SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-8K5, G-FDZF
No & Type of Engines:	2 CFM56-7B27/3 turbofan engines
Year of Manufacture:	2008 (Serial no: 35138)
Date & Time (UTC):	11 September 2021 at 1240 hrs
Location:	Aberdeen Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 67
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	56 years
Commander's Flying Experience:	15,490 hours (of which 1,524 were on type) Last 90 days - 67 hours Last 28 days - 62 hours
Information Source:	AAIB Field Investigation

Synopsis

At 1341 hrs on 13 September 2021, the AAIB was informed that a serious incident had occurred to a Boeing 737-800, registration G-FDZF, during a go-around at Aberdeen Airport on 11 September 2021.

During the manually flown go-around, which was initiated at 2,250 ft amsl, the aircraft initially climbed, but just before it reached the cleared altitude of 3,000 ft amsl it began to descend. It descended to 1,780 ft amsl (1,565 ft agl) with a peak rate of descent of 3,100 fpm, and accelerated to an airspeed of 286 kt (the selected airspeed was 200 kt) before the crew corrected the flightpath. The aircraft descended for a total of 57 seconds before the climb was re-established. It is likely that the crew allowed the aircraft to descend unnoticed having become overloaded by the high workload during the go-around.

As a result of this serious incident, Aberdeen ATC changed its procedures for aircraft being broken off from the approach, and the aircraft manufacturer issued guidance to pilots about the behaviour of the Autopilot and Flight Director System (AFDS) and autothrottle during go-arounds. The aircraft operator informed all its pilots about the event; included extensive go-around training in its training cycle; and completed a full review on pilot recency, which introduced additional restrictions to manage pilots through periods of reduced flying.

History of the flight

The crew of G-FDZF had operated a passenger flight from Newcastle International Airport to Palma de Majorca Airport before operating the incident flight from Palma to Aberdeen Airport. The aircraft departed Palma at 1047 hrs with 67 passengers and 6 crew on board. At 1230 hrs the flight crew established contact with Aberdeen Radar for a radar vectored CAT I ILS approach to Runway 34 at Aberdeen. At 1235 hrs, as the aircraft was descending through 5,100 ft amsl, the crew were informed by ATC that there was a possibility that they may have to discontinue the approach, in which case they should expect a climb straight ahead to 3,000 ft amsl. This was because a search and rescue helicopter, which was currently on the ground at the airport, would take priority once airborne.

The crew established the aircraft on the localiser and glideslope at 3,000 ft amsl with the aircraft configured with the landing gear down and flap 15. A single autopilot was engaged, as was the autothrottle. At 2,600 ft amsl the aircraft was instructed by the radar controller to break off the approach, climb to 3,000 ft amsl and turn left onto a heading of 270°. Twelve seconds later the autopilot was disengaged and the autothrottle, which remained engaged, increased engine thrust to 97% N_1. After another six seconds, at 2,250 ft amsl, the aircraft began to climb towards the cleared altitude and started a left turn towards the assigned heading. As the aircraft, which was being manually flown, approached 3,000 ft amsl, it began to descend. Further heading instructions were passed by ATC whilst the aircraft descended, with it reaching a minimum altitude of 1,780 ft, corresponding to 1,565 ft agl, before a climb was re-established. The descent rate peaked at 3,100 ft/min as the aircraft passed 2,160 ft amsl.

The tower controller noted on the radar repeater in the visual control room that the aircraft was descending unexpectedly and contacted the radar controller to advise him. This prompted the radar controller to contact the crew, instructing them to climb to 3,000 ft amsl. This call came just as the crew began to pitch the aircraft back into a climb. During the recovery the aircraft speed reached 286 KIAS[1], whereas the speed the crew had selected was 200 KIAS. As the aircraft passed through 3,000 ft amsl the crew re-engaged the autopilot and the flight path stabilised. The entire event occurred with the aircraft in IMC.

The aircraft was then given a further climb, before being radar vectored for another approach to Runway 34 where it landed without further incident.

Figure 1 shows the aircraft's flightpath during the event.

Footnote

1 Aberdeen Control Zone/Area is Class D airspace, and the speed limit is therefore 250 KIAS below FL100 as described in the UK Aeronautical Publications (AIP) Part 2 – En-Route (ENR), Section 1.4, Paragraph 2.4.

