provide distance information.

[2] Eastern Daylight-saving Time was Coordinated Universal Time (UTC) + 11 hours.

[3] At altitudes above 10,000 ft in Australia, an aircraft's height above mean sea level is referred to as a flight level (FL). FL 410 equates to 41,000 ft.

[4] For an aircraft to receive localiser and glideslope signals, the aircraft must be within range of the ground-based ILS that has been selected on the navigation control panel. The glideslope is captured when the deviation from the glideslope beam about 0.55 dots. The localiser capture point is variable and depends on intercept angle and closure rate.

flight crew to descend to FL 390 and the crew changed the aircraft's MCP-selected altitude from FL 410 to FL 390. The auto-flight vertical mode was also selected to vertical speed (V/S) on the MCP. These changes commanded the auto-flight system to descend the aircraft at a constant vertical speed to FL 390, which was the final cruise altitude for the flight. During the descent, the crew did not notice that the G/S and VOR/LOC modes were indicated as armed on the FMA.

The flight crew reported that during the subsequent cruise, the FO had the first meal break. At 2056, the flight crew requested an ILS approach, which ATC approved via a BLAKA 3 ALPHA arrival to runway 01 at Brisbane Airport. ATC also advised the crew that they would be holding at BLAKA with the requirement to exit the hold at 2130. The crew entered the arrival and approach into the FMC, which would normally have involved manually entering the Brisbane ILS frequency of 109.5 MHz. However, in this case this frequency remained set from the departure from Canberra.

The flight until this stage had been normal, and the crew identified no particular threats during the approach briefing. The captain commenced a meal break and handed the pilot flying duties to the FO.

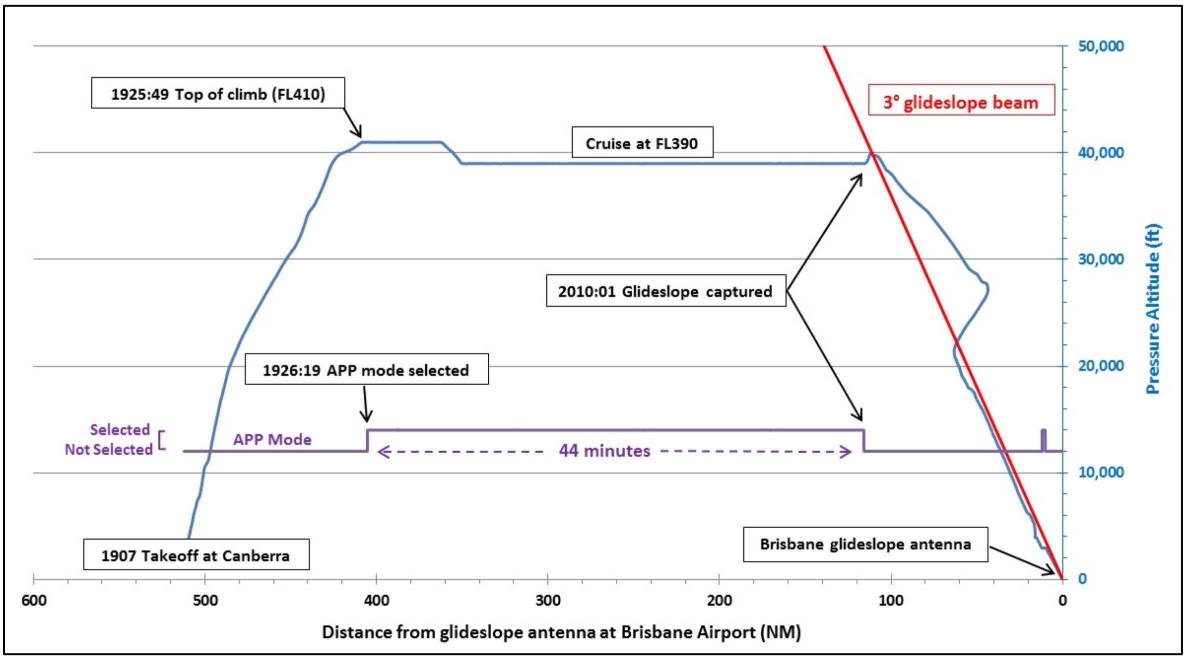
## Glideslope capture at flight level 390

At 2109:22, ATC advised the crew that 'when ready' they could descend to the cleared altitude of FL 300. The crew changed the MCP-assigned altitude indicator to the assigned altitude of FL 300. At this stage the captain was still completing their meal and the FO was the pilot flying. At 2110:01, which was about 44 minutes after the APP P/B was inadvertently selected and before the crew initiated their descent from FL 390, the aircraft's navigation system captured the glideslope signal (Figure 1). The signal caused the aircraft's auto-flight system to climb the aircraft in an attempt to intercept and track the glideslope beam, and the aircraft started climbing at 2110:07.

At the time of the glideslope capture, the aircraft was about 115 NM (213 km) south of the Brisbane glideslope transmitter and 29 NM (54 km) to the right of the localiser beam[5] (runway centre-line). The localiser signal was sensed but the aircraft was outside the localiser capture criteria and it was not captured. The calculated altitude for an aircraft to be considered 'on slope' at that distance from Brisbane was about FL 488. Due to atmospheric refraction of the glideslope beam the actual 'on slope' altitude was FL 398 (Figure 1).

5 The centre of the localiser beam coincides with the runway centre-line.

**Figure 1: Aircraft's recorded vertical flight path and key events**




Source: ATSB

The flight crew were surprised by the aircraft's climb. The FO reported that they initially looked at the MCP and attempted to change the vertical mode. At 2110:33, 26 seconds after the climb commenced, the FO disengaged the autopilot to control the climb and soon after started manually descending the aircraft to the cleared altitude of FL 300.

At 2110:39, the captain advised ATC that the crew were in the process of resolving what they believed was an autopilot issue and that the aircraft had climbed 1,000 ft. Soon after, the captain advised ATC that they were descending back to FL 390. The aircraft was recorded to have reached FL 399 before descending. At that time, G/S was still the active pitch mode and LNAV was the active roll mode displayed on the FMA, although the autopilot was not engaged.

During the descent, the crew de-tuned the active ILS frequency on the aircraft's navigation control panel in order to deactivate the G/S mode and enable them to select another mode. The FO selected V/S mode at 2111:01 and soon after the aircraft descended through FL 398.

## Lateral flight path deviation

The crew later reported that they thought they had re-engaged the autopilot during the descent to FL 390, but recorded data showed that was not the case. At about 2111:10, when approaching FL 397, the aircraft gradually banked left due to a small residual left rudder deflection, which was previously compensated for by the autopilot following the completion of the climb from Canberra.

