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INVESTIGATION REPORT

Serious incident

to the Bombardier CRJ700 registered **F-GRZL**
and to the Airbus A319-111 registered **G-EZAZ**
on 17 March 2017
at Lyon Saint-Exupéry (Rhône)

Time	14:38[1]
Operator	**F-GRZL**: *Hop!* **G-EZAZ**: EasyJet
Type of flight	Commercial air transport (passengers)
Persons onboard	**F-GRZL**: Captain (PM[2] then PF[3] while taxiing); first officer (PF then PM while taxiing); 2 cabin crew; 60 passengers **G-EZAZ**: Captain (PM); first officer (PF); 4 cabin crew; 150 passengers
Consequences and damage	None

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in March 2020. As accurate as the translation may be, the original text in French is the work of reference.

[1] Except where otherwise indicated, times in this report are in local time.

[2] PM: Pilot Monitoring.

[3] PF: Pilot Flying.

Near incursion of an aeroplane cleared to cross the runway during the take-off of another aeroplane

1 - HISTORY OF THE FLIGHT

[4] Quick Access Recorder.

Note: the history of the flight is based on radio and radar recordings, pilot reports, the controller's statement and flight parameters from the CRJ700 QAR[4].

The CRJ700, registered F-GRZL, call sign HOP83AJ, was carrying out a commercial air transport (passenger) flight between Biarritz Pays Basque airport (Pyrénées-Atlantiques) and Lyon Saint-Exupéry airport (Rhône). The exchanges between HOP83AJ and the controller were in French. The A319, registered G-EZAZ, call sign EZY748Z, was carrying out a commercial air transport (passenger) flight between Lyon Saint-Exupéry and Nantes Atlantique (Loire-Atlantique). The exchanges between EZY748Z and the controller were in English.

Runways 35L and 35R were in use and managed as a "*nominal twin runway*". The meteorological conditions were CAVOK.

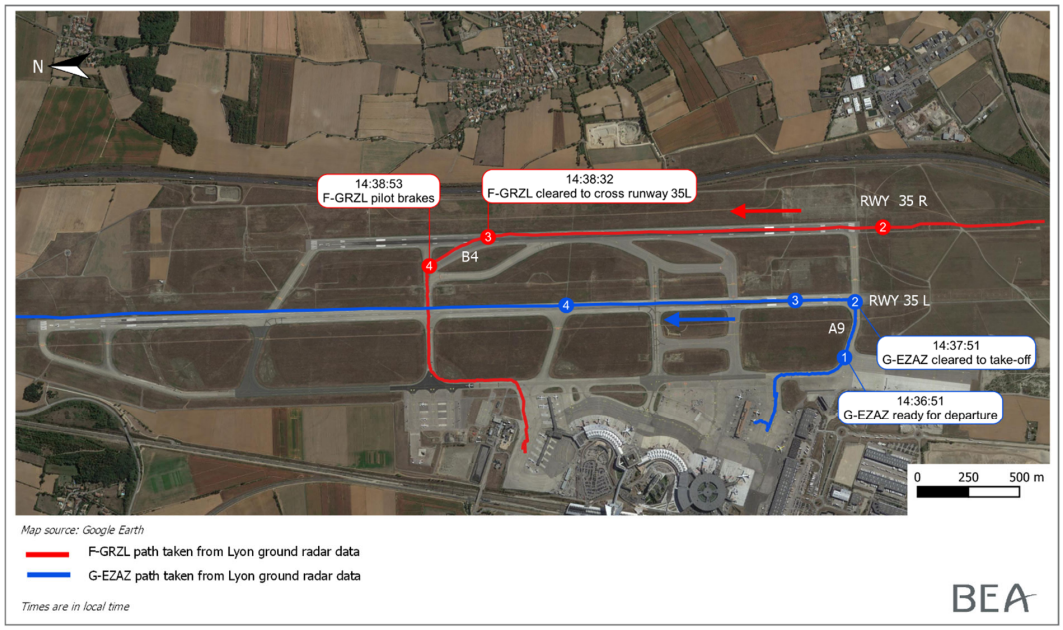

Figure 1: paths of F-GRZL and G-EZAZ

At 14:35:40, the LOC controller[5] cleared HOP83AJ to land on runway 35R, *"Alpha Juliet, […] (5) autorisé atterrissage piste 35 droite, vent calme."* The four preceding inbound aeroplanes had landed on runway 35L, at the crew's request or on the LOC controller's proposal.

