



Serious incident

to Dornier 328

registered **HB-AEO** and operated by SkyWork
and to Embraer 190

registered **PH-EXB** and operated by KLM Cityhopper
on 7 March 2016
at Bâle-Mulhouse

⁽¹⁾Except where
otherwise indicated,
the times in this
report are in
Universal Time
Coordinated (UTC).

⁽²⁾Pilot Flying

Time	10:07 ⁽¹⁾
Type of flight	Commercial air transport
Consequences and damage	No damage

Erroneous read-back by a crew not detected by ATC, runway incursion

⁽³⁾Clearance delivery:
The DEL ATC provides
the ATC departure
clearances (QFU, initial
clearances, etc.) after
the engine start-up
request from the
crew. Aircraft are only
transferred from the
DEL to the GND ATC
after engine start-up
and complete and
correct read-back of
the ATC clearance by
the pilot. Ground: The
GND ATC provides
the push-back
clearances. Their
area of responsibility
starts when the
aircraft enters the
manoeuvring area
(taxiway only). S/
he organizes the
taxiing sequence and
prevents collisions
in the manoeuvring
area. Aircraft are
only transferred to
the LOC ATC when
their routing can no
longer cause a taxiing
problem and the ATC's
clearance has been
transmitted to the
crew and read back.

1 - HISTORY OF THE FLIGHTS

Note: the history of the flight is based on the interviews of the pilots, the ATCs, the flight parameters from the parameter recorders (FDR) of the two aeroplanes and the communications with the ATCs. The data of the PH-EXB cockpit voice recorder (CVR) did not contain the event data.

The Dornier 328, registered HB-AEO, call sign SRK51R, was on a commercial air transport flight to Berne (Switzerland).

The Embraer 190, registered PH-EXB, call sign KLM1986, was on a commercial air transport flight to Amsterdam (Holland).

The first officer of flight KLM1986 was the PF⁽²⁾ for this leg. Due to the the nose gear steering control only being installed on the left-hand side, the captain temporarily acted as PF during the taxiing phase.

The DEL/GND⁽³⁾ positions in the control tower are grouped, the ATIS GOLF recorded at 10:07 UTC mentions the following points:

- runway 15 in service;
- runway 15 or 26 for take-offs wind 200°/3 kt;
- visibility 10 km;
- FEW 2,600 ft;
- broken 11,000 ft;
- temperature +06° C;
- dew point -03°C;
- QNH 1004;
- QFE 972.

⁽⁴⁾For a departure towards the North, take-off on runway 33 allows the crews to significantly shorten the departure itineraries. QFU 15 was in use on runway 15/33 on the day of the serious incident, a QFU 33 take-off is therefore a counter-QFU take off.

At 09:50:48, the crew of flight KLM1986 informed the DEL/GND controller that they would soon ask for their departure clearance and asked if runway 33⁽⁴⁾ would be available for the departure, "We will request initial clearance in just a few moments, however is runway 33 available today?" The ATC replied that he did not know yet. The crew announced that they were preparing for take-off on runway 15 and would call the ATC back during the push-back to find out if take-off on runway 33 was possible.

At 09:52:06, the DEL/GND ATC called the crew of flight KLM1986 and provided an initial runway 15 departure clearance.

At 09:52:15, the crew of flight KLM1986 read back the runway 15 departure clearance. The DEL/GND ATC confirmed the read back was correct, asked the crew to call back when they were ready for the push-back and specified that he would know then if departure on runway 33 was possible depending on the traffic.

At 09:57:31, the crew of flight SRK51R asked the DEL/GND ATC for start-up and departure clearance. They were authorised to start engines and a departure clearance on runway 15 was communicated to them.

At 10:00:48, the crew of flight KLM1986 requested start-up. The DEL/GND ATC authorised them to do so and asked them to call back for the push-back.

At 10:01:17, the crew of flight SRK51R requested push-back, which was authorised by the DEL/GND ATC.

At 10:02:10, the crew of a third flight on departure, HB-VPE, requested start-up and departure clearance. They also asked whether they could take off from runway 33. "Ground Bonjour, HOTEL BRAVO VICTOR PAPA ECHO, information FOX TROT, request start up and clearance, looking for 33 if possible!"

At 10:02:40, the DEL/GND ATC authorised the start-up of HB-VPE and announced that he would inform them of the runway available, "... so start up is approved, report taxi and we will see which runway is available."

At 10:02:51, the crew of flight KLM1986 requested push-back. The DEL/GND ATC approved and also informed them that their departure on runway 33 was accepted. He then communicated his new departure clearance to them.

At 10:06:40, the crew of flight SRK51R requested taxiing, "Skyfox 51 ROMEO, request taxi and request shortcut to the left." The DEL/GND ATC accepted the request and had them taxi to runway 15 via the BRAVO taxiway. The crew of flight SRK51R read back this clearance at 10:06:50 (**point 1**)⁽⁵⁾.

At 10:06:56, the crew of flight KLM1986 requested taxiing. The DEL/GND ATC authorised them to taxi to runway 33 and asked if they could take intersection DELTA. The crew of flight KLM1986 accepted intersection DELTA at 10:07:02 (**point 2**).

⁽⁵⁾Points 1 to 11 are shown in Fig. 1 below.

⁽⁶⁾The LOC ATC provides the control service, the information service and the alert service for the runways, the aerodrome traffic patterns and the Basel-Mulhouse CTR. S/he ensures the prevention of collisions between aircraft operating in the manoeuvring area, landing or taking off.