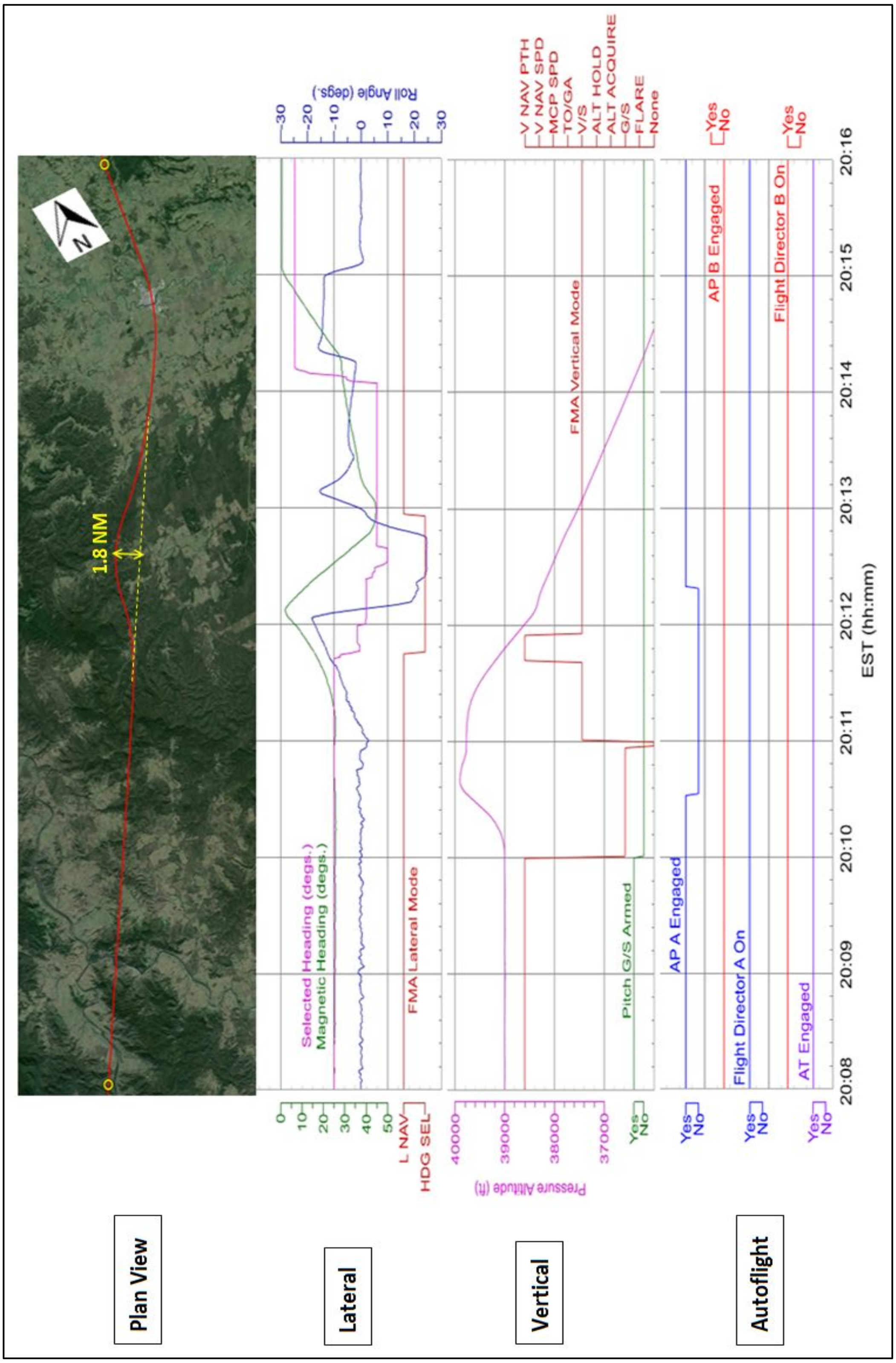
The crew identified that the aircraft was deviating left of the intended track displayed on the aircraft's navigation display and at 2111:46 the FO changed the lateral mode to heading select (HDG SEL) and changed the selected heading to 036°. However, the aircraft continued to roll left as the autopilot had (unknowingly) not been re-engaged. At 2111:56 the captain advised ATC that they were leaving FL 390 but that they now had a lateral navigation problem.

At 2112:01 the selected heading was changed to 040°. At about this time the crew realised that the autopilot was not engaged and at 2112:03 the first officer manually commenced a right turn back towards the flight-planned track. The maximum deviation from the flight plan track was about 1.8 NM (3 km). The recorded aircraft track and vertical and lateral data is shown at Figure 2.

At 2112:20, as the aircraft was passing FL 382, the FO engaged the autopilot. Soon after, the captain resumed the role of pilot flying.

Both the unexpected climb and lateral deviation were gradual in nature, and the flight crew reported that they did not need to advise the cabin crew of the problem or select the seatbelt sign on. The remainder of the flight was uneventful and the crew conducted a normal auto-coupled ILS approach for runway 01 at Brisbane Airport.

**Figure 2: Recorded aircraft track and vertical and lateral data**




Source: ATSB

# Context

## Personnel information

### *Captain*

The captain held an Air Transport Pilot (Aeroplane) Licence (ATP(A)L) and had accumulated about 20,110 hours of aeronautical experience. Of these, approximately 17,770 hours were on the B737 and the total time in command was about 14,975 hours. The captain was appropriately qualified to conduct the flight. They held a current Class 1 Aviation Medical Certificate, and reported no recent or ongoing medical or personal issues likely to have influenced their performance.

The captain completed a duty period on 23 February 2013 from 0800 to 1445 Eastern Standard Time[6] (EST) that involved two sectors and 4.8 hours flight time[7] and a duty period on 24 February from 0905 to 2107 EST of four sectors and 8.4 hours flight time. They commenced duty on 25 February at 0925 EST and the incident occurred towards the end of the fourth and last sector of the day. Their duty period on 25 February ended at 2103 EST, resulting in 11.6 hours duty time and 6.7 hours flight time that day. The workload during each of the 3 days was described by the captain as normal and not problematic.

The captain could not recall their hours of sleep in the nights preceding the flight.[8] However, they normally obtained 7–8 hours sleep a night and woke early. Based on their normal patterns and a commute time of about 75 minutes, it was expected that the captain would have obtained at least 6 hours sleep on the night prior to the occurrence and a normal sleep the previous night. They reported feeling tired towards the end of the flight.

The captain stated that on non-flying days they generally conducted about 10 hours work as part of their privately-owned non-aviation business and that they could feel tired at the end of such days. However, they did not conduct any such work on days on which they conducted flying duties.

### *First officer*

The first officer (FO) held an ATP(A)L and had accumulated about 10,230 hours of aeronautical experience. Of these, approximately 6,670 hours were on the B737, and they were appropriately qualified to conduct the flight. The FO held a current Class 1 Aviation Medical Certificate and reported no recent or ongoing medical or personal issues likely to have influenced their performance.