[5] Controller in charge of the CTR, runways, their OFZ and the taxiways between runways.

At 14:36:51, the crew of EZY748Z contacted the LOC controller and reported that they were on access taxiway A9❶ and were ready for departure, "*Tower, bonjour, Easy 748 Zulu, reaching Alpha 9, fully ready.*" The LOC controller cleared them to line up on runway 35L and to wait, *"Easy 748 Zulu, bonjour, from Alpha 9, line up runway 35 Left and wait"*, as the runway was still occupied by an aeroplane (HOP513D) in its landing run.

A minute later, the LOC controller cleared EZY748Z to take-off on runway 35L❷, "*Easy 748 Zulu, cleared for take-off, 35 Left, wind 120 degrees, 2 knots.*" At this moment, HOP83AJ flew over the threshold of runway 35R❷.

Forty-one seconds later, the LOC controller cleared HOP83AJ to cross runway 35L via B4, "*Hop83 Alpha Juliet, traversez la piste 35 Gauche*"❸, and then cleared the following flight to land on runway 35R. EZY748Z had started its take-off run and was at this point around 1,000 m from taxiway B4❸.

Twenty seconds later, the crew of HOP83AJ started braking❹ as they had seen flight EZY748Z taking off from runway 35L❹. Almost simultaneously, the LOC controller ordered HOP83AJ to hold its position, "*Alpha Juliet, maintenez position.*" The latter came to a halt before crossing the CAT III[6] runway-holding position marking. EZY748Z was at this point around 300 m from taxiway B4.

[6] This marking is situated at 150 m from the runway axis.

At 14:38:58, EZY748Z, still in the take-off run phase passed in front of HOP83AJ. Following this incident, the LOC controller was relieved by his assistant.

2 - ADDITIONAL INFORMATION

2.1 Witness statements

2.1.1 Controller statement

The LOC controller had an air traffic controller licence since 1996[7] and was qualified for the Lyon Saint-Exupéry control positions since 2005.

[7] Posted at the Reims en route control centre from 1996 to 2004.

The controller had started his shift 47 minutes beforehand and had entirely spent it in the LOC position. He explained that the meteorological conditions were good and the operating conditions normal. He specified that the LOC position is equipped with a ground radar display but that it is not used when the meteorological conditions are good and the traffic can be observed directly from the tower.

He said that the event occurred towards the end of the "*inbound hub*"[8]. He explained that the EasyJet aeroplane was at holding position A9, and that he cleared it to line up and take off from 35L. He specified that when HOP83AJ landed, his eyes were concentrated on this aeroplane in order to be able to clear the following aeroplane for landing as soon as the runway was vacated. He then cleared flight HOP83AJ to cross the runway. He thought that his out-of-window scan at this point was not all encompassing. He moved the strip[9] of flight HOP83AJ onto the [EZY748Z] strip which was positioned in the runway 35L bay of his board and put a cross on it. When he scanned out of the window again, the two aeroplanes were in his field of vision and he realised that there was a conflict. Seeing that HOP83AJ was taxiing slowly, the controller ordered the crew to stop. He did not use the emergency phraseology.

[8] Period of dense traffic during which the majority of the movements were inbound.

[9] See Chapter 2.3.2.

2.1.2 Crew statements

2.1.2.1 F-GRZL (HOP83AJ)

The crew of HOP83AJ were carrying out their third flight of the day, which was a return flight to their Lyon base. On the CRJ, as the nose wheel steering control is only on the left-hand side, the captain who was PM up to the vacating of the runway, became PF in order to taxi to the gate.