⁽⁷⁾At this point, the crew of flight KLM1986 were still on the frequency with the DEL/GND ATC and therefore could not hear the take-off authorisation issued by the LOC ATC to the crew of flight SRK51R. However, the crew of KLM1986 had previously had several indications that runway 15 was the runway in use.

⁽⁸⁾This ATC call is not a standard one as recommended by ICAO. The standard call is "hold short of holding point DELTA runway 33."

⁽⁹⁾Points N and NE are mandatory reporting points for the VFR circuit located north and north-east of runway 15/33. In order to see an aircraft flying over these points, the ATC is obliged to turn his back to the runway.

⁽¹⁰⁾This ATC call is not a standard one as recommended by ICAO. The standard call is "hold short of holding point QUEBEC runway 33."

At 10:07:08, the crew of flight SRK51R requested departure from intersection GOLF. The intersection was approved and the crew of flight SRK51R was transferred to the Tower frequency (LOC ATC ⁽⁶⁾) at 10:07:19 (**point 3**).

At 10:07:34, the crew of flight HB-VPE requested taxiing. The DEL/GND ATC authorised them to taxi to runway 33 and informed them that he would quickly re-contact them to provide them with their departure clearance.

At 10:07:39, the crew of flight SRK51R contacted the LOC ATC and announced that they were taxiing to the holding point of runway 15 intersection GOLF via BRAVO. They specified that they were ready to take off as soon as they reached the holding point (**point 4**).

At 10:07:46, the LOC ATC authorised the crew of flight SRK51R⁽⁷⁾ to take off from runway 15 via GOLF and communicated to them a wind of 240°/4 kt.

At 10:07:52, the DEL/GND ATC provided flight HB-VPE with their runway 33 departure clearance.

At 10:07:54, the crew of flight SRK51R read back their runway 15 take-off clearance via GOLF.

At 10:08:32, the DEL/GND ATC asked the crew of flight KLM1986 to maintain 33 DELTA and to contact the TOWER (**point 6**), "KLM1986 maintain 33 DELTA, contact tower 118.3 bye bye."⁽⁸⁾ The KLM crew replied, "118.3, bye bye KLM1986."

At 10:08:44, the crew of flight KLM1986 called out they were ready for departure from DELTA, "KLM 1986, hello we are ready for departure DELTA" (**point 7**).

At 10:08:47, the LOC ATC replied, "KLM1986 bonjour, hold short of runway 33 DELTA" (**point 8**).

At 10:08:51, the crew of flight KLM1986 read back, "Line up and wait runway 33 DELTA" (**point 9**), without any response from the ATC.

At 10:08:54, the pilot of a VFR aircraft contacted the LOC ATC, "FOX LIMA MIKE, NOVEMBER ECHO⁽⁹⁾, 2,000 ft." The DEL/GND ATC transferred the crew of flight HB-VPE to the LOC frequency, "HOTEL BRAVO VICTOR PAPA ECHO, maintain 33 QUEBEC⁽¹⁰⁾, contact the Tower 118.3."

At 10:08:58, the LOC ATC asked the pilot of the VFR aircraft to contact him at point NOVEMBER.

At 10:09:02, the crew of flight KLM1986 entered runway 33.

At 10:09:06, the LOC ATC was contacted by the crew of flight HB-VPE ready to take off at the QUEBEC holding point of runway 33.

At 10:09:10, the LOC ATC asked the crew of flight KLM1986 to maintain its position, "KLM1986 maintain position, stop" (**point 10**).

At 10:09:14, the crew of flight SRK51R announced that they had taken off, "We are airborne, we are airborne, don't worry" (**point 11**).

The vertical separation between the two aircraft was 380 ft at the time of crossing.