The FO had the previous 2 days free of duty. They reported sleeping well in recent days and felt refreshed.

## Aircraft information

### *Automatic flight control system*

The B737 automatic flight control system (AFCS) consists of the autopilot flight director system (AFDS) and the auto-throttle system (A/T). Both are controlled using the mode control panel (MCP) and the aircraft’s two flight management computers (FMCs). The FMC’s are controlled from the multi-function control display unit (MCDU).

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6 Eastern Standard Time (EST) was Coordinated Universal Time (UTC) + 10 hours. As the flight crew were based in Queensland, EST is used where reference is made to crew fatigue or flight and duty times.

7 The duty period was originally scheduled to be longer and have four sectors but, due to flight delays, the latter two duties could not be completed by the crew within the relevant flight duty limits.

8 The captain was not able to be interviewed until over 6 weeks after the occurrence.

Normally the AFDS and A/T are controlled automatically by the FMC to fly an optimised lateral and vertical flight path during the climb, cruise and descent flight phases. AFCS mode status is displayed on the flight mode annunciators (FMA) on each pilot's primary plight display (PFD).

#### *AFDS*

The AFDS is a dual system consisting of two individual flight control computers (FCC) and a single MCP. The two FCCs are identified as A and B. For autopilot (A/P) operation, they send control commands to their respective pitch and roll hydraulic servos, which operate the flight controls through two separate hydraulic systems.

For flight director (F/D) operation, each FCC positions the F/D command bars on the respective attitude direction indicator (ADI) or PFD. AFCS mode status is displayed on the FMAs on each pilot's PFD. Normally, the AFDS and A/T are used to maintain airspeed and/or the thrust setting as calculated by the FMC.

Procedures highlighted in the Flight Crew Operating Manual (FCOM) indicated that when operating the AFDS, attention must be given to verifying any changes on the flight instruments after making a change to the MCP. The AFDS operating procedures specifically highlighted that flight crew must identify any manually-selected or automatic changes. This included that changes made to the autopilot, flight director, auto throttle, airplane course, vertical path and speed should be verified by announcing changes displayed on the FMA and thrust mode display when they occur.

#### *Head-up guidance system*

The Qantas Airways Limited (Qantas) head-up guidance system (HGS) supplement described the HGS as a high integrity, wide field of view head-up display (HUD) that was fitted to the captain's side of the flight deck and was specifically designed for use in low visibility operations. It was recommended that when possible the captain should use the HGS system for currency and familiarity. The HUD enhanced the captain's ability to monitor the aircraft's displayed performance, flight path and navigation information for any phase of flight and maintain an awareness of the external environment.

The captain elected to use the HGS for the departure from runway 35 at Canberra. Guidance for using the HGS included that before start the HGS mode was selected to primary and the very high frequency (VHF) navigation receivers were tuned to the instrument landing system (ILS) frequency for the departure aerodrome/airport.

### *Mode control panel*

The MCP's fitted to the Qantas B737 fleet were manufactured by Honeywell or Rockwell Collins. The MCP fitted to VH-VYE was manufactured by Rockwell Collins (Figure 3). Although similar in layout to the Honeywell unit, there are some differences in the Rockwell Collins unit in the way information is displayed to the flight crew, the push-button design and the illumination of the selected push-button.

The MCP provides coordinated control of the A/P, F/D, and A/T functions and is the primary interface between the pilots and the FCCs. Crews use the MCP to:

- engage the autopilot(s)
- turn on the F/Ds
- select the AFDS mode of operation
- select course and heading
- select target speeds and altitudes.

The mode selector push-buttons are pressed to select desired command modes for the AFDS and A/T. The letters ON, two green lights, or an illuminated bar indicate that a mode has been selected and that it can be de-selected, if required, by pressing the button again. While a mode is active, de-selection can be automatically inhibited and is indicated by the push-button light being extinguished (for example, ALT HOLD at the MCP altitude). When a prospective mode engagement would conflict with current AFCS operation, pressing the mode selector button has no effect. All AFDS modes can be disengaged by selecting another command mode or by disengaging the A/P and turning the F/D switches OFF.

**Figure 3 – Rockwell Collins MCP as installed in VH-VYE**


**Source: Rockwell Collins**

## *MCP parameter selections*

### *Vertical navigation/Lateral navigation modes*

Crew selection of the lateral navigation (LNAV)[9] mode and/or vertical navigation (VNAV)[10] mode resulted in the FMCs calculating the optimum lateral and/or vertical navigation flight path. The flight path was calculated using information obtained from the FMC database, flight plan information entered by the crew and other aircraft systems information.

When conducting an approach using both the LNAV and VNAV modes, whether that information was taken from the FMC database or entered into the FMC by the pilots, the approach is known as a VNAV/LNAV approach. Alternatively, the aircraft's vertical flight path can be controlled by other AFDS modes. These other vertical modes do not interface with the FMCs and relied solely on MCP selections by the crew. As a result, any speed restrictions and altitude constraints entered by the crew into the FMCs when in those modes do not alter the aircraft's flight path.

While descending in any one of those modes with the autopilot engaged, the altitude hold mode automatically levels the aircraft at the altitude selected on the MCP. Altitude hold mode can also be selected at any altitude by pushing the altitude hold switch on the MCP and the aircraft then maintains the altitude at the time the switch was pushed. VNAV PTH mode controls the aircraft's descent to fly a vertical path that complies with the altitude and speed restrictions in the flight plan.

### *Approach mode*

Pushing the APP push-button illuminates the APP switch light and arms the AFDS for localiser and glideslope capture and tracking. One of the aircraft's VHF NAV receivers must be tuned to an ILS frequency before APP mode can be engaged. Once armed, VHF omni-directional radio range/localiser (VOR/LOC) is displayed in white in the roll mode column of the FMA and, in the pitch mode column, G/S is displayed in white to indicate that the APP mode has been armed.

The localiser capture point is variable and depends on intercept angle and closure rate. Localiser capture will occur at least by the time the deviation reduces to ½ dot[11]. Glideslope capture occurs when the deviation is less than 0.55 dots. The APP light extinguishes after localiser and glideslope capture and VOR/LOC and G/S are displayed in green on the FMA as the active engaged modes. ILS identifier, approach track and ILS/distance measuring equipment (DME) distance are displayed on the PFD on the upper left, below the FMA when both VOR/LOC and G/S are the active modes. If only the G/S captured, and the active roll mode was LNAV, then LNAV/G/S is displayed,

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9 In the lateral navigation (LNAV) mode, the roll command is calculated by the flight management computer based on the active flight plan.

10 The vertical navigation (VNAV) mode supplies pitch control in response to vertical navigation data from the flight management computer (FMC). VNAV commands the aircraft to climb or descend to the FMC target altitude at the FMC target speed.

