How pilots handle an in-flight engine shutdown

thepointsguy.co.uk/news/pilots-handle-in-flight-engine-shutdown/

by Charlie Page

News

For most passengers, the idea of losing an engine mid-flight is as bad as it gets. You're 43,000 feet above the ocean, it's the middle of the night and you're miles from the nearest airport. For some, they may imagine the pilots fighting with the controls as they struggle to keep the aircraft airborne. However, the reality is quite different.

Last week I wrote about why, in my opinion, two engines are better than four. New generation aircraft such as the Airbus A350 and the Boeing 787 Dreamliner, which I fly, are safer and more reliable than ever. They are more fuel efficient than their four-engine counterparts, so produce fewer carbon emissions. They are also much quieter, reducing the impact felt by those who live close to airports.

However, as reliable as these aircraft are, our role as your pilots is to ensure that, should something untoward happen, we are fully prepared to deal with it. This is especially true when it comes to engine failures.

A highly unlikely event

First, let me make it clear that in nearly 15 years of flying, I have never experienced an engine failure. Most pilots, even over a 40-year career, will never experience one. So, all that I talk about in this article is based purely on theory and practice in the simulator — of which I've had plenty.

Statistically speaking, takeoff and landing are the times when an unplanned situation is most likely to occur. Having sat quiet for the last few hours, the engines are wound up to nearly their maximum operating speed in a matter of seconds. Like an athlete who doesn't warm up properly, they are more prone to injuring themselves. This is why most airliner engines require a five-minute 'warm up' period between starting and setting takeoff power.

Every six months, all pilots must undergo two days of checking and training in a flight simulator. This is to make sure that should a technical problem occur, we are able to deal with it in a safe and timely manner. Part of this is practicing how to deal with engine problems in various stages of flight.

The most critical time for an engine to fail is just as we lift into the air. Therefore, as part of revalidating our Pilot's Licence, we must prove that we can handle this situation safely. An inability to demonstrate this means that we can not fly passengers until such time that this deficiency has been rectified.

Once up in the air and in the cruise, statistically, you are less likely to encounter an engine problem. However, this doesn't mean that we don't expect them. Fail to prepare, prepare to fail.

Engine failure in the cruise

It's the middle of the night and you're flying back to London from New York. It's been a good trip, a successful business meeting and you've managed to catch up with some friends. You had dinner in the lounge at the airport and now you're snuggled under your duvet in your flat bed, dreaming of seeing your kids when you get home.

In the flight deck of the 787 Dreamliner, all is calm. Your two pilots are monitoring the instruments as they sip coffee, chatting about a new sports bar they found in Manhattan, which shows the football *and* the cricket. A rare find in New York. The Canadian coastline is a few hundred miles behind the aircraft, the distance between Keflavik in Iceland and Gander in Canada is now almost the same.

Out of the window, the stars are spectacular. With clears skies and no light pollution, the human eye can see far more stars than you can ever imagine. Then it starts.

First, it's a rumble. Both pilots' eyes immediately dart to the engine instruments. Another rumble. The engine oil pressure seems to be falling on the right-hand engine. The coffee mugs are placed in their holders and the adrenaline starts to course into both pilots' systems.

Then a loud bang which shakes the whole aircraft. It's game time.

As if the bang and shaking of the aircraft wasn't enough to get their attention, the quadruple "whop-whop whop-whop" of the Master Caution System alerts the pilots to a problem. The EICAS (Engine Indicating and Crew Alerting System) display is showing that the right engine has failed.

"I have control", declares the pilot allocated to the flying duties for that flight, the Pilot Flying (PF). The other pilot is the Pilot Monitoring, or PM. The definition of roles is key to a successful outcome when dealing with a non-normal scenario.

At any stage of flight, the number one priority throughout is to make sure that one person is always flying the aircraft, hence the definition of roles. This may sound obvious but it can be all too easy for both (or all, if there are more than two) pilots to get sucked into dealing with the problem. Ever found yourself driving a car on the motorway and your passenger can't work the radio? Did you try and get involved and sort it yourself? There you go.

Whenever something out of the ordinary happens, a good crew will first go to the mnemonic 'FNC'. Fly. Navigate. Communicate.

Fly

With one engine now providing all the power, the aircraft will continue to fly safely but will be unable to maintain its altitude *and* speed. The autopilot will prioritise maintaining the assigned altitude, to the detriment of the airspeed. As the airspeed starts to slowly reduce, the PF must take action to stop it from becoming too slow. With the remaining engine already generating maximum power, the only way to keep the speed up is to descend.