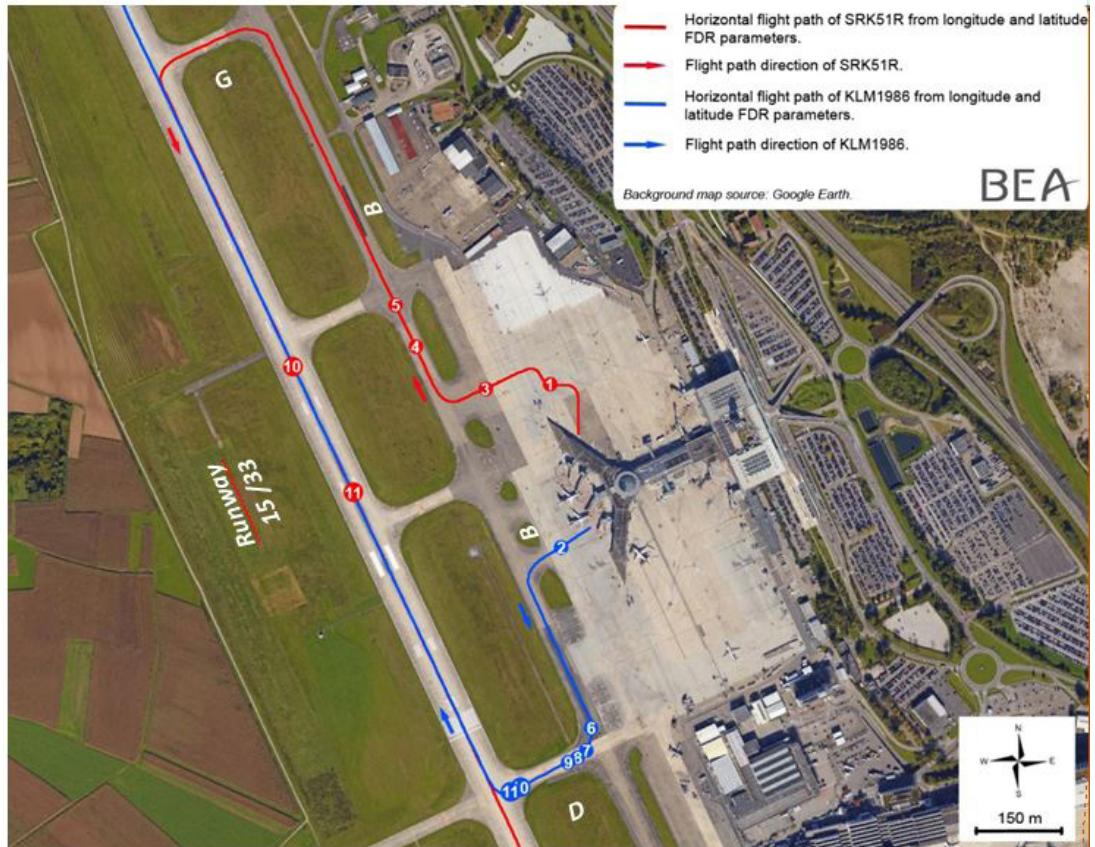


Figure 1: Horizontal flight paths of SRK51R and KLM1986

2 - ADDITIONAL INFORMATION

2.1 Aerodrome information

The Basel-Mulhouse aerodrome is an international airport open to commercial traffic. It has two runways. The runway 15/33⁽¹¹⁾ has nine taxiways.

In accordance with regulatory requirements⁽¹²⁾, stop bars have been installed to protect the runways. These are permanent stop-bars only used during the implementation of LVP procedures⁽¹³⁾. Not individually controllable, except for those located at the runway 15 and 33 thresholds, they all light up to prohibit the use of the nine taxiways and were therefore not used on the day of the serious incident⁽¹⁴⁾.

Due to the length of runway 15/33 and the virtually central position of the commercial terminal, taxiways D, E, F and G in the vicinity of the terminal allow take-offs in both directions with a short taxiing time.

The distance between taxiways G and D is 1,370 meters. Between the two intersections, the runway gradient is not sufficient to conceal an aircraft on the runway (the slope between taxiways D and G is about 0.22% downwards). In certain light conditions, the presence of a forest in the background can make an aircraft difficult to see. However, in the weather conditions of the day of the event (visibility of 10 km), the crew of an aircraft taxiing on one of these two taxiways could see an aircraft located on the other taxiway or already engaged on runway 15/33.

MOUVEMENTS A LA SURFACE
Ground movements

BALE MULHOUSE

ATTENTION PARTICULIÈRE / CAUTION

Points situés sur des TWY.

Etre très attentif aux clairances de traversée, alignement piste et roulage sur TWY. La traversée ou l'alignement piste, ainsi que le roulage sur les TWY ne s'effectuent que sur demande explicite du contrôle. Le collatéralisation de toute instruction est exigé.

HS1 : l'exploitation de l'aire de maintenance Sud-Ouest fait l'objet d'un protocole définissant les conditions de gestion des entrées et sorties de cette aire de maintenance. (voir AD2 LFSB APDC 03).

HS2 : en raison du manque de visibilité, l'utilisation de moyen vidéo rend difficile la surveillance de l'accès et sortie de l'aire d'entretien du Jet-Aviation et Swiss ainsi que l'accès et la sortie de la piste 08/26 via le TWY C1.

HS3 : en raison du manque de visibilité, l'utilisation de moyen vidéo rend difficile la surveillance de l'alignement ou la sortie de la piste 08/26 via les TWY C et J, ainsi que les traversées via ces deux TWY.

Holding points based on TWY.

Particular attention shall be paid to the crossing, lining up and taxiing clearances. For crossing or alignment with RWY as well as taxiing on TWYs, an explicit control clearance must be obtained. Readback is required for any instruction.

HS1 : The use of the West-South area is subject to a protocol that defines the conditions for managing the entries/exit from this maintenance area. (See AD2 LFSB APDC 03).

HS2 : Due to low visibility the use of video equipment makes it difficult to monitor the access and exit from the Jet-Aviation and Swiss maintenance area, as well as the access and exit from RWY 08/26 via TWY C1.

HS3 : Due to low visibility the use of video equipment makes it difficult to monitor the RWY lining up and exit from RWY 08/26 via TWY C and J, as well as the crossing runway via these TWYs.