11 Localiser and glideslope deviations are displayed on the crew's PFDs in units of dots. For the Brisbane runway 01 ILS, a localiser deviation of ½ dot equates to an angle of 0.75° from the runway centre-line.

indicating the source of the deviation for each scale. The localiser and glideslope deviation scales are displayed when the localiser frequency is tuned.

A representation of the PFD just prior to glideslope capture for an ILS approach to runway 01 at Brisbane it shown at Figure 4 and at capture Figure 5.

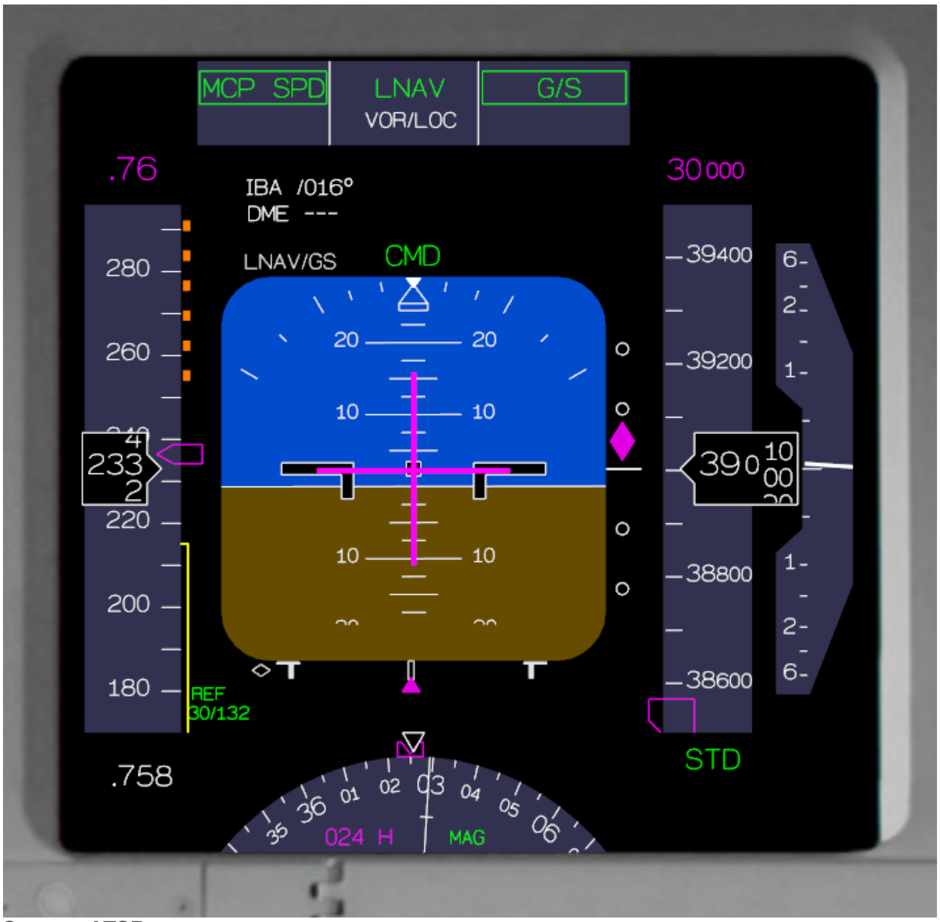
After localiser and glideslope capture, APP mode can be disengaged by:

- pushing a take-off go-around (TOGA) switch
- disengaging the autopilot(s) and turning off both F/Ds
- de-tuning the relevant VHF NAV receiver.

**Figure 4 – Representation of the PFD at 2110:00 – just prior to glideslope capture**


**Source: ATSB**

**Figure 5 – Representation of the PFD at 2110:01 – glideslope capture**




Source: ATSB

## *Operation of the ILS*

The ILS provides lateral and vertical position data necessary to align the aircraft with the runway for approach and landing. The system uses angular deviation signals from the glideslope antennas (located approximately 1,000 ft from the touchdown point on the runway) and the localiser antennas (located past the far end of the runway). The glideslope signals provide the angular deviation from the nominal glide path (usually 3°) and the auto-flight system generates fly-up or fly-down commands to track the glide path down to the touchdown point on the runway. Glideslope deviation is displayed on the PFD in units of dots, where 1 dot equates to 0.41° deviation from the glide path.

The localiser signals provide the angular deviation from the runway centre-line and the autopilot generates fly-left or fly-right commands to track the centre-line until the landing roll is completed. Localiser deviation is displayed on the PFD in units of dots, where typically 1 dot equates to 175 ft deviation from the runway centre-line at the threshold.

The multi-mode receivers receive tuning inputs, such as the ILS frequency, from the VHF NAV receivers. While most navaids can be automatically tuned by the FMS, ILS frequencies are manually tuned.

In Australia there are 35 ILS installations but the frequencies are not distributed evenly across the available frequency range. For example, there are eight installations that use 109.5 MHz, including Avalon, Brisbane, Cairns (localiser only), Canberra, East Sale, Launceston, Perth and Sydney.

At the time of glideslope capture, the aircraft was closest to the Brisbane ILS (115 NM or 213 km) and was suitably oriented to receive the glideslope signal. The next closest glideslope transmitter with the same frequency was at Sydney (runway 16R) at a range of 250 NM (463 km). Apart from the excessive range, the aircraft's orientation was also unsuitable to receive a glideslope signal from Sydney.

### *Auto-flight system configuration and guidance material*

According to Boeing, the B737NG auto-flight system can be configured in two ways prior to aircraft delivery. In this respect, Qantas had the option to configure their aircraft's auto-flight system to either inhibit glideslope capture prior to localiser capture or, as was the case with all of the Qantas B737 fleet, enable glideslope capture prior to localiser capture. The option of enabling glideslope capture prior to localiser capture was recommended by Boeing for those operators trying to achieve fleet commonality and for those operating in terminal areas where FMC positioning can be relied upon. Qantas reported that this option assisted flight crew to perform stabilised descents using established procedures, such as a visual approach procedure, while not being fully established on the localiser.

Guidance material included in the Qantas FCOM, Flight Crew Training Manual (FCTM) and flight operations review bulletins (appendix A) provided flight crew with information about the auto-flight system specific to the B737-800 and the system's ability to capture the glideslope. The FCOM Section 4.20.12 incorrectly stated that 'glideslope capture was inhibited prior to localiser capture', which contradicted other operational guidance material. Despite this, the flight crew correctly recalled that it was possible for the aircraft's autopilot to descend to capture the glideslope without first being established on the localiser. Furthermore, the flight crew reported that because the aircraft had this capability, the standard operating procedure (SOP) was to only arm the approach mode when cleared by ATC for the ILS approach and established on the localiser. The FCTM highlighted that flight crew should not select the APP mode until:

- the ILS was tuned and identified
- the aircraft was on an inbound intercept heading
- both the localiser and glideslope pointers appeared in the proper position on the attitude display
- clearance for the approach had been received.