At this stage, the Flight Management Computer will have detected the engine failure scenario and will display the altitude at which the aircraft will be able to keep its airspeed at a safe value. On a heavy aircraft, this could be as low as 18,000 feet.

CRZ ALT in the top left shows the single engine cruise altitude

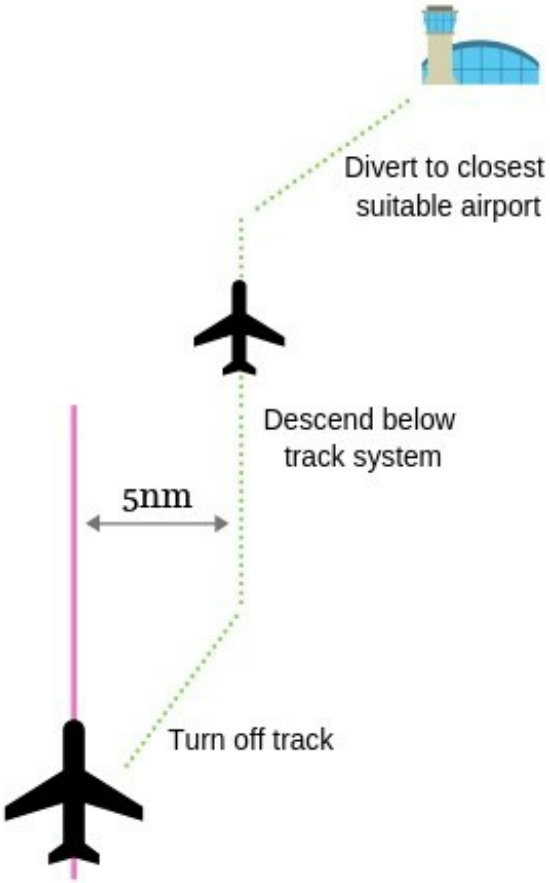
The PF selects this value in the autopilot control panel and tells the aircraft to start descending to this altitude. Normally this will be done at as slow a speed as possible — the aircraft is in effect gliding down to this safe altitude. This doesn't need to be done in a hurry, as it could take a minute or two for the speed to decay back to the minimum speed. It does, however, need to be done correctly. More haste, less speed.

As soon as the slower target speed has been reached, only then will the aircraft start to descend. Once the aircraft is flying safely, the next job is to navigate.

Navigate

Mid-Atlantic in the middle of the night is a far busier place than you may expect. Each night, hundreds of flights make the eastbound crossing from North America to Europe. To ensure a safe and efficient flow of flights across the Pond, aircraft fly a series of tracks called the North Atlantic Track system. For more on this, check out my previous article, Hopping across the pond: How pilots find their way to the USA .

For this system to work, pilots must fly on their track at their designated altitude and speed. However, we've already learned that in the case of an engine failure, aircraft are unable to maintain either of these. With a number of aircraft using the same track, there's a chance that there could be another aircraft directly below — not ideal if the upper one needs to descend in a hurry.



In order to avoid this conflict, before the aircraft starts to descend the pilots must turn the aircraft off their assigned track. As mentioned before, it can take a minute or two for the aircraft to start descending, so pilots have some time to make this turn.

When leaving the track system, aircraft must fly 5 nautical miles either left or right of track. This is at the pilot's discretion. By the time the aircraft is flying the 5 nautical miles offset, it will be starting to descend.

Once these two important actions are complete, the final task is to communicate.

Communicate

With the change of plan, there are a number of people who must be informed. Firstly, the surrounding aircraft need to know. By broadcasting their actions on the emergency frequency (monitored at all times by all aircraft), pilots nearby know that there is an aircraft descending through the track system. Next, ATC have to be informed.

As there is no direct radio link to ATC whilst over the Atlantic, a type of text message must be sent to inform them. CPDLC (Controller Pilot Data Link Communications) is a service that allows ATC and pilots to exchange messages. In an emergency situation, pilots are able to send a quick message to the relevant ATC unit, informing them of their actions.

The Emergency Report CPDLC page.

As part of the task sharing, all communications are performed by the PM, allowing the PF to focus solely on the task of flying the aircraft.