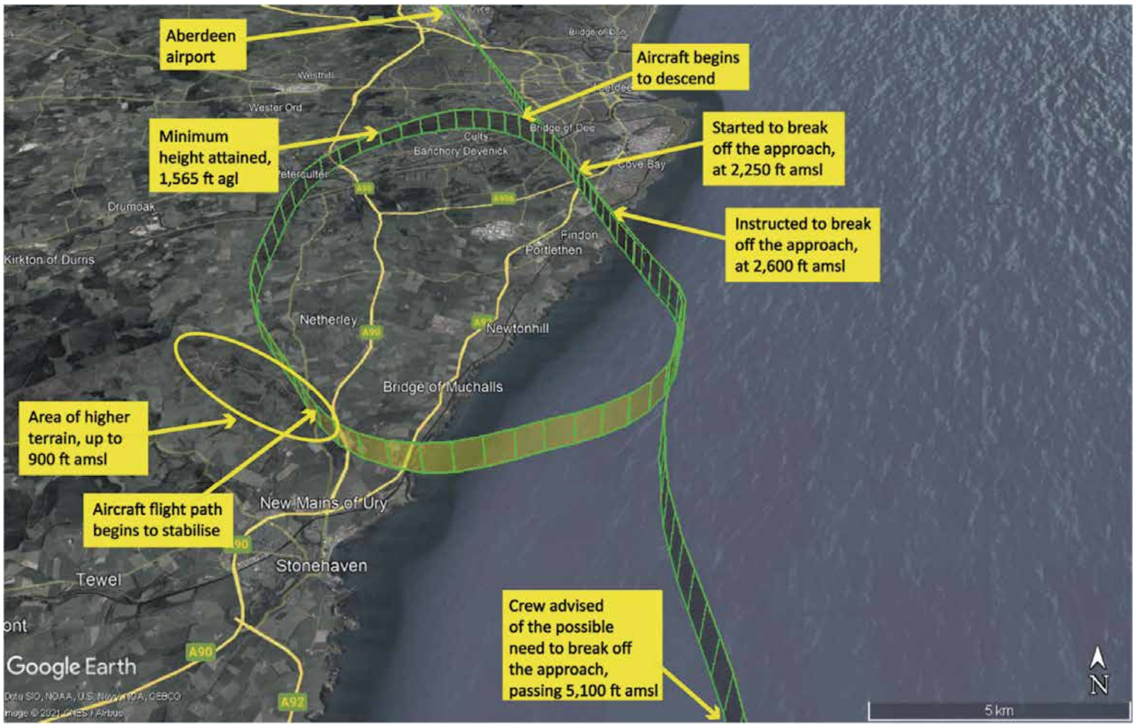

Figure 1

G-FDZF's flightpath into Aberdeen and the unintended descent

Recorded data

The aircraft's Cockpit Voice Recorder had been overwritten because the aircraft remained in service before the AAIB was notified and began an investigation into the event. However, the data from the operator's flight data monitoring (FDM) provider was available, as well as radar and R/T recordings from Aberdeen. Figure 2 shows a summary of the FDM data for the approach and the subsequent unintended descent. The four shaded areas are described below. Each square on the x-axis represents 10 seconds.

Area A shows the flightpath from when the crew responded to the ATC instruction to break off the approach and shows the disconnection of the autopilot, whilst the autothrottle remained engaged. It shows that the thrust increased automatically towards 97% N_1, the landing gear was retracted, and the aircraft's pitch attitude increased. The aircraft climbed and turned left towards a heading of 270°. The data shows a strong correlation between the engine power setting and changes in the pitch of the aircraft, noting that the flap setting did not change, and that no manual pitch trim inputs are recorded in Area A.

Area B shows that as the aircraft, which was being manually flown, approached the selected altitude of 3,000 ft, the autothrottle reduced the engine power setting and the pitch of the aircraft decreased as the flight director began to command the level-off. As the aircraft passed 2,850 ft amsl, the flaps were retracted from flap 15 to flap 5, and after reaching 2,930 ft amsl the aircraft began to descend. G-FDZF then briefly levelled at 2,650 ft amsl and the flaps were further retracted from Flap 5 to Flap 1. Four seconds later, the flaps were fully retracted and G-FDZF again started to descend.