Following this occurrence, the manufacturer amended the FCOM to reflect the system fitted to the Qantas B737-800 fleet.

## Meteorological information

Recorded flight data indicated that the aircraft encountered light turbulence approaching the top of climb at FL 410. The turbulence prompted the crew's subsequent descent to FL 390 in search of smoother conditions; however, the flight crew reported that the turbulence did not impact on the flight.

At the time of the occurrence it was night and the flight crew could not recall if there were any outside visual cues. A full moon about 27° above the horizon meant that some atmospheric lighting was present.

## Operational information

### *Non-normal operations*

The Qantas Flight Administration Manual (FAM) listed the hierarchy of operational documents and the procedures that flight crew were required to follow when operating Qantas aircraft. If reference to these procedures was required, preference was given to the procedures in the Quick Reference Handbook (QRH), followed by the FCOM and then the FAM, with additional guidance given in the FCTM.

Despite the climb from FL 390 on glideslope capture being identified by the flight crew as a malfunction of the aircraft's autopilot, no associated warnings or alerts were indicated to the crew that they had a non-normal situation. From a technical standpoint, the autopilot-initiated climb was a valid response to the selection of the APP push-button and capture of a valid glideslope signal and so was consistent with the lack of warning/alert. There was no non-normal checklist item in the QRH that would have assisted the crew resolve the apparent malfunction.

In this case the flight crew applied some of the guidance in the FCTM by reducing the level of automation to control the aircraft's flight path before attempting to restore the automation.

### Navigation aid selection

Following the occurrence, the flight crew sought information from other Qantas pilots about the appropriate method of ILS frequency selection during departure. They reported that other pilots normally de-selected the ILS frequency after departure, changed it to an appropriate en route frequency, before manually retuning to the appropriate destination ILS frequency if required. No specific guidance material pertaining to navigation aid frequency selection was identified in the Qantas operational documents, although the FAM had a general statement that for route operations, all relevant approach and landing aids shall be used.

### In-flight briefings and checklists

The flight crew reported that, prior to the calculated top of descent point, they conducted the relevant procedures to prepare for the descent and subsequent approach into Brisbane. The descent procedure as stated in the FCOM NP.21.46 included that the flight crew should:

- Review the system annunciator lights [pilot flying].
- Recall and review the system annunciator lights [pilot not flying].
- Verify VREF on the APPROACH REF page [pilot flying].
- Enter VREF on the APPROACH REF page [pilot not flying].
- Set the RADIO/BARO minimums as needed for the approach [both pilots].
- Set or verify the navigation radios and course for the approach [both pilots].
- Set the AUTO BRAKE select switch to the needed brake setting [pilot not flying].
- Verify HUD settings and modes as required [both pilots].
- Do the approach briefing [pilot flying].
- Call "DESCENT CHECKLIST" [pilot flying]…

The approach briefing included that the pilot flying should brief the pilot not flying of their intentions for the approach and that both flight crew should be familiar with all aspects of the approach.

### Automation systems management and communication

The FAM described the preferred method of managing automatic flight management systems. It highlighted that while automation can be a valuable tool for flight crew, a good understanding of the systems and an awareness of the flight modes is required. If flight crew experienced a reduced awareness of the status of the automation, then a reversion to a less complex automation mode should be made to ensure positive control over the automation.

To maintain a positive awareness of the automation system status, and to ensure that both flight crew have a shared understanding of any changes made to the MCP or flight modes, standard operating procedures (SOP's) outlined in the FAM were to be applied. This included a number of standard calls and procedures. The most relevant procedure to this occurrence was the verbalisation of any changes to the FMA or autopilot status. This entailed a call acknowledging that a change had occurred followed by a 'checked' confirmation call from the other pilot.

Section 1.24 of the FCTM also listed sample calls relating to the FMA. This included a requirement for annunciated modes to be called by the pilot flying and checked by the pilot not flying at the initial level-off altitude; however, any subsequent cruise altitude change required only the mode changes to be called. Those procedures would have applied when the aircraft initially levelled off at

FL 410 and when subsequent MCP changes were made by the flight crew to descend the aircraft to FL 390 in a changed vertical flight mode.

## Related occurrences

### Glideslope capture during cruise

Boeing and Qantas reported that they were not aware of any previous occurrences where an aircraft's auto-flight system captured a glideslope during cruise flight. In this regard, Qantas analysed over 200,000 flights on its B737 fleet, and no instances were identified where the approach mode was armed and the auto-flight system unexpectedly captured a valid ILS signal. Some flights were identified where the approach mode was armed outside 30 NM (56 km) from the landing destination; however, these were associated with long final approach segments and approaches where a go-around and diversion to an alternate airport was required.

### Mode awareness occurrences

Ineffective auto-flight system mode awareness has been identified as a contributing factor in many occurrences since the introduction of complex auto-flight systems (Federal Aviation Administration 1996). A recent report into the operation of flight path management systems (PARC/CAST Flight Deck Automation Working Group 2013) stated:

> The 1996 FAA report identified insufficient auto-flight mode awareness as an important vulnerability area…
>
> Since that report was published, some changes to flight deck equipment design have been made in new aircraft to address this vulnerability area (e.g., only showing selected target values or modes on the PFD, to foster the pilots reviewing the information on the mode annunciator display rather than on the mode selection panel).
>
> In addition, the issue has been addressed in training through increased emphasis on mode awareness and in some operators' flight crew procedures by having the pilots call out all mode changes. However, other operators find this use of callouts to be too burdensome and a potential distraction.
>
> These mitigations are only partially successful. The data analysis reveals that auto-flight mode selection, awareness and understanding continue to be common vulnerabilities…

The report also noted that manual handling errors were one type of concern. This included cases of not effectively taking over control because of not realising that the autopilot was disconnected.

There have been many previous incidents where a crew thought they had engaged the autopilot but did not ensure that it was successfully engaged. For example, in the 5 years up to June 2014, there were at least 11 such occurrences listed in the US Aviation Safety Reporting System database.[12] All involved two-crew operations, although seven involved corporate jet operations where they may not have had the same level of procedures and training in two-crew operations as would be expected in scheduled air transport operations. In all of the occurrences, the aircraft did not comply with altitude, route or other requirements. In one case the aircraft's 'Bank Angle' alert sounded and the aircraft reached a 45° bank angle before the crew realised the problem. In some cases the crew reported workload or distraction issues, but in the majority of cases no significant problems in this area were noted.

A search of the ATSB occurrence database identified six examples in the 5-year period up to December 2014 where the aircraft's autopilot was either not engaged when intended or was inadvertently engaged with an inappropriate flight mode selected. In one case, the flight crew did not identify that the approach mode had not been armed until the aircraft flew through the runway centre-line. In addition to the six autopilot-related occurrences, there were 18 other occurrences where reduced flight mode awareness was identified, and incorrect or inappropriate mode selections were made.