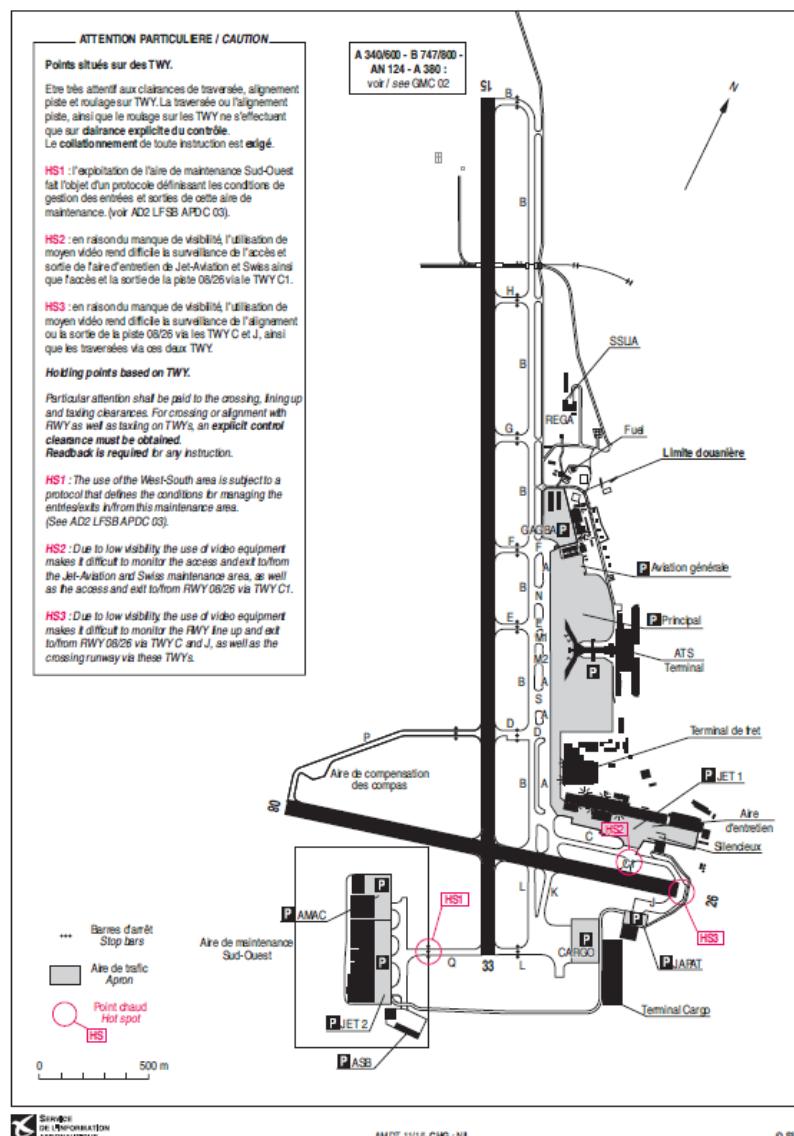


Figure 2: Ground movements chart

2.2 Witness accounts

2.2.1 ATC Instructor in LOC position witness account

The On-Job-Training Instructor (OJTI) had been at the LOC position with a trainee since 09:00 UTC. He considered that the traffic was rather low at the time of the event. Throughout the time-slot, the frequency was held by his trainee.

Just before the incursion, a VFR pilot called them to inform them of his move to the NE point. The instructor said that he turned to locate him visually. When turning his eyes back towards the runway, he found that the trainee had detected the incursion and had intervened on the frequency asking the KLM to stop.

2.2.2 Trainee ATC in LOC position witness account

The trainee ATC had been on duty since 08:00 UTC. He stayed in the LOC position, with another instructor (OJTI), for one hour. He did not particularly remember this time-slot because of the low amount of traffic.

At around 09:00 UTC, he then worked as a team with the second OJTI. He added that he did not feel the need to take a break and did not think fatigue could be a contributing factor in the occurrence of the event.

He could see the SRK51R when he cleared it to take off. The crew's request to take off from the GOLF taxiway did not surprise him because of the short take-off capabilities of this aircraft.

After asking the crew of flight KLM1986 (which he could also see) to hold short of runway 33 DELTA, he turned to the right. He did not remember the reason why he looked away from the runway. It was either to see the VFR aircraft calling at point NE or to coordinate with the tower cab coordinator.

He specified that he noticed the runway incursion when he looked back to the runway and the "*DELTA area*". He then asked the aircraft to stop.

2.2.3 Crew of flight SRK51R witness account

The crew of flight SRK51R said that they became aware of the risk of collision with the KLM1986 when their aircraft was close to V1/VR. They estimated that the horizontal distance between their aircraft and the KLM1986 was then about 300 meters. The V1/VR announcement was made and the first officer who was the pilot flying carried out the rotation normally. They believe that when they flew over the KLM there was at least 10 meters between them.

The crew stated that at no moment had they considered aborting the take-off because it seemed to them that the collision would have been inevitable if they had done so.

The crew added that they felt it was necessary for the ATCs to provide more information to the crews when conducting counter-QFU take-off procedures and, in particular, if a crew is instructed to maintain its position at an intersection from where it must take off counter-QFU.

2.2.4 Crew of flight KLM1986 witness account

The captain was scheduled for a three-day rotation. The flight from Basel-Mulhouse to Amsterdam was the sixth flight of the rotation and the third flight of the second day. He considered the quantity and quality of his sleep during the rotation and the pace of work had not resulted in fatigue likely to have contributed to the event.

The first officer was scheduled for a four-day rotation. The flight from Basel-Mulhouse to Amsterdam was the tenth flight of his programme and the third flight of the third day. The first officer said that he was well rested and fit to fly.

2.3 Flight KLM1986

The crew explained that the first and second legs of 7 March 2016 from Göteborg-Landvetter (Sweden) to Amsterdam and then to Basel-Mulhouse took place normally and the crew landed one minute behind the scheduled time in Basel-Mulhouse. The aeroplane was prepared for the return to Amsterdam in about 35 minutes.

The Captain said that when he was doing the pre-flight inspection of the aeroplane he noticed an aircraft departing from runway 33. He therefore calculated in advance the performance of the aeroplane for a take-off from runway 33 and inserted the data in the FMS. He stated that a departure from runway 33, in the case of a flight to Amsterdam, meant a reduction in flight time, fuel consumption and a greater time margin on the arrival time in order to compensate for an unforeseen delay. The crew stated that most passengers had a connecting flight and that it was therefore crucial to respect the timetable. Should runway 33 not be available, he had also calculated the performance for a take-off from runway 15.