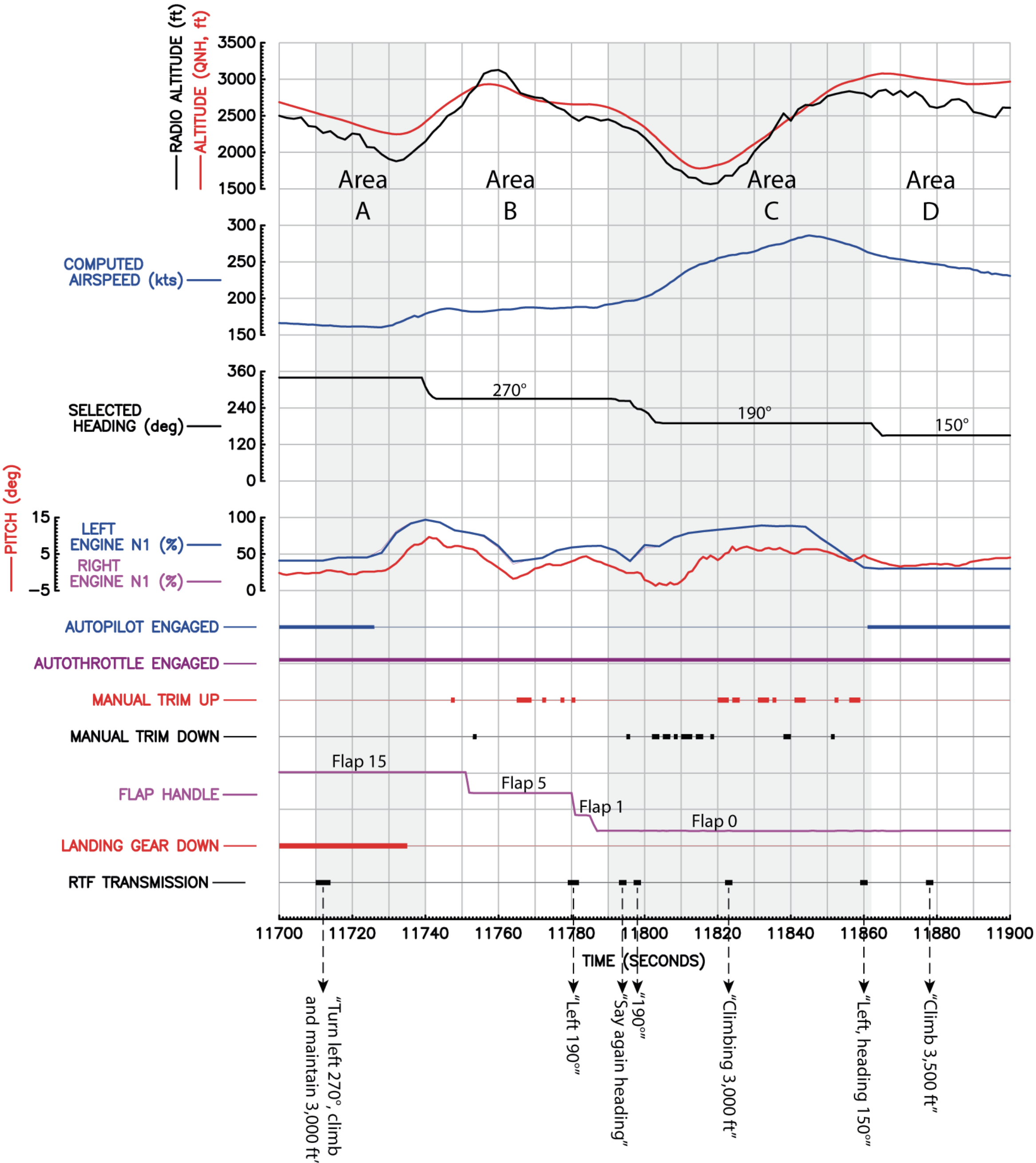

Figure 2

Flight data for the approach and subsequent unintended descent

Area C shows several radio transmissions from the aircraft, as the crew responded to new headings assigned by ATC, and the lowest altitude reached by the aircraft before a climb was re-established. The climb was initiated at about the same time as the crew replied to ATC's instruction to climb, with the peak airspeed of 286 kt recorded in the climb.

Area D shows the autopilot re-engagement and the flight path of the aircraft beginning to stabilise.

The FDM data also showed that the Terrain Awareness and Warning System did not activate during G-FDZF's unintended descent.