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[12] The US Aviation Safety Reporting System is a confidential, voluntary, non-punitive reporting scheme for occurrences that occur in the US or involve US civil aviation operations.

In addition, there have been accidents involving crews who thought they had engaged the autopilot but it was not engaged. For example, on 5 May 2007, a B737-800 aircraft, operating as Kenya Airways Flight 507, crashed soon after take-off from Douala Airport, Cameroon in dark night conditions.[13] As soon as the aircraft became airborne, it had a tendency to roll slightly to the right, which was easily controlled by the captain to maintain a wings-level attitude. Soon after passing 1,000 ft, the crew provided no flight control inputs for 55 seconds and the aircraft gradually rolled to the right. During this period the captain attempted to engage the autopilot, without success, and this error was not detected by the crew. Another recent air transport aircraft accident in Lebanon appeared to involve similar issues.[14]

The ATSB has recently investigated several occurrences involving mode awareness issues in air transport aircraft. These include:

- AO-2012-040, Descent below minimum safe altitude involving Boeing 737-476, registered VH-TJS, which occurred 21 km south of Canberra Airport, Australian Capital Territory, on 12 February 2012, where the aircraft descended below the minimum safe altitude while conducting an approach to Canberra Airport. The ATSB found that during the approach the automatic flight system was in the level change mode, rather than the vertical navigation mode specified by the operator for such approaches. While in that mode the flight crew selected an altitude lower than the applicable minimum safe altitude, with the effect that unless the crew intervened, the aircraft would descend to that lower altitude.
- AO-2012-103, Descent below segment minimum safe altitudes involving Airbus A320-232, registered VH-VQA, near Queenstown, New Zealand on 16 July 2012. While on approach to Queenstown the crew unintentionally continued to descend with the aircraft's auto-flight system in open descent mode, which did not provide protection against infringing the instrument approach procedure's segment minimum safe altitudes. The ATSB also found that the crew were not strictly adhering to the operator's sterile flight deck procedures, which probably allowed the crew to become distracted.
- AO-2012-138, Descent below the minimum permitted altitude involving Boeing 737-838, registered VH-VXB, which occurred 35 km south-west of Canberra Airport, Australian Capital Territory on 17 October 2012. During an approach to Canberra Airport the aircraft's auto-flight system vertical mode changed from a flight management computer- derived and managed vertical navigation mode into the vertical speed mode. This was followed by a number of automated, but unnoticed, and crew- initiated changes in the aircraft's auto-flight system vertical mode. The combination of auto- flight system mode changes and management of the airspeed during the descent resulted in a high workload environment where the 7,000 ft altitude clearance limit was overlooked by the flight crew.
- AO-2013-041, Operational event involving Boeing 737, registered VH-VUZ, which occurred near Launceston, Tasmania on 4 January 2013. During the departure from Launceston, the aircraft's vertical auto-flight system mode was selected by the crew as a level change (LVL CHG) mode. Later in the climb the crew intended to switch from that mode to a vertical navigation (VNAV) mode but this was overlooked and the aircraft could not climb in accordance with a programmed speed schedule that the VNAV mode would have provided. Instead, the aircraft climbed at a constant speed/Mach Number until, at altitude, the aircraft reached the minimum manoeuvre airspeed and a cautionary 'buffet alert' activated.

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13 *Technical investigation into the accident of the B737-800 registration 5Y-KYA operated by Kenya Airways that occurred on the 5th of May 2007 in Douala*. Ministry of Transport, Republic of Cameroon.

14 *Investigation report on the accident to Ethiopian 409 – Boeing 737-800, Registration ET-ANB at Beirut – Lebanon on 25th January 2010*, Republic of Lebanon, Ministry of Public Works & Transport.

# Safety analysis

## Introduction

During cruise flight preceding the descent into Brisbane, Queensland the aircraft experienced an unanticipated climb followed by a lateral deviation from the flight planned route. This analysis will examine a number of events that had to occur for the aircraft's autopilot to climb the aircraft to capture the glideslope associated with the Brisbane runway 01 instrument landing system (ILS) approach, and then for the aircraft to deviate from the flight planned route. The discussion also highlights a number of human performance limitations associated with the operation of automated aircraft systems.

## Conditions required to capture the glideslope

An incorrect or inadvertent mode selection is not ideal and in itself may not contribute to an undesired autopilot control input. However, this occurrence shows that a combination of conditions/selections can result in the autopilot climbing the aircraft to capture the glideslope.

The conditions for the autopilot-initiated capture of the glideslope were that the departure and destination ILS frequencies were the same, this frequency remained active in the aircraft's navigation system and there was a subsequent selection of the approach (APP) push-button on the aircraft's auto-flight system. This selection armed the glideslope and localiser, meaning that when the aircraft was within range of the Brisbane ILS signal, the glideslope would become the active vertical flight mode. The combination of glideslope as the active vertical mode and an auto-flight system that allowed glideslope capture despite not being on the localiser allowed for the autopilot to command the aircraft to capture the signal.

The Qantas Airways Limited (Qantas) procedures would normally prevent the capture of a glideslope as, in accordance with these procedures, the APP push-button would not normally be selected before the aircraft was on an inbound intercept to capture the localiser. In this occurrence, this defence was negated as the crew did not detect that they had inadvertently selected the APP push-button during the cruise phase of flight.

## Navigation aid selection

The pre-start procedure for the use of the heads-up guidance system included tuning the departure runway ILS frequency, if available. The flight crew manually entered the Canberra ILS frequency of 109.5 MHz into the aircraft's navigation system as per the procedure; however, did not de-select it after departure or re-tune to a frequency more appropriate for the next phase of flight. Instead, the frequency remained the active frequency, which meant that if a signal of the same frequency was received from another ILS ground facility, such as approaching Brisbane, the flight crew's primary flight displays (PFD) would indicate a glideslope and localiser deviation scale. There was no procedure or guidance available that specifically addressed the de-selection of ILS frequencies and re-selection of radio aids after departure, although re-selection of another more appropriate frequency was reportedly practiced by other Qantas pilots.

The practice of de-selecting an ILS and re-tuning it to a more appropriate en route frequency was not intended as a defence to prevent undesired ILS frequency detection. However, it does reduce the risk of an unintended ILS signal being received and followed.

## Selection of approach mode

The APP push-button was manually selected by the crew soon after reaching the cruise altitude of flight level (FL) 410. As the crew were aware that the approach mode should not be armed that early in the flight, the selection was considered to be inadvertent.

At the time the APP push-button was inadvertently selected, the flight crew also made minor changes to the heading selector, which was in close proximity to the APP push-button. The captain may also have had their finger on or near the altitude selector at about this time when confirming that they had reached the assigned level of FL 410. In either case, the crew's interaction with a number of nearby controls and systems could explain the inadvertent selection of the APP push-button, which may have been more likely given the light turbulence at the time. Alternatively, one of the crew may have unintentionally selected the APP push-button instead of another control selection, although there was no apparent need to select any of the mode control panel (MCP) push-buttons at that point in the flight.

