

Serious Incident

Aircraft Type and Registration:	Boeing 787-8, G-TUIB	
No & Type of Engines:	2 General Electric Co GEnx-1B64/P2G01 turbofan engines	
Year of Manufacture:	2012 (Serial no: 34423)	
Date & Time (UTC):	21 December 2023 at 0830 hrs	
Location:	Birmingham Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 10	Passengers - 291
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	62 years	
Commander's Flying Experience:	23,499 hours (of which 2,964 were on type) Last 90 days - 105 hours Last 28 days - 61 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

G-TUIB had crossed the Atlantic and was holding to make an approach into Manchester Airport (MAN), on a day of significant weather disruption owing to the high wind conditions that were forecast to affect the northern half of the UK. The commander then elected to divert to the nominated alternate of East Midlands Airport (EMA) but was denied because of capacity constraints at EMA and instead diverted to Birmingham Airport (BHX). On final approach to BHX, the aircraft encountered windshear and carried out a missed approach. A fuel emergency was declared and the aircraft subsequently landed below final reserve fuel after its second approach.

Safety action in relation to diversions and aircraft emergencies has been implemented by both EMA and BHX following their own internal investigations. The actions taken addressed the process for determining and communicating airport capacity for diversions, and prioritisation for aircraft that have declared an emergency.

History of the flight

G-TUIB was operating an overnight flight from Cancun, Mexico, to Manchester Airport (MAN), United Kingdom where it had a scheduled arrival time of 0735 hrs. During the planning stage the crew reviewed the weather and loaded additional fuel to account for strong winds forecast at MAN. The aircraft was not at maximum weight and the crew elected to load an additional 984 kg of fuel.

Flight planning

The weather information provided to the crew before the flight included TAFs and METARs for relevant airports. The amended TAF for MAN was timed at 1758 hrs on 20 December 2023 which covered the period of the expected arrival for the aircraft. The forecast showed low cloud with light to moderate precipitation with westerly winds of 25 kt gusting to 42 kt, but with clouds clearing between 0800 hrs and 1100 hrs.

'EGCC 201758Z 2018/2124 27018G28KT 9999 SCT020 PROB40 TEMPO 2018/2023 8000 RA BKN009 BECMG 2023/2101 BKN012 TEMPO 2023/2109 6000 RA -RADZ PROB30 TEMPO 2101/2107 BKN006 BECMG 2103/2106 28025G42KT BECMG 2108/2111 FEW020 PROB30 TEMPO 2109/2122 7000 SHRA BECMG 2116/2119 30020G32KT'

The TAFs for EMA (EGNX) and for BHX (EGBB) for the same period indicated similar weather conditions.

'EGNX 201654Z 2018/2118 26015KT 9999 SCT030 TEMPO 2018/2110 BKN012 TEMPO 2018/2024 27018G28KT 6000 -RADZ BECMG 2100/2103 26020G30KT PROB40 TEMPO 2100/2110 6000 -RADZ PROB30 TEMPO 2108/2118 29030G40KT'

'EGBB 201654Z 2018/2118 27012KT 9999 SCT030 TEMPO 2018/2021 6000 -RADZ BKN012 PROB30 TEMPO 2018/2024 29015G25KT PROB30 TEMPO 2021/2024 BKN012 BECMG 2100/2103 27015G28KT TEMPO 2100/2110 BKN012 PROB40 TEMPO 2100/2110 6000 -RADZ PROB30 TEMPO 2108/2118 29028G38KT'

The crew interpreted that there would likely be strong winds on arrival, but mistakenly believed these would dissipate after 0600 hrs. They decided to add some discretionary fuel sufficient to be able to carry out a missed approach and still protect diversion fuel, to account for potential disruption on arrival at MAN due to the strong winds.

The Operational Flight Plan (OFP) stated the final reserve fuel was 1,911 kg and listed EMA as its nominated destination alternate. The minimum diversion fuel to divert to EMA was calculated as 3,217 kg. This included destination alternate fuel and the final reserve fuel. The plan also detailed fuel requirements to divert to other airports. A diversion to BHX required an additional 149 kg. The 984 kg of extra fuel equated to about an additional 15 minutes. As the aircraft was operating below the maximum takeoff and landing weights, significant extra fuel capacity was available to the crew.