Somatogravic illusion

Because aircraft can accelerate and decelerate at much greater rates than our bodies evolved to detect, our perception of an aircraft attitude can be erroneous. If an aircraft rapidly accelerates it can, especially in the absence of visual cues, create a false sensation of being in an increasingly nose-up attitude. If the pilot reacts by pushing on the controls to reduce the pitch of the aircraft, it can lead to a descent, which, if the aircraft is close to the ground, can be extremely dangerous. A deceleration can give the sense of a nose-down attitude change. This is known as the somatogravic illusion. There are many examples of pilots being affected by this illusion including during takeoffs and go-arounds where the aircraft's pitch and speed are changing rapidly, especially if external visual references are limited such as at night or in IMC.[2]

In this event, the rapid acceleration in IMC on application of full go-around thrust may have been perceived by the flight crew as the aircraft abruptly pitching up. Therefore, the FDM data was analysed to see if the control column force sensors, which sense the magnitude and direction of the force applied to either control column, recorded any nose-down inputs during this phase of the flight (Area A of Figure 2).

This analysis showed that nose-down, or push, forces were recorded by the control column sensors but that these forces did not adversely affect G-FDZF's climb during the initial part of the go-around. Because a substantial amount of thrust had been applied in the preceding seconds and there were no manual pitch trim inputs, these forces most likely indicate that the aircraft was out of trim.

As G-FDZF accelerated during the unintended descent (Area C of Figure 2), the FDM data was also analysed for this region. This showed that no abnormal nose-down forces were recorded.

Aircraft information

Autopilot and flight director

The automatic flight control system consists of the AFDS and the autothrottle. The AFDS and the autothrottle are controlled through the Mode Control Panel and the flight management computer. The AFDS and autothrottle status are displayed to both pilots through Flight Mode Annunciators at the top of the primary flight displays.

Footnote

2 Recent examples in large commercial aircraft and helicopters include:
Accident to B767-300 N1217A, 2019 https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR2002.pdf [accessed August 2022].
Accident to B737-800 A6-FDN, 2016 https://mak-iac.org/upload/iblock/3d1/report_a6-fdn_eng.pdf [accessed August 2022].
Accident to AW139 G-LBAL, 2014 https://assets.publishing.service.gov.uk/ [accessed August 2022]. media/56162ac0e5274a625100000f/Agusta_Westland_AW139_G-LBAL_10-15.pdf [accessed August 2022].

The flight director displays command bars on the primary flight display as long as a pitch and/or roll mode is selected on the AFDS. The relevant bar will not appear if no mode is engaged. The flight director can be operated with or without the autopilot and autothrottle.

B737-800 Go-around mode

The Boeing 737-800 is a dual autopilot, Category 3 approach capable aircraft. Normal procedures, as outlined by the manufacturer, require the use of a single autopilot on an ILS approach unless the intention is to conduct a CAT II or III approach and landing. Automatic go-arounds are only available from a dual autopilot approach. The AFDS go-around mode is engaged by pressing the Takeoff/Go-around (TO/GA) switches. Pressing either of the switches when the engagement criteria are met will disconnect the single autopilot (if connected) and place the flight directors in go-around mode. The aut othrottle (if engaged) will move to go-around thrust, and the flight directors will then command 15º nose-up pitch. Below 2,000 ft radio altitude, one press of a TO/GA switch will cause the autothrottle (if engaged) to advance to a power setting for a climb rate between 1,000 and 2,000 ft/min. With two presses of a switch, the autothrottle (if engaged) will advance to the full go-around N_1 limit. Above 2,000 ft radio altitude, one press of a TO/GA switch commands thrust to the full go-around N_1 limit.

The commander recalls pressing the switches only once when commencing the go-around, and at this point the aircraft was above 2,000 ft radio altitude. At the time of this serious incident the Flight Crew Operating Manual described autothrottle behaviour following one or two presses of the TO/GA switch below 2,000 ft radio altitude but did not describe the different behaviour above 2,000 ft. The single press leading to the movement of the thrust to the full go-around limit was unexpected by the crew.

Autopilot altitude modes

The AFDS can capture and hold a pre-selected altitude. These modes are altitude acquire (ALT ACQ) and altitude hold (ALT HOLD). When the AFDS is engaged in TO/GA mode, the pitch mode will change to ALT ACQ when approaching the altitude selected on the mode control panel. ALT HOLD commands pitch to hold the selected altitude. Successful engagement of ALT HOLD requires the altitude difference between the selected altitude and the aircraft's actual altitude to be less than 60 ft and the aircraft's rate of climb to be less than 5 ft/s, or 300 ft/min. As G-FDZF climbed towards the selected altitude of 3,000 ft, ALT ACQ mode was entered automatically. The aircraft reached a maximum altitude of 2,930 ft amsl and, although the rate of climb was less than 300 ft/min, the aircraft did not come within 60 ft of the selected altitude for ALT HOLD to engage. The AFDS therefore remained in ALT ACQ as the aircraft began to descend away from the selected altitude.