The captain said that the controller cleared them to cross runway 35L while they were vacating runway 35R. He specified that being based at Lyon, he knew of the possibility of conflicts when crossing runway 35L. This point is covered in their arrival briefing. The two pilots thus checked that runway 35L was actually free of traffic before entering it. The captain, seeing the aeroplane at a high speed on the runway, braked and brought the aeroplane to a halt at the CAT III runway-holding position marking.

2.1.2.2 G-EZAZ (EZY748Z)

The crew of EZY748Z were carrying out their first flight of the day. The crew are based at Lyon. The captain was the PM; he is an English speaker.

The captain said that when the A319 was in the high-speed phase of the take-off, he thought he understood that the traffic then starting to vacate runway 35R had just been cleared to cross runway 35L. As he is not a French speaker, he had doubts about what he had heard. As the speed was then in excess of 100 kt and judging that their aeroplane would be past the taxiway B4 crossing point before the CRJ reached it, he decided not to ask the first officer (PF) to abort the take-off.

He specified that he saw the CRJ brake before crossing the runway-holding position marking and that the A319 passed in front of the CRJ at a speed close to V1.

He said that the mix of French and English in the exchanges significantly reduced situational awareness for non French speaking crews.

2.2 Aerodrome information

2.2.1 Use of runways

Lyon Saint-Exupéry airport is an international airport open to commercial air traffic. It has two parallel runways which are dependent with respect to wake turbulence. They are normally managed as a "*nominal twin runway*", i.e. take-offs are performed on the inner runway 17R/35L and landings on the outer runway 17L/35R. According to the density of the traffic, the controller can accept a landing on the inner runway.

When managed as a "*nominal twin runway*", and if visibility is greater than 5 km and the ceiling higher than 1,500 ft, the simultaneous landing and take-off procedure is authorized.

Runway 35L at Lyon Saint-Exupéry is relatively flat between the two runway thresholds which means that the crew of an aeroplane waiting to cross the runway have a good view over all of this runway.

The taxiways leading to the runway have two runway-holding position markings. The CAT I holding position is situated 90 m before the runway centre line. It is shown by two yellow solid lines and two yellow dashed lines painted on the ground. When not in LVP conditions[10], an aircraft or vehicle situated before this holding position is outside the runway OFZ. The CAT III holding position is situated at 150 m from the runway centre line. It is shown by a "*ladder*" marking painted on the ground. In LVP conditions, crossing this holding position marks entry on the runway.

[10] *Low Visibility Procedures*, in force at the earliest when RVR is less than 800 m or the ceiling below 300 ft, and at the latest when RVR reaches 550 m or the ceiling 200 ft.

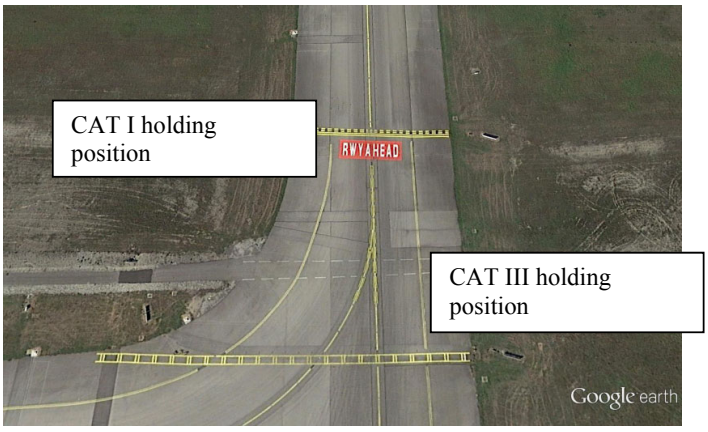

Figure 2: holding position markings on Lyon Saint-Exupéry taxiway B4.

2.2.2 Stop bars

A stop bar system was installed to protect runways 17 and 35. The stop bars are made up of unidirectional red lights positioned across the taxiway, at the CAT III runway-holding position marking. They are only activated in LVP conditions.

When the system is activated, all of the stop bars are lit. Certain stop bars can be controlled to allow aeroplanes to line up for departure and to cross the runway. Only the taxiways equipped with controllable stop bars can therefore be used in LVP conditions. The controller manually deactivates the applicable stop bar from a control panel. The stop bar is reactivated after a time-out or via the control panel.