MAN has dual runways, left and right, both aligned 05/23. EMA has a single Runway 09/27. BHX has a single Runway 15/33. The Aeronautical Information Publication for BHX includes the following warning:

'Due to runway orientation relative to prevailing winds, pilots should anticipate crosswinds and may experience building induced turbulence and wind shear on aerodrome in strong wind.'

The latter stages of the flight

Once the aircraft reached UK airspace, it descended towards 9,000 ft amsl and pertinent events from this point are shown in Figure 1.

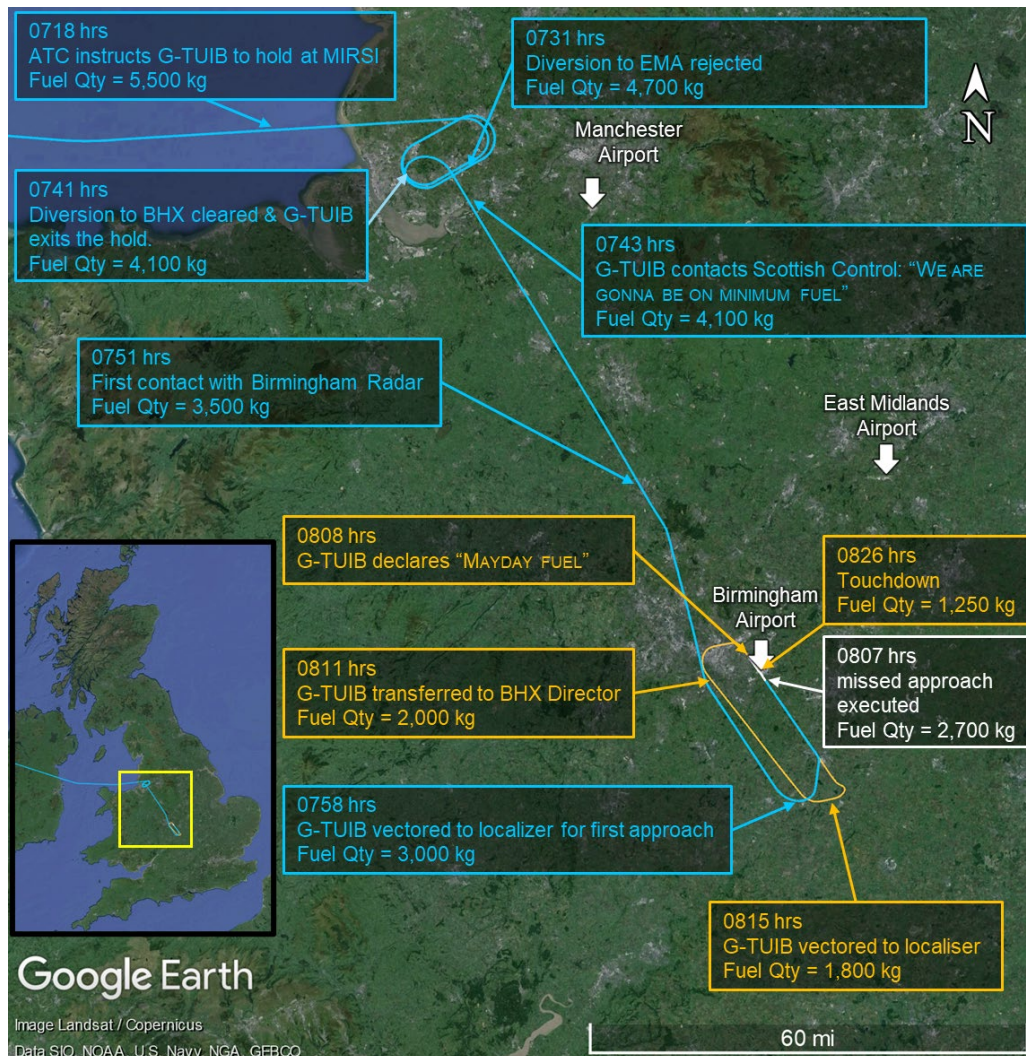


Figure 1

G-TUIB recorded ground track annotated with significant events

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The Pilot Monitoring (PM) contacted Manchester Radar at 0718 hrs. The controller instructed the crew to hold at MIRSI, and that seven aircraft were ahead in the hold. When the crew asked the length of delay they should expect, the controller responded that there was a queue of arrivals awaiting improvements in the wind and that it was not possible to provide an Expected Approach Time (EAT) since the delay was not known. The runway in use was Runway 23R and the controller reported a surface wind of 280° at 28 kt, with gusts up to 41 kt¹.