Simulator trial

During the investigation the AAIB used a Boeing 737-800 simulator to examine the characteristics of the aircraft in conditions like that experienced by the crew of G-FDZF.

The Boeing 737 family has underslung engines and is therefore susceptible to a pitch/ power couple. If power is increased, the tendency of the aircraft is to pitch up, and it tends to pitch down when power is reduced. This pitch/power couple is strong, especially with large changes in power at slower speeds. Selecting TO/GA for a go-around at approach speed requires the pilot to apply a forward force on the control column until the aircraft is trimmed in order to fly the aircraft at the required pitch for the go-around. Once the aircraft is trimmed for the go-around, further adjustment is then required as power is reduced from Go-Around thrust for the level-off at the selected altitude.

Changing the lift profile of the wings by altering the flap setting also requires a change in the trim of the aircraft to maintain the selected pitch attitude. Retracting the flaps causes a pitch down, which is most acute when the flaps move from Flap 5 to Flap 1 and from Flap 1 to Flap up.

Both these requirements are common to many other aircraft types and are very familiar to crews that operate the Boeing 737. They are well practised, generally presenting no issues to crews when manually flying the aircraft.

Aircraft performance

The press of the TO/GA switches is not recorded on FDM data, but the associated disconnection of the single engaged autopilot, which occurs momentarily afterwards, is recorded. In the data from G-FDZF this coincided with the autothrottle mode changing to N_1, which indicates that the thrust was being commanded towards the full Go-Around thrust limit. Had the autothrottle been commanding the reduced thrust for the 1,000 – 2,000 ft/min rate of climb, the mode would have been Go-Around.

Meteorology

Low pressure was centred to the northeast of the UK, with a cold front running across the far north of, and turning down the east coast of, Scotland. There were thick layers of cloud across northeast Scotland associated with the frontal system. There was some convective activity along the North Sea coast to the east of Aberdeen.

The crew reported that throughout the arrival, initial approach and go-around they were in IMC.

Airfield ATC information

Aberdeen has three runways and the main runway, which is orientated 160°/340°, is used for fixed wing movements. The airport has intensive large helicopter activity associated with the North Sea oil and gas industry.

During the period of COVID 19, the airport movements were not significantly reduced due to the ongoing support for the oil and gas industry. For some parts of the period, Aberdeen was the busiest airport within the UK by movement numbers. This meant that the ATC staff at Aberdeen were working with a more usual workload than many other controllers around the country and had no significant periods away from work due to the pandemic.

Aberdeen has its own approach radar control station, which is situated at the airport together with the visual control tower. The approach controller is responsible for positioning the aircraft onto the final approach and the aircraft is then handed over to the tower controller. The approach controller and tower controller communicate with regards to movements and sequencing. In the case of G-FDZF, the tower controller was aware of the possibility that a search and rescue helicopter would require priority. The tower controller notified the approach controller who informed the crew that there was a possibility that they would be broken off the approach as a result. The tower controller also has a screen which displays the approach radar picture and information.

Approach controller

The approach controller instructed the pilots to break off the approach when the aircraft was just below 3,000 ft amsl, which was the go-around altitude. The controller considered that it was reasonable for the crew to complete a turn to the left and climb back to 3,000 ft amsl. The intention was to reposition the aircraft for a further approach with the minimum of delay. The controller felt that, had the aircraft been significantly lower, it would have been more appropriate to instruct the crew to conduct a standard missed approach, which was to continue straight ahead, climbing to 3,000 ft amsl.

The approach controller, having instructed the crew of G-FDZF to break off the approach and having seen the aircraft Mode C return approach 3,000 ft, was engaged with two recent departures that required some action and did not detect the subsequent descent. The tower controller noted that the aircraft began to descend and contacted the approach controller. The approach controller then instructed the crew of G-FDZF to climb to 3,000 ft amsl. This call coincided with the aircraft beginning to climb again from its minimum altitude.