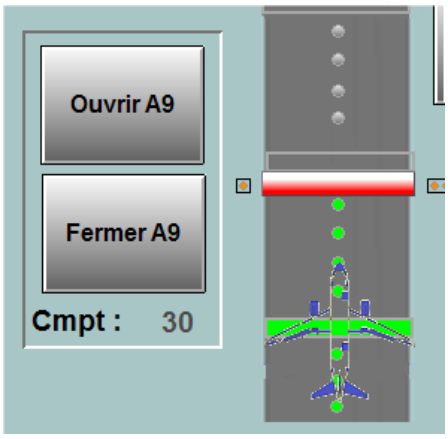

Figure 3: detail of stop bar control at control position

The controllers interviewed specified that having to carry out a manual action for each aeroplane movement and not being able to use all the taxiways means that this stop bar system is poorly adapted to the denser traffic existing outside LVP.

2.3 Control information

2.3.1 Control procedures

In order to help detect conflicts, the controller uses a board on which he positions strips (of paper) representing the various travelling objects (vehicles and aeroplanes). Magnetic bays are used to represent each runway and to thus create two "*runway areas*" and an "*inter-runway area*".

Inbound aircraft are represented by green strips and outbound aircraft by orange strips.

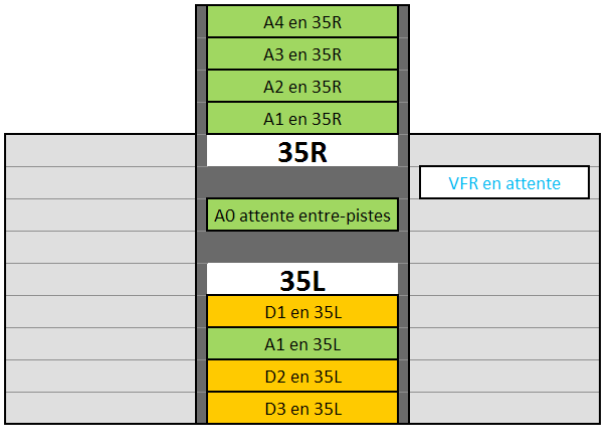

Figure 4: strip board (excerpt from Lyon Saint-Exupéry operations manual)

An aeroplane which has just vacated runway 35R and which is not yet cleared to cross runway 35L will have its strip positioned as the "*A0*" strip in the above figure.

When an aeroplane is cleared to land or take-off, its strip is positioned in the corresponding runway bay (35R or 35L). The controller rings the runway number shown on the strip. If the aircraft is cleared to line up and hold, the strip is positioned in the corresponding runway bay and the runway number shown on the strip is simply underlined. The strip is kept in the runway area the whole time the aircraft occupies the runway.

When the controller clears an aircraft to cross a runway, he positions the strip in the corresponding runway bay. He indicates on the strip, the name of the intersection taxiway and makes a cross. If the controller clears an aircraft to cross a runway occupied by an aircraft which has lined up and is holding, the controller places the crossing strip over the lined up aircraft strip. The strip is kept in the runway area the whole time the aircraft occupies the runway.

It is specified in the operations manual that when one strip is placed on top of another, the controller slightly offsets the top strip so that the bottom strip is not entirely covered. It is, however, recommended to limit the number of strips on top of each other for the same runway to three.

The Lyon Saint-Exupéry airport tower operations manual specifies that before clearing an aircraft to land, take-off or enter a runway, the controller visually checks the runway. The operations manual also specifies that the ground radar is a surveillance aid tool supplementing the controller's direct scan of the traffic. The ground radar is not equipped with a warning system in the event of a runway incursion.

2.3.2 Operation during occurrence

During the occurrence, the meteorological conditions were good and the controller said that he did not use the ground radar display. When he gave the crossing clearance to HOP83AJ, he positioned the latter's strip on the EZY748Z strip which was positioned in the runway 35L bay. This positioning was carried out "*mechanically*" and the placing of one strip over the other did not allow the controller to detect the conflicting clearance.