At the time of push-back, the crew was one minute behind the scheduled departure time. During the taxiing, the captain noticed two aircraft that were also travelling in the direction of the threshold of runway 33. He explained that this observation led him to believe that runway 33 was the runway in use at that time.

The crew estimated that the taxiing to holding point DELTA lasted approximately two minutes, which corresponds to the time required to allow the engine temperature to rise. He was therefore ready to take off shortly before arriving at holding point DELTA. The captain added that at that particular moment the first officer transferred a call from the purser advising him that the cabin was ready and a call from the GND ATC asking him to transfer to the LOC ATC.

Neither of the two crew members accurately recalled the sequence of the event, the clearance provided by the LOC ATC or their read back, but explained that they were both convinced at that time that they had received authorisation to line up on runway 33.

The captain stated that he looked towards the threshold of runway 33 to ensure that there were no aircraft on take-off or on short final and then entered the runway. He stated that he did not look to the right as he did not consider it necessary because, according to him, only runway 33 was in use at that particular time.

The crew added that amongst the passengers there were two members of the airline's cabin crew who were not on duty on that flight. The captain had proposed that one of them fly in the cockpit on the jump seat. The crew reported that this practice was frequent as it enhanced mutual understanding between flight crew members and cabin staff. The crew said that the cabin crew member was wearing a headset and spoke during the taxiing phase. Although there was no real discussion between the cabin crew member and the flight crew members, they felt that they were nevertheless distracted by these communications.

2.4 Basel-Mulhouse Air Traffic Services

The air traffic service consists of an IFR room and a tower cab.

⁽¹⁵⁾The Basel-Mulhouse aerodrome operations manual mentions that the IFR room may be closed during the winter period (November to March).

⁽¹⁶⁾The strip is a strip of paper on which the information relating to each flight taken over by the air traffic control is written.

On the day of the event, the IFR room was closed⁽¹⁵⁾. The manning of the control positions of the tower cab complied with the provisions of the operations manual.

The LOCAL (LOC) position was supervised by a trainee ATC and his On-Job-Training Instructor (OJTI). With the exception of the trainee ATC, all the other ATCs had the required qualifications to occupy their positions. The trainee ATC was an experienced controller who was previously qualified to occupy the same position and as OJTI at Nice airport.

The air traffic control service provided by the tower cab ATCs is based on ATC authorisations and instructions communicated to the crews by radio-telephony and on methods of managing a strip board⁽¹⁶⁾.

The Basel-Mulhouse aerodrome has a movement display system that informs the ATC of the ground movements of the traffic (Figure 2). This system provides a synthetic colour image of the aircraft and vehicles on the runways and taxiways. This basic informative system does not include automatically generated runway details, easy identification of moving vehicles or runway incursion warnings. The ATCs also said that the accuracy of the system is such that the exact position of an aircraft cannot be located.



Figure 3: Excerpt from replay of event: SRK51R (00009) is taxiing on runway 15 and KLM1986 (00014) is on the DELTA taxiway

2.4.1 Phraseology

All of the communications between the ATC, the KLM1986 and SRK51R flight crews and the others crews at the time of the serious incident were conducted in English.

Taxi and hold short clearance

At the time of the serious incident, the radio-telephony procedures for the use of general air traffic, in force in France, were different to those recommended by ICAO in terms of the vocabulary used for the hold short clearances. France had notified ICAO of this difference:

ICAO recommends the following phraseology:

- "KLM1986 hold short of holding point DELTA runway 33."

France uses the following phraseology:

- "KLM1986 maintain holding point DELTA runway 33."

(17) Annex 10: Aeronautical Telecommunications, Volume II- Communication Procedures; Doc 4444 (PANS-ATM): Procedures for Air Navigation Services – Air Traffic Management; Doc 9432: Manual of Radio-telephony; Doc 7030: Regional Supplementary Procedures; Order Respecting Radio-telephony Procedures for the Use of General Air Traffic (1 May 2016). Training Manual for General Air Traffic Phraseology (updated 27 June 2013).

The DEL/GND ATC clearance was "KLM1986 maintain 33 DELTA, contact tower 118.3 bye bye."

The hold short clearances given by the LOC ATC were in accordance with those defined in the ICAO texts⁽¹⁷⁾.

Read-back

Read-back involves repeating all or part of a message so that the ATC or pilot behind the message verifies that it has been correctly received and understood. The documents cited in the previous footnote mention that a flight crew will repeat to the ATC the parts of the ATC authorisations and instructions communicated by radio-telephony that are relevant to safety. Authorisations and instructions for take-off or landing on a runway, holding short, crossing and back-taxiing will always be read back.

The documents also specify that the ATC will listen to the read-back to ensure that the flight crew has correctly received and understood the authorisation or instruction and will immediately intervene to correct any discrepancies identified by the read-back.

2.4.2 Choice of runway in service

The Basel-Mulhouse air traffic service operations manual states in the chapter "Choice of use of runway by day" that "*runway 15 is preferred for landing. Runway 26 is preferred for take-offs. Runway 33 is used only if the tailwind component on runway 15 is greater than 5 kt or at the pilot's request, if traffic permits.*"

There is no specific instruction in the manual when departures are made counter-QFU on runway 33 while runway 15 is in use.

In practice, the use of runway 08/26 is reserved for take-offs by short and medium-haul aircraft to the west. The number of movements on the runways between 2011 and 2015 shows that there are approximately 5 times more take-offs on runway 15 than runway 33 and 10 times more take-offs on runway 15/33 than on runway 08/26.