ATC safety nets

Aberdeen radar data processor is equipped with 'safety nets', which are not required by regulation but are functions intended to increase safety, and two of these are related to terrain clearance. Neither alert activated for G-FDZF. The first is a decent rate monitor, introduced after a fatal North Sea helicopter accident, that alerts the controller when an aircraft has a rate of descent of 2,500 ft/min or greater when below 3,000 ft amsl in controlled airspace. The second is a minimum safe altitude warning that provides an alert if the aircraft descends, or is predicted to descend, below a height of 500 ft above the terrain model, which represents terrain and obstacles. This warning has two levels of alert, with a stage 1 alert if the aircraft is predicted to breach 500 ft within 23 seconds, and a stage 2 alert if a breach is predicted within 15 seconds. An exclusion area exists around the extended centreline of the main runway to prevent an alert being generated by every aircraft on approach, although G-FDZF was outside this area as it reached the point of minimum altitude.

The FDM data from G-FDZF indicated that the aircraft had a descent rate of more than 2,500 ft/min for approximately nine seconds, which should have triggered the descent rate monitor alert. However, because the radar data processor rounds successive aircraft altitude responses to the nearest 100 ft and radar responses occur some six seconds apart, it is likely that the derived vertical speed did not exceed the alerting threshold due to the lack of granularity in the processed data.

Regarding the minimum safe altitude warning, although the aircraft descended to 1,800 ft amsl, the terrain at that point was 250 ft amsl, and the aircraft did not reach the point of being within 23 seconds of breaching 750 ft amsl, which would have been required to trigger a stage 1 minimum safe altitude alert.

National guidance

The CAA produces guidance for the provision of air traffic services in the form of CAP 493[3], *The Manual of Air Traffic Services Part 1,* (MATS Part 1). The manual describes when controllers should instruct an aircraft to perform a missed approach and states that:

> *Missed approach instructions shall include the level to which the aircraft is to climb and, if necessary, heading instructions to keep the aircraft within the missed approach area.*

In the case of Aberdeen there was no requirement to issue a heading as the standard missed approach, which takes aircraft straight ahead on runway heading, would have kept the aircraft within the missed approach area.

Local guidance

Each ATC unit produces a MATS Part 2 specific to that particular unit. The MATS Part 2 for Aberdeen at the time of the incident did not specify that the controllers should instruct the crew to conduct a standard missed approach, nor did it give any guidance to the controller regarding the possible high workload of the pilots.

ATC Investigation

Aberdeen ATC investigated the incident which included confirming that their radar data processor terrain alerts were functioning as designed. As a result of this investigation, they made some changes, through a supplementary instruction to MATS Part 2, which included introducing a procedure for aircraft being broken off an approach within the Final Approach Fix to only be instructed to conduct a standard missed approach (unless there are over-riding safety considerations, or the crew have already been issued with alternative instructions). Headings may be allocated once the aircraft is level at the missed approach altitude.

Aircraft crew

Crew recency

The crew of G-FDZF differed in their recency levels but both had experienced significant periods without flying in the preceding 18 months. The commander had flown 10 flights during the previous month. For the co-pilot, this was only his fourth flight in nearly 11 months, having completed two training flights seven days before the day of this incident. Both pilots had completed numerous simulator sessions during the 18-month period to gain or retain recency or to complete their annual recurrent check.

Footnote

[3] CAA MATS Part1 https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=11137 [accessed August 2022].

Airlines faced significant challenges to keep crews current in the two years leading up to this event. Whilst there are legal requirements for crews to complete three takeoffs and landings within 90 days, there are no regulatory requirements laid out for crews to have operated the aircraft, especially on commercial flights. Operators had to adapt and develop their own programmes to ensure that crews were prepared and competent to fly, often after significant periods away from the aircraft.

Simulators were used not just for the takeoff and landing requirements but also to try and maintain crew skill levels when operating in both normal and emergency situations. The challenge was, and is, to try and represent the real world of flying in a simulated environment. It can be difficult to replicate moments of high crew workload caused by the effects of ATC instructions and background communications, the presence of other aircraft in the area, poor weather and other operational pressures. The safety benefits of simulator training are well established. However, the real-world environment creates different demands on crews, and it is possible that this event illustrates that lack of recent exposure to the real-world environment can erode crews' capacity to deal effectively with those challenges. Regulators were concerned that pilots returning to the flight deck following extended periods without flying could be at risk of performing below their normal standard during their first few flights.