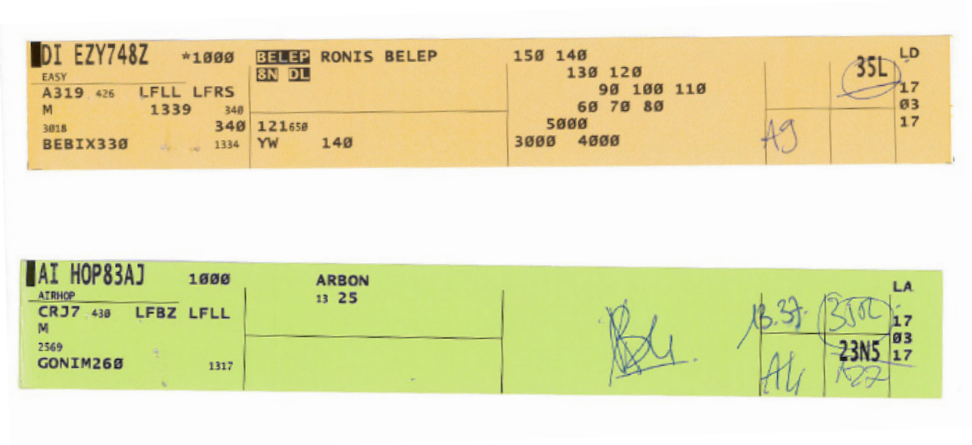

Figure 5: HOP83AJ and EZY748Z strips

During the 40 minutes spent in the LOC position, the controller managed 2 departures[11], 16 arrivals and a VFR flight in transit. Of the 16 arrivals, 11 had landed on runway 35R. The small number of departures in this period implied the near absence of conflicts between runway crossings and departures on runway 35L. The transcript of the radio exchanges shows that for the last six landings on runway 35R, the controller had proceeded as follows:

- clearance to land on runway 35R for aeroplane N;
- as soon as the runway is vacated, clearance to cross runway 35L for aeroplane N;
- clearance to land on runway 35R for aeroplane N+1.

The last four aeroplanes had landed on runway 35L.

[11] The second departure is that of EZY748Z.

2.3.3 Occurrence follow-up

The local analysis by the "*Service Quality and Safety*" subdivision determined that the cause of the occurrence was a conflicting clearance given by the controller. As this cause was assessed as being solely non-systemic and as the clearance was corrected by the controller in time to enable HOP83AJ to stop before the CAT III holding position, it was decided not to take any specific measure or to have this event examined by the Local Safety Commission.

2.4 Similar event which occurred at Lyon Saint-Exupéry on 13 February 2016

The occurrence, analysed by the Local Safety Commission, concerned a near-incursion involving a Jetairfly Boeing 737-800 cleared for take-off and an EasyJet Airbus 319 cleared to cross the runway. The radio exchanges with these two aircraft were in English. The occurrence took place at night, in a context of low traffic and very good meteorological conditions.

At 20:11:05, the LOC controller cleared the A319 to land on runway 18L[12].

[12] The names of the runways changed in September 2016.

At 20:12:53, the LOC controller cleared the B737 to take-off from runway 18R. At the same moment, the A319 flew over the threshold of runway 18L.

At 20:14:04, the A319 vacated runway 18L and the B737 started its take-off run.

At 20:14:23, the LOC controller cleared the A319 to cross runway 18R. The crew of the B737 immediately advised that they were in the process of taking off.

At 20:14:31, the LOC controller ordered the A319 to hold position. The crew advised that they were holding and could see the traffic taking off.

The Local Safety Commission noted that the work methods had been duly complied with but that a certain number of elements, which shall generally act as a barrier before the safety occurrence, had failed for purely "*human factors*" reasons. The Commission specified that the fact that the two pilots spoke in English permitted an immediate reaction from the pilots to prevent the accident.

The Commission members noted that from a technical aspect, only one known tool could have prevented the event from occurring: an automatic lighting system when the runway is occupied (RWSL[13]), a system that was being tested at that time at Paris–Charles de Gaulle.