The selection of the APP push-button required a distinct application of force. Inadvertent activation of push-buttons can be minimised through increasing the force required to activate them, increasing separation from other controls, introducing protective covers or requiring multiple actions for activation. However, given that this type of occurrence has not been reported before, and was considered unlikely to lead to a hazardous situation, changes to the MCP design were not required.

## Detection of approach mode selection

Although inadvertent selections will occasionally occur, of interest in this occurrence was why the selection of the APP push-button and the consequent arming of the glideslope (G/S) and very high frequency omni-directional radio range/localiser (VOR/LOC) approach modes were not detected by the flight crew until after the G/S mode engaged and the aircraft started climbing. This was despite the Qantas procedures providing an opportunity for the crew to detect the armed mode as the aircraft levelled at FL 390, as well as the time available in the cruise between the inadvertent selection and the aircraft climbing.

The flight crew were not expecting the APP push-button to be activated, or for there to be any other mode changes after levelling out in the cruise, particularly given the routine nature of this flight. Expectations are based on past experience and other sources of information, and they strongly influence where a person will search for information, what they will search for, and their ability to notice and recognise something if it is present (Wickens and McCarley 2008).

Research has also shown that pilots do not spend much time scanning the flight mode annunciator (FMA) or other auto-flight mode indications (Sarter and others 2007), which is not surprising given that flight modes do not change frequently. The same research also showed that pilots do not always scan their instrumentation when a change is expected, and do not always detect mode changes even when they do fixate their scan on the FMA, particularly if the changes were unexpected. Björklund and others (2006) found that even when flight crews were required to call out auto-flight mode changes, they did not always do so, and sometimes called out changes without scanning the FMA. They concluded that an FMA 'may not really be attention-getting, whether there is boxing or flashing or not. Indeed, empirical data show that the current FMA does not assist in flight crew awareness in a dominant way…'.

Despite the observed limitations in its application, the procedure for calling out FMA changes is important. However, such a procedure focusses on flight crew calling out and verifying expected changes to the FMA rather than reviewing all the active and armed modes on the FMA. For this reason, the procedure may not always be effective in identifying unexpected mode changes, as there is an inherent tendency for people to seek to confirm hypotheses rather than disconfirm them (a phenomenon known as 'confirmation bias'). The importance of flight crews reviewing modes rather than calling out mode changes has also been noted in previous ATSB reports.[15] However, it is acknowledged that reviewing all modes every time there is a mode change may result in the checks becoming perfunctory in nature.

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15 For example, see AO-2012-103, *Descent below segment minimum safe altitudes involving Airbus A320-232 VH-VQA, near Queenstown, New Zealand, 16 July 2012,* available at www.atsb.gov.au.

## Response to the glideslope capture and unexpected climb

The aircraft captured and responded to the ILS signal by climbing to intercept the glideslope. The flight crew were initially surprised when the aircraft started to climb and they were possibly confused as to why. The flight crew had flown together on many previous occasions and reported that they normally communicated effectively with each other. On this occasion the captain thought that the surprise and confusion associated with the unexpected climb disrupted their communications to some extent.

The crew reported that the first officer attempted various actions through the MCP to decrease the climb before they both reviewed the FMA and diagnosed why these actions were not effective. Research has found that flight crew responses to unexpected automation-related problems are generally effective but that they often perform limited diagnostic activities prior to implementing actions and often do not follow the ideal or standard path when responding (Nikolic and Sarter 2007). In this case, the crew appeared to transition fairly quickly to the appropriate response of disconnecting the autopilot and manually controlling the aircraft until the appropriate modes could be re-selected. In addition, they promptly advised air traffic control (ATC) of their deviation from the cleared flight level.

## Use of the autopilot and flight path monitoring

Contrary to the flight crew's intentions, during the descent back down to FL 390 the autopilot was not re-engaged and the aircraft started gradually banking to the left. The operator's procedures stated that when engaging or re-engaging the autopilot, the pilot flying was required to call out the annunciated changes to the autopilot status and the pilot not flying was to verify this and call out 'checked'. The crew both reported that it was their normal practice to follow this procedure, but they could not recall doing so on this occasion. The captain noted that they were probably still confused by the unexpected climb event at that stage.

A recent report into the operation of flight path management systems (PARC/CAST Flight Deck Automation Working Group 2013) noted that observational audits had identified that incomplete compliance with procedural requirements to cross-verify flight management system entries is commonplace in line operations. The report stated:

> Simply put, it is easy to omit an onerous cross verification, or merely perform a perfunctory one when workload is high, time is short, or confidence is high and the likelihood of finding a mistake is low. However, this confidence is invalidated if an incorrect selection is made by the crew in the first place…

Ensuring that the autopilot has successfully engaged is an important task, particularly in situations where the flight crew are managing ongoing threats or have some uncertainty regarding the performance of aircraft systems. There have been many previous occurrences where verifying the status of the autopilot has not been effective, resulting in flight path deviations. More importantly, there have also been previous accidents where the crew mistakenly believed they had engaged the autopilot and then there was a gradually increasing bank angle that was not promptly detected or effectively managed.

In this case the crew were monitoring the aircraft's flight path and detected the problem with the aircraft's heading after it deviated about 10° off track after 36 seconds, although they did not effectively diagnose the problem until 17 seconds later, after the initial response actions were identified by the crew as not resolving the issue. As noted above, research has shown that flight crews' initial diagnosis and responses to unexpected automation-related problems are generally effective but not always efficient. Given that they had just dealt with what they thought was another autopilot-related issue, the crew thought they were dealing with a second autopilot-related issue. It is therefore not surprising that they took some time to realise that they were actually dealing with the autopilot not being engaged.

If the crew had not been monitoring the aircraft's flight path, or their attention had been diverted due to other factors, there was the potential for a more serious occurrence. However, it should be noted that there were a number of other risk controls in place to help detect a more significant problem, such as an aural 'Bank Angle' alert if the bank angle exceeded 35°, ATC monitoring of the aircraft's flight path and flight crew training in recovery from unusual attitudes. Nevertheless, in very rare occasions these detection and recovery controls are not always effective, which reinforces the importance of flight crew ensuring that autopilot and mode selections are effective and cross-verified in order to avoid getting into an unusual attitude situation.

## Ineffective rest and cumulative fatigue

The event occurred towards the end of a four-sector duty period and the captain noted feeling tired at the time. Although it was a relatively long duty period, the workload had not been high. The captain's sleep period may have been less than normal on the night prior to the occurrence, but it was likely to have been more than 6 hours. Research has indicated that levels of fatigue are not likely to be problematic for people having more than 6 hours sleep the previous night (Dawson and McCullough 2005, Thomas and Ferguson 2010, Williamson and others 2012), particularly in situations where workload has not been high. The potential for fatigue also increases as the time awake increases, but this depends on factors such as time of day and the amount of recent sleep. Overall, based on the available information, there was insufficient evidence to conclude that the captain was experiencing a level of fatigue likely to have had a demonstrated influence on performance.