Footnote

¹ The maximum crosswind limit for the Boeing 787 during landing is 40 kt. However, various factors, including runway condition and runway width, may affect the crosswind limit. Crews are advised that gusts do not need to be taken into consideration for landing.

The METAR issued for MAN at 0720 hrs reported the same wind conditions and stated good visibility but with broken clouds at 1,400 ft agl and overcast at 2,000 ft agl, with temporary fluctuations bringing rain and broken clouds with a base at 900 ft agl.

At 0723 hrs, ATC passed information that the wind was from 280° at 31 kt, with gusts up to 46 kt to a different aircraft. Another aircraft, which executed a missed approach at MAN, informed Manchester Radar that they experienced windshear on approach and indicated that they would soon need to divert to Birmingham. At this time, the PM of G-TUIB informed Manchester Radar that they could hold for “ABOUT 10 MINUTES BEFORE WE NEED TO THINK ABOUT EAST MIDLANDS”.

At 0728 hrs, the PM called East Midlands Radar advising that they may divert to East Midlands Airport (EMA). Three minutes later, the controller responded that they “CANNOT ACCEPT YOUR SIZE AIRCRAFT”. The PM subsequently contacted Birmingham ATC, who confirmed they could accept them. The METAR for BHX at 0720 hrs reported the wind from 290° at 21 kt gusting 36 kt.

At 0737 hrs, the PM asked Manchester Radar for a diversion to BHX. Other aircraft were also requesting diversions. When the controller approved the diversion direct to BHX at 0741 hrs and transferred them to Scottish Control, G-TUIB had been holding for around 20 minutes and had 4,100 kg of fuel remaining. The minimum fuel required for a diversion from MAN to BHX would have been 3,366 kg.

Following first contact with Scottish Control, the PM reported that “WE ARE GONNA BE ON MINIMUM FUEL²”, which the controller acknowledged. During the transit, the INSUFFICIENT FUEL Engine Instrumentation and Crew Alerting System (EICAS) message annunciated; the crew executed the checklist and discussed the consequence of the low fuel situation during the approach brief in case of further delay or a missed approach.

At 0750 hrs, shortly after G-TUIB commenced its diversion, the METAR for BHX stated wind was from 290° at 25 kt with gusts up to 39 kt, and scattered clouds at 2,800 agl. Following transfer to Birmingham Radar, the controller informed the crew that they had 33 nm to run and vectored G-TUIB for an ILS approach to Runway 33 at BHX. The aircraft intercepted the glide path with 2,900 kg of fuel remaining.

At 0805 hrs, with G-TUIB about 3.5 nm from touchdown, Birmingham Tower cleared the aircraft to land and reported the wind was from 300° at 27 kt gusting 37 kt. 1 nm before touchdown, the crew received a windshear warning from the aircraft system at 240 ft agl and, as required under Standard Operating Procedures, the crew commenced a missed approach with 2,700 kg of fuel remaining. During the climb out, on contacting Birmingham Radar, the crew declared “TOM173 REPORTING MAYDAY MAYDAY MAYDAY, TOM173 MAYDAY FUEL”. The Birmingham Radar controller then instructed the aircraft to climb to 4,000 ft altitude and vectored G-TUIB for a further ILS, stating a track of 25 nm. The controller then transferred G-TUIB to Birmingham Director.

Footnote

² The declaration of ‘Minimum Fuel’ informs ATC that, upon reaching the intended destination, any change to the existing clearance may result in arriving with less than the planned final reserve fuel. ‘Minimum Fuel’ is an ICAO recognised term, and that ATC should minimise any delays to the aircraft’s route where practicable.

While G-TUIB was routing downwind for another approach, the EICAS FUEL QTY LOW message annunciated, and the crew executed the checklist. The controller vectored another aircraft, HA-LZY, which was already on frequency, for its approach to land ahead of G-TUIB. G-TUIB landed with 1,250 kg of fuel remaining, below the final reserve fuel of 1,911 kg indicated on the OFP.