2.5 KLM Cityhopper

2.5.1 Procedure for the preservation of flight recorders

The Embraer 190 is equipped with two data recorders (DVDR 1 and 2), each of which contains a flight data recorder (FDR) and a cockpit voice recorder (CVR of 120 minutes).

Only DVDR 1 was sent to the BEA by KLM Cityhopper. The read-out of this DVDR revealed that the cockpit voice recorder data did not include the first part of the flight (notably the taxiing phase). KLM Cityhopper conducted an internal investigation to determine the reasons. The investigation showed that at the time of the event:

- the documentation for the crew requested the "deactivation" of DVDR 2, while the documentation for the maintenance personnel requested the preservation of DVDR 1;
- the organization set up by KLM Cityhopper as part of the preservation of recorders involved a large number of personnel and procedures which did not always result in the preservation of recorders as early as possible.

For example, in the case of this serious incident, the crew requested that the maintenance staff preserve the DVDR after their arrival in Amsterdam and did not apply the procedure (deactivation of DVDR 2) or log their request in the Aircraft Maintenance Logbook (AML). The maintenance personnel in contact with the crew were not authorised to remove the DVDR without the agreement of a Duty Maintenance Controller who was supposed to send them a specific maintenance task for this operation. Without this task, the maintenance personnel did not remove the DVDR and continued to perform other maintenance operations while the DVDRs continued to record. The controller was informed later by another KLM service which had been alerted by the Dutch Safety Board (DSB) following the BEA request. When the DVDR 1 was finally removed from the aircraft, it had continued to operate long enough to erase the audio data of the event.

2.5.2 Sterile flight deck

In his report, the captain explained that he was distracted by the conversation of the cabin crew member sitting on the jump-seat in the cockpit. He added that next time, he will tell the third person in the cockpit when s/he can speak. The absence of CVR data at the time of the event did not allow the investigation to determine the extent to which the crew could have been distracted by the presence of a third person in the cockpit.

⁽¹⁸⁾Regulation (EU) No 965/2012 dated 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008.

European regulation No 965/2012⁽¹⁸⁾ lays down that the captain shall ensure that access to the cockpit does not cause distraction and does not interfere with the performance of the flight. The KLM Cityhopper Operations Manual defines the principle of a sterile cockpit.

"Sterile flight deck

A sterile flight deck is to guarantee an undisturbed working environment. To create a sterile flight deck the flight crew should:

- Refrain from duties other than those required for the safe operation of the aircraft;*
- Limit the exchange of information with the cabin crew to procedural calls/replies, safety and security issues;*
- Limit intra-flight deck communication to the necessary communication for the operation of the aeroplane and the proper conduct of duties..."*

Figure 4: Excerpt from the KLM Cityhopper Operations Manual

3 - LESSONS LEARNED AND CONCLUSION

⁽¹⁹⁾Statistics published in the European Action Plan for the Prevention of Runway Incursions (EAPPRI) .

According to the statistics⁽¹⁹⁾, two runway incursions occur every day in Europe

ICAO defines runway incursions as, "Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft".

At the Basel-Mulhouse aerodrome, the safety barriers for the prevention of runway incursions are:

- clear signage of taxiways and runways;
- issuance of clearances;
- compliance with these clearances by the crews, which presupposes reliable communication, supported by the read-back principle;
- visual surveillance of aircraft when taxiing by the ATCs and position reports by crews;
- ATC keeping the strips up to date to reinforce his situational awareness;
- crew vigilance before entering a runway, which includes visual vigilance and careful listening to the frequency.

3.1 Read-back principle and malfunctions

The read-back principle was adopted in order to promote safety in the context of radio-telephony communication. It is intended to ensure that an authorisation or instruction has been received and that it has been correctly understood by the crew to whom it was transmitted. This rigorous phraseology is directly related to the seriousness of possible misunderstandings in the transmission and receipt of ATC authorisations and instructions.

It is also essential that the ATC listens to the read-back (hear-back) to ensure that the flight crew has correctly received and understood the clearance or instruction and immediately intervenes to correct any discrepancies identified by the read-back.

The pilot-ATC communication loop is a confirmation and correction process that ensures the integrity of the communications.

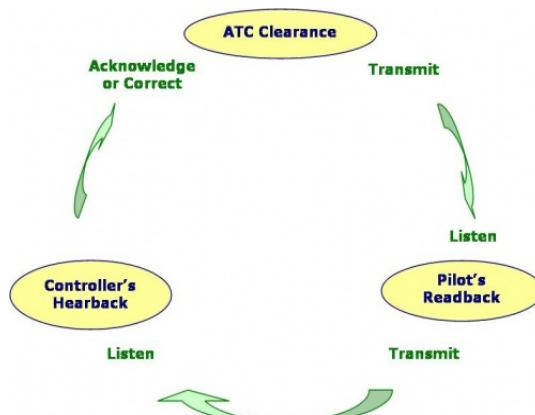


Figure 5: The pilot-ATC communication loop (Source Eurocontrol)

(20) Eurocontrol (Air-Ground Communications Incidents) :
<http://www.eurocontrol.int/sites/default/files/news/content/documents/nm/safety/agc-action-plan.pdf>
 DSAC:
http://www.ecologique-solidaire.gouv.fr/sites/default/files/bulletin_securite_DSAC_No25.pdf

According to several studies and safety bulletins based on accidents, serious incidents and notified events, read-back errors represent the largest category in all communication problems.

These include the European Action Plan for Air Ground Communications Safety⁽²⁰⁾ published in May 2006, which contains the following paragraphs which correspond to the situation of an undetected erroneous read-back, the main ones being underlined:

Omission of read-back or inadequate read-back

6.23. ICAO Annex 11 requires that the safety-related part(s) of any clearance or instruction be read back to the air traffic controller.