Missed approaches in large commercial air transport

Data provided from UK airports suggested that the overall go-around rate for commercial operations pre-pandemic was in the region of three per 1,000 arrivals. This figure illustrates that go-arounds are a relatively rare event for a pilot as well as for the ATC controller. A pilot flying for the operator of G-FDZF might have completed 250 flights per year at pre-covid levels and therefore might have expected to perform a go-around in flight once a year. With the decrease in flying during the pandemic, many pilots may have not encountered a go-around in flight for several years.

Whilst operators, including that of G-FDZF, regularly practise go-arounds in the simulator, these are most regularly for licence qualification and are therefore often flown from a single engine approach or for qualification of the crews for low visibility operations. In low visibility operations both autopilots would be engaged and an autopilot-coupled go-around would generally be available. The operator had a program to ensure that the crews practised two engine go-arounds in the simulator, but these go-arounds were often performed from close to minimum descent altitude and not from an altitude close to the missed approach altitude.

The AAIB has investigated other go-around incidents which have similarities to G-FDZF[4], and the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) recently published a report into a similar incident at Paris Orly Airport[5].

Footnote

4 Report into the serious incidents involving G-THOF, https://www.gov.uk/aaib-reports/aar-3-2009-boeing-737-3q8-g-thof-23-september-2007 [accessed November 2021],
and I-NEOT, https://www.gov.uk/aaib-reports/aaib-investigation-to-boeing-737-86n-i-neot [accessed November 2021].

5 https://www.bea.aero/en/investigation-reports/notified-events/detail/serious-incident-to-the-boeing-737-registered-7t-vjm-operated-by-air-algerie-on-06-12-2019-at-paris-orly/ [accessed November 2021].

Analysis

The aircraft descended from close to 3,000 ft amsl for 57 seconds before a climb was re-established, and this represented a significant deviation from the crew's expected flightpath. The rate of descent peaked at 3,100 ft/min before the aircraft began to climb having descended to 1,565 ft agl, significantly reducing the aircraft's separation from terrain. During the descent and subsequent recovery, there was an uncommanded and undesirable increase in airspeed to 286 kt that was not corrected in a timely manner.

Having pressed the TO/GA switches once for the go-around, the crew expected the engaged autothrottle to select power for a climb rate of between 1,000 – 2,000 ft/min. However, the aircraft was above 2,000 ft radio altitude and as a result, unexpected by the crew, the power advanced towards the full Go-Around N_1. With the underslung engines, and at an approach speed for the flap selected, this large increase in power meant that the aircraft pitched up significantly and climbed towards the selected altitude of 3,000 ft amsl very rapidly. The autothrottle remained engaged, and as the aircraft approached the level-off it reduced the thrust towards that required to maintain the selected speed in level flight. The reduction in thrust caused the aircraft pitch attitude to reduce, and this was exacerbated by trim changes due to the retraction of the flaps from Flap 15 to Flap 5. The aircraft then began a descent, and since it had not reached the criteria for ALT HOLD, the AFDS remained in ALT ACQ. The retraction of the flaps from Flap 5 to Flap 1, and then from Flap 1 to Flap up during the descent also further decreased the pitch attitude. As the aircraft was descending, the speed increased despite the selected speed remaining at 200 kt.

The crew were assigned several heading changes both before and during the aircraft descent. These instructions placed an additional burden on a crew that was already working hard. The heading instructions had to be acknowledged and actioned by the co-pilot, which could have distracted him from his monitoring tasks. The commander, who was manually flying, had to manoeuvre the aircraft in roll during a very dynamic period in pitch control.

Although the crew seemed unaware of the descent for a significant period, there remained further barriers to a continued descent that might have alerted them to the situation. These were the aircraft's Terrain Avoidance and Warning System and the ATC radar system alerts. In this instance, the ATC radar system alert that was supposed to warn of an aircraft with a rapid rate of descent failed to recognise that G-FDZF'S descent rate exceeded 2,500 ft/min for a total of approximately nine seconds. This barrier, therefore, did not function as expected. However, the crew became aware of the descent and began to correct it at the same time as the tower controller noticed their descent on the radar repeater in the tower - both the crew and ATC therefore acted to correct the flight path as soon as it was noticed.