Dealing with the problem

You may have noticed that so far, we have done nothing to actually tend to the failed engine. Flying the aircraft is the priority and it's not until the FNC has been completed that the pilots will look at what's actually going on.

The EICAS is a great system that identifies the problem and suggests the relevant checklist to the pilots. That said, it is up to the pilots to action whichever checklist they deem most appropriate at the time. When there has been a series of loud bangs and vibrations, the chances are that there has been serious damage to the engine and the chances of starting it up again are slim. Therefore, the Severe Damage actions may be more appropriate than the Engine Fail checklist.

Joint study of the engine instruments will not only confirm the damage, but also give a second diagnosis of which engine has suffered the damage. Shutting down the wrong engine is not something that you want to do.

Whilst both pilots will take time to properly diagnose the problem, once again it is the PM who carries out the checklists. Remember, the aircraft is still descending in an area of busy traffic, so the PF must be focused on flying the aircraft at all times.

When the relevant checklists have been completed there's a little time to relax and review what's happened before starting the diversion.

At all stages of flight, a good crew will have a plan up their sleeve should something untoward happen. This will also include the airport to which they'd divert to at the time. As a result, by the time the descent and checklists have been completed, they should already know which airport they want to divert to, what the weather is like and if the runway is long enough to land.

Green rings around diversion options mid-Atlantic. Keflavik in Iceland to the left, Lajes in the Azores to the right and Shannon in Ireland ahead.

Once all this has been completed and the diversion is underway, it's time for a review. A good decision-making process should close the loop by returning to the top and reviewing what has happened and what has been done. Are those decisions still valid? Did we do the correct checklists? Have we missed anything?

A good way of doing this is to do another FNC. Is the aircraft flying the way in which we want it to be flying? Are we navigating towards where we want to go? Have we communicated our plan to everyone who needs to know?

Not quite. The passengers.

You may have been reading all the above wondering at what point we'd let you, the passengers, know what's going on. There's no straight-forward answer to this but I would say that, depending on the severity of the situation, it's one of the lowest priorities for the pilots. Don't get me wrong, if half the aircraft were woken up by the bangs and vibrations, we may try and make a quick announcement earlier on to calm their fears. Once the diversion has been initiated, then we'd get back on the PA with some more information.

The main point being that flying the aircraft is *the* most important priority at all times. So if you're ever on an aircraft where you can tell something isn't quite right, please don't be perturbed that your pilots haven't spoken to you. They will most likely be dealing with the problem and formulating a plan. Once the situation is under control, they will of course then inform you what's going on.

Bottom line

An engine failure at any stage of flight is incredibly unlikely. That said, pilots always expect the unexpected. Losing an engine over the Atlantic adds some complexities but the procedures are well practiced and rehearsed before every crossing. At all stages of the flight, the pilots will know which is the closest usable airfield so should the need arise, an expeditious diversion can be initiated.

Featured photo by CHRISTOPHE ARCHAMBAULT/AFP/Getty Images.

Charlie Page Charlie Page is an airline pilot flying the Boeing 787 Dreamliner. Each Saturday he gives you a 'behind the cockpit door' insight to life in the flight deck.
News and deals straight to your inbox every day.

I would like to subscribe to The Points Guy UK newsletter and special email promotions. The Points Guy UK will not share or sell your email. See PRIVACY POLICY.

- Earn 40,000 Membership Rewards points when you spend £6k in your first 3 months of Card Membership
- Up to 99 free Supplementary Cards - one complimentary Platinum Employee Cards and 98 Complimentary Gold Employee Cards
- Global Lounge Collection - Access to more than 1,200 airport lounges across 130 countries, including The Centurion® Lounges and membership of Priority Pass™
- Hotel Status at Hilton, Marriott Bonvoy™, Meliá Hotels International, Radisson Hotel Group, Shangri-La Hotels & Resorts – enjoy benefits such as complimentary upgrades, early check-in and late check-out, enhanced loyalty points, complimentary Wi-Fi and more
- The Times and The Sunday Times annual digital subscription (£312 value per Card) – available for Primary and all Supplementary Cardmembers
- Fine Hotels and Resorts – Enjoy a collection of over 1,000 hand-selected iconic 5-star properties worldwide. Receive complimentary benefits worth an average total value of £400 per stay.*
- £150 statement credit for every booking with onefinestay (unlimited use)
- Dedicated Account Management Team

Annual Fee

£595

Terms and restrictions apply. See rates & fees.