6.24. The pilot's read-back must be complete and clear to ensure a complete and correct understanding by the controller.

6.25. The action of reading back a clearance gives the controller an opportunity to confirm that the message has been correctly received, and if necessary, to correct any errors.

6.26. Full read-back should never be replaced by the use of a term such as "Roger" or "Copied".

6.27. Similarly, a controller should not use terms such as "Roger" to acknowledge a message requiring a definite answer (e.g. acknowledging a pilot's statement that an altitude or speed restriction cannot be met).

Failure to correct faulty read-back

6.28. The absence of an acknowledgement or a correction following a clearance read-back is perceived by most flight crews as an implicit confirmation of the read-back.

6.29. The absence of acknowledgement by the controller is usually the result of frequency congestion and the need for the controller to issue clearances to several aircraft in succession.

6.30. An uncorrected erroneous read-back (known as a hear-back error) may lead to a deviation from the intended clearance and may not be detected until the controller observes the deviation on his/her radar display.

6.31. Less than required vertical or horizontal separation (and an AIRPROX [or a runway incursion]) is often the result of hear-back errors.

Expectations

6.32. Bias in understanding a communication can affect pilots and controllers.

6.33. The bias of expectation can lead to:

(a) transposing the numbers contained in a clearance (e.g. a flight level) to what was expected, based on experience or routine; and,

(b) shifting a clearance or instruction from one parameter to another (e.g. perceiving a clearance to maintain a 280° heading as a clearance to climb/descend and maintain flight level 280, [or hold short as line up]).

Figure 6: Excerpt from European Action Plan for Air Ground Communications Safety

3.2 Situational awareness of crew of flight KLM1986

During the serious incident at Basel-Mulhouse, it appears that the crew of flight KLM1986 was not on the LOC frequency when the ATC authorised the crew of flight SRK51R to take off on runway 15. However, the crew of KLM1986 had previously had several indications via ATIS and ATC communications that runway 15 was the runway in use.

The flight crew witness accounts also show the various confirmation biases (several aircraft heading towards the threshold of runway 33 or taking off from runway 33), which led to an erroneous mental representation in which runway 33 was the active runway.

The short taxiing time to the DELTA holding point (approximately two minutes), the resulting workload and the presence of a third person in the cockpit may have led them to paying less attention to ATC communications which did not allow the crew to re-establish their situational awareness. They also did not completely read back the taxiing clearance provided by the DEL/GND ATC.

Convinced that the runway was free and that QFU 33 was the QFU in service, the crew aligned with runway 15/33 without taking the precaution of visually checking for the presence of another aircraft from QFU 15.

3.3 Situational awareness of ATCs

Before transferring the crew of flight KLM1986 to the LOC frequency, the DEL/GND ATC requested them to maintain 33, "*KLM1986 maintain 33 DELTA, contact tower one one eight decimal three bye, bye.*" The crew partially read back this clearance by answering, "*one one eight decimal three, bye, bye KLM1986.*" The investigation was not able to determine how this incomplete and non-compliant clearance was interpreted by the crew. Nevertheless, the crew witness account did not mention having been destabilized by this incomplete clearance which did not comply with ICAO recommendations.

In response to the ATC clearance, "*KLM1986 bonjour, hold short of runway 33 DELTA*" the crew of flight KLM1986 read back, "*Line up and wait runway 33 DELTA.*"

The LOC ATCs (trainee and instructor) did not detect that the crew had not understood its hold short of holding point clearance and therefore did not correct the crew read-back.

This could have been perceived by the crew as an implicit confirmation to line up on runway 15/33.

The studies cited above mention that listening to the read-back can be affected by an expectancy bias. Thus the ATCs may have perceived only a "correct" part of the read-back ("*one one eight decimal three*", "*runway 33 DELTA*") and concluded that the whole message was correct.

Three seconds after the read-back error on the LOC frequency, calls from a VFR pilot and a crew ready to take off on QFU 33 probably caught the attention of the LOC ATCs by bringing new information to be handled, to the detriment of the task of analysing the previous read-back and the visual check of the aircraft during taxiing. The ATCs added that in fact they had then looked at the VFR and then the SRK51R then taxiing for take-off. They only detected the presence of KLM1986 when it was too late and had already entered the runway.

The erroneous understanding of the ATC's request, probably due to the crew's inaccurate situational awareness (active runway, take-off order number) and failure to detect the read-back error, led to the serious incident. The lack of a visual check of the two ends of the runway by the crew before entering the runway and the late visual detection by the ATCs did not prevent the runway incursion.

3.4 Preventing runway incursions

Runway incursions are a major risk due to the potential severity of a collision and the aviation community considers them to be one of the priority safety objectives.

⁽²¹⁾<http://www.skybrary.aero/bookshelf/books/482.pdf>

⁽²²⁾<http://www.skybrary.aero/bookshelf/books/151.pdf>

⁽²³⁾<http://www.ecologique-solidaire.gouv.fr/symposium-securite#e10>

⁽²⁴⁾Carte AIP France
AD2 LFSB GMC 01
https://www.sia.aviation-civile.gouv.fr/dvd/eAIP_01
MAR 2018/FRANCE/AIRAC-2018-03-01/html/eAIP/FR-AD-2.
[LFSB-fr.FR.html](https://lfsb-fr.FR.html)
⁽²⁵⁾http://www.stac.aviation-civile.gouv.fr/sites/default/files/stac/manifestation/jt2013/comm/JT2013-STAC_14_RWSL.pdf

ICAO has published a manual on the prevention of runway incursions (Doc 9870⁽²¹⁾) and a working group coordinated by Eurocontrol and consisting of several operators, manufacturers and authorities defined in 2003, the EAPPRI⁽²²⁾. This plan contains recommendations and guidelines for the attention of aerodrome operators, aircraft operators, air traffic service providers, aircraft manufacturers, civil aviation authorities and the European Agency EASA. These recommendations are taken into account by a certain number of European countries in their State Safety Programme (SSP).