Recorded information

The CVR/FDR had been overwritten, because the aircraft had remained in service following the event. However, the operator's Flight Data Monitoring program had data available from the flight.

While G-TUIB declared a fuel emergency on its first contact with Birmingham Radar after being transferred following the missed approach, the MAYDAY prefix was not used on first contact with Birmingham Director or in any subsequent R/T transmission.

The radar traces showed that Birmingham Director controller vectored another aircraft, HA-LZY, for its approach to land ahead of G-TUIB. HA-LZY was not yet established on the localiser for the ILS and flew through the localiser before it became established at 18 nm. This resulted in G-TUIB flying an additional track distance above the original 25 nm stated by ATC. The data showed that from the point of the missed approach to the point of landing, the actual track distance flown was 53 nm, and 1,450 kg of fuel was used. It was estimated from the recorded data that G-TUIB used about 400 kg of fuel to fly this additional track.

Fuel planning requirements

ICAO Annex 6, Part 1, section 4.3.6.3 outlines the fuel required to be carried. This included:

Fuel planning

d) destination alternate fuel, which shall be:

1) where a destination alternate aerodrome is required, the amount of fuel required to enable the aeroplane to:

- i. perform a missed approach at the destination aerodrome;*
- ii. climb to the expected cruising altitude;*
- iii. fly the expected routing;*
- iv. descend to the point where the expected approach is initiated;*
and
- v. conduct the approach and landing at the destination alternate aerodrome;*

e) final reserve fuel, which shall be the amount of fuel calculated using the estimated mass on arrival at the destination alternate aerodrome or the destination aerodrome, when no destination alternate aerodrome is required:

2) for a turbine engine aeroplane, the amount of fuel to fly for 30 minutes at holding speed at 450 m (1 500 ft) above aerodrome elevation in standard conditions;

g) discretionary fuel, which shall be the extra amount of fuel to be carried at the discretion of the pilot-in-command.'

These requirements are captured in AMC1 to Part-CAT.OP.MPA.150(b) Fuel policy.

Part-CAT.OP.MPA.180 *Selection of Aerodromes — Aeroplanes* requires the operator to select at least one destination alternate aerodrome for each instrument flight rules (IFR) flight, except under specific circumstances.

Aircraft emergencies

On declaring an emergency, CAP 413 states:

'8.12 Following the initial distress or urgency message, it is permissible for pilots and controllers to use 'MAYDAY' and 'PAN' as a callsign prefix at their discretion, where it is judged that this would have a beneficial effect on the outcome.'

Fuel emergencies

A Safety Notice³ outlines a 3-stage escalation process (obtaining delay information from ATC, declaring minimum fuel and declaring a fuel emergency) for crews to follow. SN-2019-002 states:

'The term MINIMUM FUEL was introduced by ICAO in 2012 and is used 'to describe a situation in which an aircraft's fuel supply has reached a state where the flight is committed to land at a specific aerodrome and no additional delay can be accepted.'

Recommendations

4.1 Operators and ATS providers should highlight during training that MINIMUM FUEL is not an emergency declaration but a statement of fact. Once ATC has responded with delay information (or distance to touchdown), the pilot will determine whether or not to declare a fuel emergency.'

On fuel shortage, CAP 413 states:

'8.29 A pilot's declaration of "MINIMUM FUEL" indicates that no further fuel diversion options are available where the aircraft is committed to land at the pilot's nominated aerodrome of landing with not less than 'final reserve fuel'. However, "MINIMUM FUEL" RTF phraseology is not universally used by every aircraft operator and pilot. Controllers are not required to provide priority to pilots of aircraft that have declared "MINIMUM FUEL" or that have indicated that they are becoming short of fuel.'

Footnote

³ CAA SN-2019/002 *Protecting Final Reserve Fuel*, version 3 dated 24 March 2023. Available at <https://www.caa.co.uk/our-work/publications/documents/content/sn-2019-002/> [accessed 4 October 2024].

8.30 Controllers shall respond to a pilot's declaration of "MINIMUM FUEL" by:

1. confirming the estimated delay they can expect to receive expressed in minutes if the pilot is en-route to, is joining, or is established in an airborne hold; or

2. by expressing the remaining track mileage from touchdown if the aircraft is being vectored to an approach.