The captain's roster met the relevant requirements and did not appear to be unduly problematic, although multiple four-sector days with duty periods over 11 hours has the potential to increase the likelihood of fatigue. Of more concern is that the captain reported conducting an average of 10 hours work unrelated to their flying employment on days where they were not conducting flight duties. This level of work has the potential to lead to cumulative fatigue and interfere with a person's ability to ensure that they are getting adequate rest periods between rostered flight duty periods. It is very difficult for an operator to control such activities and there is a significant onus on the crew member to ensure that they are appropriately rested prior to reporting for duty.

# Findings

From the evidence available, the following findings are made with respect to the flight path deviation involving Boeing 737-838, registered VH-VYE, about 213 km south-south-east of Brisbane Airport, Queensland on 25 February 2013. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

## Contributing factors

- Depending on the auto-flight and instrument landing system frequency selections by the flight crew, the configuration of the auto-flight system logic on the operator's Boeing 737 fleet allowed the aircraft to capture and follow a glideslope signal despite not being established on the localiser.
- The flight crew inadvertently selected the approach push-button after reaching cruising altitude, which was not detected for an extended period, allowing the aircraft's auto-flight system to capture the glideslope signal at cruise altitude while still about 213 km from the destination.
- Following departure from Canberra the instrument landing system frequency for that airport, which was the same as for the system at Brisbane Airport, remained active on the aircraft’s navigation control panel, permitting the auto-flight system to capture and follow the glideslope signal as the aircraft approached Brisbane.
- Contrary to their intent, the flight crew did not re-engage the autopilot after the climb associated with the glideslope capture approaching Brisbane, resulting in the aircraft laterally deviating from the flight planned track.

## Other factors that increased risk

- The captain conducted significant non-aviation work when free from flight duty, which had the potential to lead to ineffective rest and cumulative fatigue.

# General details

## Occurrence details

| | | |
|---|---|---|
| Date and time: | 25 February 2013 – 2110 EDT | |
| Occurrence category: | Incident | |
| Primary occurrence type: | Operational | |
| Location: | 213 km SSW of Brisbane Airport, Queensland | |
| | Latitude: 29º 16.02' S | Longitude: 153º 33.27' E |

## Aircraft details

| | | |
|---|---|---|
| Manufacturer and model: | Boeing 737-838 | |
| Registration: | VH-VYE | |
| Operator: | Qantas Airways Limited | |
| Serial number: | 33993 | |
| Type of operation: | Air Transport High Capacity | |
| Persons on board: | Flight crew – 2 | Passengers – Not Known |
| Injuries: | Crew – Nil | Passengers – Nil |
| Damage: | None | |

# Sources and submissions

## Sources of information

The sources of information during the investigation included:

- Airservices Australia
- the Boeing Aircraft Company (Boeing)
- the Bureau of Meteorology
- the flight crew of VH-VYE
- Qantas Airways Limited (Qantas).

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## Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to Airservices Australia, Boeing, the Civil Aviation Safety Authority, the flight crew of VYE, the United States National Transportation Safety Board and Qantas. A submission was received from Boeing. The submission was reviewed and where considered appropriate, the text of the draft report was amended accordingly.

# Appendices

## Appendix A – Operator Flight Crew Training Manual extract

**Flight Crew Training Manual**

**BOEING**

Flight Operations ***REVIEW***

A MESSAGE TO FLIGHT CREWS FROM THE BOEING COMMERCIAL AIRPLANE GROUP

**Aircraft Applicability:** 737, 747, 757, 767, 777
**Reference Number:** 737-29, 747-29, 757-25, 767-25, 777-02

**Issue Date:** December 16, 1996

### Inadvertent Descent on the ILS Glideslope Before Localiser Capture

The ability to capture the glideslope prior to localiser capture during autopilot and flight director approaches has raised concerns about increased aircraft exposure to the risk of terrain or obstruction contact. Glideslope capture before localiser capture is permitted by onboard Flight Control Computers (FCC) which will capture and track the glideslope signal without localiser capture. During an ILS approach with an autopilot coupled to the ILS or when manually flying the flight director, a pilot might prematurely descend on the captured glideslope while the aircraft is not yet positioned on the localiser course. The exposure to terrain contact is increased when an undetected map shift is present for EFIS/FMC equipped aircraft.

EFIS-equipped aircraft which use Flight Management Computers (FMCs) to generate the navigation map display using inertial reference inputs can experience a drifted lateral position if insufficient radio navigation aids are available to regularly update the inertial position. When flying in LNAV mode using the EFIS navigation map in a drifted (map shift) condition and without a cross-check of appropriate radio navigation aids, an aircraft may commence approach and be laterally displaced outside protected airspace while descending on glideslope, and in some cases, may never capture the localiser. Thus the approach path and subsequent missed approach path may be unfavourably positioned.

While perfect or near-perfect lateral position (e.g. by using GPS positioning) reduces the possibility of lateral position error somewhat, it should be understood that early glideslope capture and descent prior to localiser capture inherently increases risks of terrain/obstruction contact, irrespective of navigation equipment accuracy.

When on approach with LNAV engaged, Boeing recommends that pilots consider localiser capture prior to glideslope capture to significantly reduce the risk of inadvertent terrain or obstruction contact on approach.

**November 20, 2010** **Page 1 of 2**

**Boeing Flight Operations Review 737-29, 747-29, 757-25, 767-25, 777-02**
**December 16, 1996**

Options are available on all Boeing aircraft to inhibit early glideslope capture. Glideslope deviation and localiser deviation indications are always available on both pilot's flight displays for all FCC options.

Whether EFIS-equipped or not, there may be legitimate and valid reasons for an early glideslope capture capability to cope with ATC altitude clearances. Its use is safe and effective provided proper situational awareness is employed in the decision to exercise early glideslope capture. Specific situational awareness should be part of any decision to intentionally capture glideslope early. Pilots should be aware of the inherent risks associated with performing early glideslope capture if not properly aligned on the localiser course.

Boeing publishes the 'Flight Operations Review' for operators and their flight crews in order to provide advisory information related to flight operations. All information in the 'Flight Operations Review' is considered accurate. However, it is not intended to replace or supercede information contained in approved operating documentation.

# Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

## Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

## Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

**Australian Transport Safety Bureau**

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Investigation

**ATSB Transport Safety Report**
Aviation Occurrence Investigation

Flight path management occurrence involving Boeing 737-838, VH-VYE
213 km SSE of Brisbane Airport, Queensland, 25 February 2013

AO-2013-049
Final – 27 April 2015