The investigation looked at the possibility that the crew were affected by a somatogravic illusion as the aircraft accelerated, but although this could not be completely dismissed, an analysis of the FDM data showed it was unlikely. Any nose-down force on the controls during the initial part of the go-around was most likely due to the aircraft being out of trim, with the large increase in thrust causing a pitch up that the commander countered by pushing forward on the control column. There were no abnormal nose-down forces on the controls during the subsequent acceleration during the descent.

The COVID 19 pandemic led to most pilots flying significantly less than normal. This presented challenges to operators and crews in remaining current and maintaining skill levels to levels equivalent to when the flying intensity was greater. These same challenges applied also to those providing a service to the aircraft, such as ATC. The operator of G-FDZF had a plan for both aspects of the lack of flying. The simulator program was designed not just to maintain crews' legal currency requirements, but also to allow them to maintain their skills in both the normal and emergency phases of flight. Whilst simulators provide an excellent environment for practising operations, they do have some limitations in reflecting real-world experience.

Two engine go-arounds in day-to-day flight operations are rare. With a go-around rate around three per 1,000 flights in the UK, the average crew from the operator might have expected to experience one a year when flying at the pre-pandemic rate. Regular practise in the simulator is usually conducted from the approach minimums for regulatory compliance, either single engine or with an autopilot-coupled go-around available. Go-arounds from higher altitudes on the approach are less regularly practised. It is unlikely that either crew member had conducted a go-around in the aircraft in the previous two years.

Whilst the go-around should have presented little problem to the experienced crew, the combination of less than average flying in the recent period (and very little flying in the case of the co-pilot), the unexpected large increase in thrust and the changes in heading given by ATC probably combined to overload the crew. Subsequently, they were unable to retain their situation awareness. The changes in thrust generated corresponding changes in the pitch of the aircraft, which together with the pitch changes generated as the crew changed the flap configuration were not dealt with through manually trimming the aircraft. The pitch of the aircraft was not managed effectively by the commander and the aircraft began to descend.

Conclusion

The crew of G-FDZF were instructed to go-around by ATC. After initially climbing towards the miss approach altitude, the aircraft began to descend. The descent continued for 57 seconds reaching a minimum of 1,565 ft agl before the aircraft was recovered to a climb. A combination of an unexpected large increase in thrust when the go-around was initiated, instructions from ATC to fly a heading, a lack of manual pitch trimming, and the changes in the flap configuration, caused the crew to become overloaded, allowing the aircraft to descend unnoticed for a significant period. Both pilots had experienced significant periods away from flying the aircraft type during the pandemic.

Safety actions

The aircraft operator completed an investigation into the serious incident, and took the following safety action:

> An extensive review of pilot recency related safety events was conducted, and additional company restrictions were introduced to safely manage pilots through a period of reduced flying.

Pilots of the Boeing 737 were informed that above 2,000 ft radio altitude a push of the TO/GA switches will provide full go-around thrust.

The operator's non-Boeing 737 pilot community was notified of the incident.

Go-around training would be included in the next recurrent simulator cycle to address the issues raised in this serious incident. The training objectives would be to increase the knowledge of the AFDS system in GA mode, increase exposure to two engine go-around events to reduce possible startle effects, and to encourage the use of appropriate pilot competences including threat and error management. The package would include a total of at least six go-around scenarios to be flown by the crew, including one above 2,000 ft radio altitude so crews would experience the thrust increasing to full go-around thrust.

Details of the serious incident were shared with other operators through the CAA Flight Operations Liaison Group.

Aberdeen ATC conducted an investigation into the serious incident and subsequently took the following safety action:

Changes were introduced through a supplementary instruction to MATS Part 2, which included introducing a procedure for aircraft being broken off an approach within the Final Approach Fix to only be instructed to conduct a standard missed approach (unless there are over-riding safety considerations, or the crew have already been issued with alternative instructions). Headings would only be allocated once the aircraft is level at the missed approach altitude.

The aircraft manufacturer took safety action in relation to the aircraft Flight Crew Operations Manual:

Clarification was introduced relating to the first push of the TO/GA switches at or above 2,000 ft radio altitude, with the Flight Crew Operations Manual amended to read:

> *'If pushed at or above 2,000 ft RA (or below 15,500 ft if both RA's have failed) with glideslope engaged or the flaps down:* [autothrottle] *(if armed) engages in N1 mode and advances thrust towards the full go-around limit. The* [autothrottle] *Engaged Mode annunciation on the FMA indicates N1.'*

Published: 18 August 2022.