8.31 Controllers shall respond to a pilot who has indicated that they are becoming short of fuel but has not declared "MINIMUM FUEL", as above but shall then ask the pilot if they wish to declare an emergency.

8.32 Pilots declaring an emergency should use the following RTF phraseology "MAYDAY, MAYDAY, MAYDAY" or "MAYDAY, MAYDAY, MAYDAY FUEL" and controllers shall provide such aircraft with flight priority category A (ICAO Annex 6).'

East Midlands ATC investigation

An internal investigation by East Midlands ATC established that, prior to G-TUIB's request, Scottish Control had spoken to the East Midlands ATC asking which type of aircraft EMA could accept. At 0720 hrs, The ATC assistant spoke directly with the Airfield Operations unit, which is responsible for the monitoring of handling and movement at aircraft stands. Airfield Operations advised ATC that the airport could only accept two Boeing 737-800 or equivalent size and anything else would be dependent upon the ground handling agent capacity at the time of the request.

The radar controller received the request to divert from G-TUIB at 0728 hrs. The ATC assistant (ATCA) confirmed, based on the information provided to him by Airfield Operations, that the airport advised they could only accept B737-800 size aircraft, and the controller informed G-TUIB accordingly at 0731 hrs. Subsequently, at 0736 hrs, the ATCA spoke with the airport Centre Control Room (CCR), which is responsible for the allocation of aircraft stands, and established that the airport could accept a Boeing 787. This was then passed to the radar controller who then sought to contact G-TUIB at 0740 hrs but received no response.

An investigation by East Midlands ATC determined that the channels used to establish what the airport could accept had not resulted in a clear and effective understanding.

Following this event,

East Midlands ATC clarified that:

- the airport's Centre Control Room (CCR) was responsible for communicating the type and number of aircraft that the airport can accept to ATC and,
- any requests for additional or larger aircraft were to be passed to the CCR to make a decision.

Birmingham ATC investigation

An internal investigation by Birmingham ATC established that, at the time that the crew declared a MAYDAY, there were multiple aircraft in the approach sequence. An additional controller position (Birmingham Director), sat beside the Radar controller, had been opened due to the complexity and volume of inbound traffic resulting from the adverse weather

The investigation established that the Director controller sequenced HA-LZY ahead of G-TUIB since HA-LZY was already on frequency when G-TUIB made contact. It concluded that the controller was faced with a complex and high workload scenario which resulted in the opportunity to prioritise G-TUIB while repositioning HA-LZY being missed. This resulted in G-TUIB flying an extended track even though it had declared a fuel emergency.

As a result,

Birmingham ATC issued an internal Safety Bulletin which emphasised that when an aircraft has declared an emergency:

- controllers provide an aircraft in an emergency with flight priority category A and ensure that it has an uninterrupted approach to the selected aerodrome and rearrange the traffic pattern if necessary and,
- when it is known that the emergency aircraft is committed to landing at the selected aerodrome, units shall consider the sterilisation of the landing runway.

Analysis

G-TUIB had crossed the Atlantic to make an approach into MAN but diverted to BHX owing to the high wind conditions. The aircraft had previously been denied the option to divert to its nominated airport of EMA. The serious incident was the result of the aircraft declaring a fuel emergency on executing a missed approach in response to windshear on final approach to BHX.

There were strong crosswinds at MAN and, for Runway 23, the wind was 50° off the runway centreline. One aircraft had experienced windshear on the approach while G-TUIB was holding. EMA would have afforded the opportunity to make an approach to Runway 27, substantially more into wind. The approach to Runway 33 at BHX was within crosswind limits for the aircraft but with a wind 40° off the runway centreline. It would have been reasonable to conclude that windshear was a likely threat, in view of what was being experienced at MAN for similar conditions.

Weather Assessment and fuel management

While allowing for the contingencies required by the regulations, operators seek to minimise the carriage of fuel necessary for the flight, owing to the fuel burn penalty from carrying excess fuel. Nevertheless, the crew identified a threat of high winds and the potential for delays on arrival at MAN. Incorrectly believing that the winds would dissipate from 0600 hrs, the commander requested some extra fuel, equivalent to about an additional 15 minutes of fuel. Given the aircraft weights, the crew had the option to load significantly more fuel.