In 2007, as part of its SSP, the DGAC identified a runway incursion as an undesirable event which it describes as a "*targeted risk*". The objective of the DGAC is to reduce the rate of runway incursions and to limit the severity of the potential consequences of these events. On 29 November 2007, the DGAC held a symposium on the subject of runway incursions⁽²³⁾. Among all the measures set up, there were, in particular:

- the implementation of local runway safety teams (LRST) at eleven French airports, including the Basel-Mulhouse airport. They were intended to help identify safety deficiencies and the corrective measures to be implemented. In particular, they helped to improve ground marking and to indicate "Hot Spots" on the aerodrome charts i.e. areas requiring great vigilance⁽²⁴⁾ and to propose greater investments, such as for the implementation in Roissy/Charles-de-Gaulle of an automatic beacon lighting system when the runway is occupied (RWSL Runway Status Light System)⁽²⁵⁾;
- the deployment of an Advanced Surface Movement Guidance and Control System (A-SMGCS). It indicates to the ATC the position of land vehicles on the apron and can be supplemented by a runway incursion alert function. The deployment of such a system is planned for 2018 in Basel-Mulhouse.

Actions taken after the serious incident

Local level

A few days after this serious incident, the following measures were taken:

- publication on 11 March 2016 of a local memo with a reminder on the importance of read-back;
- publication on 18 March 2016 of a directive issued by the Direction des Opérations (Operations Division) prohibiting counter-QFU take-offs from an intermediate taxiway.

The local safety committee (CLS) of the Basel-Mulhouse Air Traffic Services met on 18 April 2016. This event was classified as a major incident, the severity of which and probability of occurrence were considered significant. The study of this event by the CLS revealed the following important points:

- the traffic load was moderate and without any particular complexity;
- nine Air Traffic Services at other airports were questioned on this issue and it appears that some services have locally modified the phraseology of hold short clearances. The GND ATCs no longer mention the runway but the holding point when transferring from the GND ATC to the LOC ATC. The study also specified that information on the reason for the holding situation is provided to crews whenever possible. For example: "No. 2 at departure, traffic on arrival or departure."

The CLS proposed to give thought in a further working group, to naming the different holding points and to cut, during GND/LOC transfers and transfers to the LOC, all references to the runway when holding short of holding point. A Service Note issued on 15 September 2016 requests that the runway is no longer quoted in the instructions for holding short of holding points in order to reduce any confusion with a runway entry authorisation. However, this note does not ask ATCs to specify the reason for holding short of the holding point.

National level:

The analysis of this event at national level by the l'Instance de Traitement des Evènements Sécurité (ITES) of the DSNA which is the air traffic safety event processing unit took place on 8 December 2016 and concluded that the use of the counter-QFU was not a contributory factor. The Operations Division is studying the need to maintain the protective measure prohibiting counter-QFU take-offs issued on 11 March 2016.

⁽²⁶⁾https://www.ecologique-solaire.gouv.fr/sites/default/files/Reglement_No2016-1185_modifiant_le_923-2012_FR.pdf

As part of the execution of Implementing Regulation (EU) No 2016/1185 concerning air traffic services and procedures ⁽²⁶⁾, a working group at the national level was created to take into account developments in the phraseology and to update the phraseology manual. This version of the manual entered into force on 12 October 2017. In the part regarding taxiing, it was written:

"b) Short of a runway

The word "position" must not appear in the message.

The word "runway" should only be used for clearance of take-offs, landings and crossings of runways to prevent the possibility of an interpretation by the pilot and a runway incursion, except if the word is necessary to understand the situation."

The measure set up at Basel-Mulhouse is therefore applicable to all French airports since 12 October 2017.

3.5 Conclusions

The runway incursion resulted from an incorrect understanding of the ATC instruction by the crew of flight KLM1986 and the ATC not detecting the read-back error. A partial visual check by the crew, prior to entering the runway, and partial ATC surveillance did not prevent the incursion.

The following factors may have contributed to the event:

- an inaccurate perception of the crew regarding the runway in use;
- time pressure and distraction in the cockpit;
- use of a short taxiway to the runway which left little time for the crew to build an appropriate perception of the actual situation;
- simultaneous management by the ATC of a VFR flight and another IFR flight leaving from runway 33.

This serious incident highlights the weakness of safety barriers when they are based solely on:

- crew/ATC communication;
- vigilance of crews and ATCs.

This serious incident demonstrates that these safety barriers are not always a guarantee against the risk of runway incursion. This latter is higher on aerodromes such as Basel-Mulhouse whose configuration offers crews the possibility of take-off in both directions from short intermediate taxiways.

The following factors could have contributed to the prevention of this event:

- implementation of a specific phraseology to reduce the risk of confusion and to inform crews of the reasons for holding short. When SERA entered into force in October 2017, this phraseology was generalized to all aerodromes;
- implementation of a system for monitoring surface movements and automatic detection of runway incursions (A-SMGCS Level 2). Implementation is expected to begin in 2018.