[13] RunWay Status Light. https://www.eurocontrol.int/runway-status-lights-rwsl-fr

The Commission classed the probability of this type of event re-occurring as low. No measure at either local or national level was recommended.

2.5 Preventing runway incursions

2.5.1 European Action Plan for the Prevention of Runway Incursions (EAPPRI[14])

[14] European Action Plan for the Prevention of Runway Incursions.

A work group, coordinated by Eurocontrol and composed of several operators, manufacturers and authorities, defined in 2003, a European Action Plan for the Prevention of Runway Incursions: the EAPPRI.

According to the statistics in this European plan, two runway incursions occur every day in Europe.

This action 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 Aviation Safety Agency (EASA). The third issue of this plan was published in November 2017[15].

[15] https://www.eurocontrol.int/publication/european-action-plan-prevention-runway-incursions-eappri

As part of the implementation of the EAPPRI in France, Advanced Surface Movement Guidance and Control Systems (A-SMGCS[16]) were deployed. They inform the controller of the position of land vehicles on the platform and can be supplemented by a runway incursion alert function. These systems have four levels according to the services provided:

[16] Advanced Surface Movement Guidance and Control System.

- level 1 (improved surveillance): display of vehicle and aircraft identification;
- level 2 (safety net): addition of a runway incursion alert system;
- level 3 (conflict detection);
- level 4 (conflict resolution).

On the day of the incident and at the date of publication of this report, the A-SMGCS system at Lyon Saint-Exupéry is level 1.

Local runway safety teams (LRST) are another measure implemented in France as part of the EAPPRI. They must identify safety deficiencies and the corrective measures to be implemented. They have contributed, in particular, to proposing major investments, such as the implementation at Roissy-Charles-de-Gaulle, of an RWSL. The LRST have also contributed to improving ground markings and to mentioning hot spots on aerodrome charts. The identification of hot spots, as defined in ICAO document 9870, must be accompanied by risk reduction strategies which include not only providing information (for example on the aerodrome charts) but also, according to needs, adding visual aids and adapting control methods.

There is a LRST at the Lyon Saint-Exupéry airport. This team is made up of air traffic services, engineering services, airport managing body and operator representatives. This team meets once a year. It is not a decision-making body, it submits proposals to the Safety Promotion Committee. In 2014, the Lyon Saint-Exupéry LRST indicated that setting up a RWSL system at Lyon was too costly given the existing traffic. In 2017, the Lyon Saint-Exupéry LRST indicated that it appeared necessary and relevant to define hot spots for runway crossings.

In the updated aeronautical information publication of 27 February 2020, three hot spots concerning runway crossings were added to the ground movements charts[17].

[17] https://www.sia.aviation-civile.gouv.fr/dvd/eAIP_27_FEB_2020/FRANCE/AIRAC-2020-02-27/html/index-fr-FR.html

2.5.2 Eurocontrol working group (Safety Improvement Sub-Group)

A Eurocontrol working group identified five safety priorities in the summer of 2012. The detection of an occupied runway is one of them. Following this, an operational study was carried out[18]. It concluded that the use of a visual memory aid (such as the strip board) is in theory a very reliable barrier but that in practice, it is not an effective safety barrier. The safety barrier which had operated in the cases studied was the alert given by the pilots. This barrier can only work, however, if the language used for the radio exchanges allows all the actors to have good situational awareness, i.e. a common language.

[18] https://www.eurocontrol.int/sites/default/files/publication/files/201604-top-5-safety-priorities-oss-controller-detection-potentiel-runway-layout.pdf

3 - LESSONS LEARNED AND CONCLUSIONS

Scenario

The LOC controller, in position for less than an hour, had principally dealt with inbound aircraft. The majority of the time, he had cleared them to cross runway 35L as soon as they had vacated runway 35R, without there being a potential conflict, due to there being no departures.

The controller cleared the EZY748Z flight to take off from runway 35L and then gave a crossing clearance to the HOP83AJ flight without detecting the conflict. During the out-of-window scan, probably carried out partially, he did not see the aeroplane taking off and was not alerted when overlaying the strips in the bay dedicated to the runway.