Alternate selection and acceptance

Destination alternate airports are required to be nominated and accounted for in the fuel planning by the regulations. The destination alternate options were listed on the OFP with the additional fuel required above that for the planned alternate and included EMA and BHX. The nomination of an alternate does not guarantee that an aircraft will be accepted except in the case of a declared emergency. Instead, this will be dependent upon the airport's capacity to accept the diversion. On receiving a request for a diversion, ATSU would contact the relevant airport ATC who in turn will speak with the airport's ground agencies to determine stand and ground handling capacity.

EMA identified that the internal communication channels used had not clearly established the capability of the airport to accept an aircraft of the size of G-TUIB, a Boeing 787. This was as a result of ATC speaking directly to the airport Airfield Operations unit instead of the CCR. The consequence of the refusal of East Midlands to accept the requested diversion, meant that G-TUIB made an approach to an airport with significant crosswind and a possibility of windshear on final approach.

Decision-making and emergency handling

On arrival in the Manchester area, the crew ascertained from ATC that there were seven aircraft ahead and it was not possible to be given an EAT. ATC also advised the crew that MAN was also experiencing strong crosswinds and that an aircraft had executed a missed approach owing to windshear. Recognising that continuing to hold would not assure a landing at MAN, the crew made a decision to divert early, thereby helping to protect the extra fuel that remained.

The crew fulfilled the appropriate steps to protect minimum fuel and declared the MINIMUM FUEL on transfer to Scottish Control. Throughout, the relevant ATC agencies and crew had the necessary awareness of the situation.

Following the missed approach at BHX, the crew declared a fuel emergency on Birmingham Radar in accordance with the escalation process for '*Protecting Final Reserve Fuel*.' However, they did not subsequently use the MAYDAY callsign prefix on transfer to Birmingham Director, nor at any stage thereafter, but CAP 413 indicates it is permissible for crews to do so where it is judged that this would have a beneficial effect on the outcome.

Birmingham Director was aware that G-TUIB had declared a fuel emergency, as this had been relayed from the Radar controller, sitting beside him. Consequently, the absence of the use of the callsign prefix by the crew had little material effect with regards to their interactions with ATC. However, it did mean that crews of other aircraft on frequency would have been unaware of G-TUIB's low fuel status.

Extended track following the missed approach

Following the missed approach and declaration of the fuel emergency by the crew, the Birmingham Radar controller advised the crew to expect an estimated track of 25 nm to landing. While the Birmingham Director controller was fully aware of the situation, an

internal investigation determined that the controller was faced with a complex and high workload scenario which resulted in the opportunity to prioritise G-TUIB ahead of HA-LZY being missed. The consequence was that G-TUIB used more fuel than anticipated by flying an extended track even though the crew had declared a fuel emergency. The consequential reduction in fuel remaining had the effect of reducing the options available to achieve a safe landing, if the aircraft had encountered windshear on the second approach.

Conclusion

The serious incident was the result of strong winds generating difficult conditions at the time of the arrival of the flight into the UK. The aircraft had departed Cancun with 15 minutes of additional fuel, although significant extra capacity was available. Having diverted from MAN to BHX the aircraft made a missed approach due to a windshear warning on final approach. This was followed by an extended track flown for a further approach because an opportunity to prioritise G-TUIB for an expeditious landing was missed. Safety action has been taken to clarify the process for determining and communicating airport capacity for diversions, and for the prioritisation of aircraft that have declared an emergency.

Safety action

The following safety actions were taken:

East Midlands ATC clarified that:

- the airport's Centre Control Room (CCR) was responsible for communicating the type and number of aircraft that the airport can accept to ATC and,
- any requests for additional or larger aircraft were to be passed to the CCR to make a decision.

Birmingham ATC issued an internal Safety Bulletin which emphasised that when an aircraft has declared an emergency:

- controllers provide an aircraft in an emergency with flight priority category A and ensure that it has an uninterrupted approach to the selected aerodrome and rearrange the traffic pattern if necessary and,
- when it is known that the emergency aircraft is committed to landing at the selected aerodrome, units shall consider the sterilisation of the landing runway.