The rhythm imposed by the density of the traffic, and the repetition of the same clearances, in particular during the inbound hub, inevitably led to the controller carrying out the various tasks somewhat automatically (management of strips, clearances, out-of-window scan). The detection of a conflicting clearance can then fail, particularly as the strip board, used in the conditions laid down at Lyon Saint-Exupéry, does not constitute a robust barrier. The distinction between an aeroplane lined up and an aeroplane cleared to take-off is solely based on the runway number being ringed or simply underlined. This difference is barely noticeable when quickly handling the strips. Overlaying the strips in these situations leads to the masking of an aircraft which might be conflictual.

When the crew of the EZY748Z flight were cleared to take-off, the crew of the HOP83AJ flight were flying over the threshold of runway 35R. The EZY748Z crew did not understand the crossing clearance given to the HOP83AJ crew as it was given in French. In the similar occurrence at the same aerodrome a year earlier, the crew were listening on the frequency to the clearances given in English which permitted the detection of the conflict. The use of several languages in exchanges with crews may reduce the situational awareness of the crews in the surrounding traffic with the possibility of recovery becoming more uncertain.

The HOP83AJ crew saw EZY748Z taking off when they visually checked the runway before crossing it. The fact that the HOP83AJ crew were based at Lyon and were aware of the runway incursion risk probably contributed to them actively checking the runway before crossing it. Simultaneously, the controller detected the conflict when he carried out the out-of-window scan again. This prevented the runway incursion from occurring. The HOP83AJ aeroplane came to a halt before the CAT III holding position, i.e. 60 m before the CAT I holding position marking the entry onto the runway outside LVP conditions.

4 - SAFETY RECOMMENDATIONS

Note: in accordance with the provisions of Article 17.3 of Regulation No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation in no case creates a presumption of fault or liability in an accident, serious incident or incident. The recipients of safety recommendations report to the authority in charge of safety investigations that have issued them, on the measures taken or being studied for their implementation, as provided for in Article 18 of the aforementioned regulation.

The analysis of the occurrence carried out by the "*Service Quality and Safety*" subdivision and the analysis by the Local Safety Commission of the similar event which occurred one year earlier did not go beyond the human error finding, and concluded that there was a small risk of a new occurrence and did not propose a corrective action.

The investigation carried out by the BEA has, however, led to some lessons to be learnt from these two near runway incursions:

Outside LVP conditions, at Lyon Saint-Exupéry airport, the LOC controllers rely on their memory, the strips and the out-of-window scan. During certain phases, the controller carries out repetitive tasks at a sustained rate. This leads to the tasks being carried out in an automatic way which may negatively affect the controller's memorizing of the clearances given and the outside monitoring of the traffic. The occurrences at Lyon also highlight the extent to which the barrier formed by the strip board is insufficiently robust in these situations. The overlaying of strips masks an aircraft which might be conflictual and no salient element then shows that the runway is occupied.

Moreover, outside LVP conditions, Lyon Saint-Exupéry airport does not have a runway incursion alert or protection system. The possibilities of recovery in the event of conflicting paths mainly rely on the visual detection of the conflict by the crews or the controller.

In addition, the operational failures observed during the two occurrences at Lyon, in part linked to the weakness of the methods and tools used to manage the traffic, are likely to occur again and, if not recovered, have serious consequences.

Lastly, the repetition of two similar occurrences at a year's interval calls into question the Local Safety Commission's opinion a year earlier that the probability of a new occurrence was low.

Consequently, the BEA recommends that:

- **The DSNA implement suitable work tools and methods to, in particular, reinforce the physical indication of the runway's occupancy so as to prevent conflicting clearances being given while the runway is being crossed.**
  [Recommendation FRAN-2020-003]

- **The DSNA, in collaboration with the Lyon Saint-Exupéry airport managing body suitably implement alert systems and runway protection tools so as to increase the possibilities of detecting conflicts while the runway is being crossed, even when outside LVP conditions.**
  [Recommendation FRAN-2020-004]