BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
www.bea.aero
@BEA_Aero

INVESTIGATION REPORT

Serious incident

on 14 November 2019
at Lyon Saint-Exupéry airport (Rhône)
to the BOEING - 737 - 800
registered 7T-VKR
operated by Air Algérie

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

BEA2019-0685.en/**February 2022**

Safety investigations

The BEA is the French Civil Aviation Safety Investigation Authority. Its investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liabilities.

BEA investigations are independent, separate and conducted without prejudice to any judicial or administrative action that may be taken to determine blame or liability.

SPECIAL FOREWORD TO ENGLISH EDITION

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in September 2021. As accurate as the translation may be, the original text in French is the work of reference.

Contents

Glossary

Abbreviation	English version	French version
ADL	Lyon Saint-Exupéry aerodrome operator	Aéroports De Lyon
ANS	Air Navigation Services	
ARFF	Aircraft Rescue and Fire Fighting service on aerodromes	
ASMGCS	Advanced Surface Movement Guidance and Control System	
ATIS	Automatic Terminal Information Service	
CAT III	Category III	
CDM	Collaborative Decision Making	
CTR	Control Traffic Region	
DGAC	French civil aviation authority	Direction Générale de l'Aviation Civile
DSAC	French civil aviation safety directorate	Direction de la Sécurité de l'Aviation Civile
DSAC-IR	Civil aviation safety directorate - Regional office	Direction de la Sécurité de l'Aviation Civile Inter Régionale
FMP	Flow Management Position	
ft	Feet	
GRF	Global Reporting Format	
ICAO	International Civil Aviation Organization	
kt	Knots	
LVP	Low Visibility Procedures	
METAR	Aviation routine weather report	
NOTAM	NOtice To AirMen	
OM	Operations Manual	
SNA-CE	Lyon control centre	Service de la Navigation Aérienne Center-Est
Snow Plan	Abbreviation for snow and black ice crisis plan operational guide	
TAF	Terminal Aerodrome Forecast	
TOGA	Take-Off Go Around	
TSB	Transportation Safety Board (Canadian safety investigation organization)	
UTC	Coordinated Universal Time	

Definitions

Runway incursion: ICAO defines a runway incursion 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.*"

Synopsis

Incursion of snow-clearance vehicles cleared to enter the runway, rejection of take-off run by an aeroplane

Time	Around 22:35[1]
Operator	Air Algérie
Type of flight	Passenger commercial air transport
Persons on board	Captain, co-pilot, 6 cabin crew members, 87 passengers
Consequences and damage	None

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

On 14 November 2019, there was a substantial snowfall in the Lyon region. The snow episode, early in the season and underestimated by all the aerodrome actors due to a lack of knowledge about the isothermal phenomenon, was taken into account fairly late.

At 22:30, the snow was still being cleared, LVP conditions were current and both runways were open. The GND controller cleared the snowploughs to enter the inner runway to clear snow to join a taxiway and the runway. The snowploughs were kept on the GND frequency. At the same time, on the TWR frequency, the LOC controller cleared the crew of an Air Algérie flight to line up and take off from the same runway.

The LOC controller, who was monitoring the ground radar screen and outside environment, identified the entry (cleared by the GND controller) of the lead vehicle of the snowploughs into the runway safety area. The crew of the Air Algérie flight immediately reacted to his request to reject the take-off run.

The runway incursion was linked to an erroneous clearance to enter the runway as a result of a coordination failure between the GND and LOC controllers, and to keeping the vehicles cleared to enter the runway on the GND frequency.

The following factors contributed to the conflictual clearance and to the use of an inappropriate frequency:

- A high workload in an unusual context where the roles were sometimes poorly delimited.
- The reopening of the inner runway although the snow clearance of the taxiways and the junctions with the runway required the snow-clearance vehicles to enter the runway.
- Practices without a clear framework regarding the use of frequencies for the vehicles during temporary runway closures.
- A stop bar configuration incompatible with the snow-clearance paths taken by the vehicles.

The runway incursion, while it can be considered a failure in itself, is above all else symptomatic of the confusion and disorganization generated by the management of the episode of snow. The following factors may have contributed to this situation:

- A Snow Plan whose definition was too formal and in part, disconnected with operational realities.
- Inaccurate measurements of the runway surface condition resulting in a high workload and difficulties in the snow-clearance strategy to be implemented.
- Rules for regulating and suspending operations which were difficult to apply by the persons directly involved in traffic management and snow clearance.

The BEA has issued four safety recommendations concerning:

- Air operation regulation and suspension decisions in case of an episode of snow.
- Coordination of snow clearance operations.

1- FACTUAL INFORMATION

1.1 History of the flight

Note: The following information is principally based on statements, radio-communication recordings, radar data and an excerpt of the Air Algérie flight data analysis.

On 14 November 2019, at Lyon Saint-Exupéry airport[2] (Rhône), the Low Visibility Procedures (LVP[3]) had been in force since 20:24 due to the low ceilings accompanied by snowfall and mist. Runways 35L and 35R were in use and managed as a nominal twin runway[4]. Runway 35L was closed to clear snow shortly before 20:00 and reopened at 21:38.

The Boeing 737-800, registered 7T-VKR, call sign AH1157, was carrying out a passenger commercial air transport flight between Lyon Saint-Exupéry airport and Annaba-Rabah-Bitat airport (Algeria).

At 22:19, the crew of flight AH1157 contacted the GND controller who cleared the push-back.

At 22:20, the lead vehicle of two snowploughs working in the manoeuvring area[5], call sign ELEC8, contacted the GND controller and asked for clearance to enter runway 35L in order to "do the junction" between the runway and taxiway A3. The GND controller asked him to remain outside the safety area of taxiway A3 and then cleared him to enter the runway, specifying that there was a vehicle on the runway carrying out measurements.

At 22:27, the GND controller cleared the crew of flight AH1157 to taxi to the A9 CAT III holding point (point ❶ of Figure 1).

The driver of lead vehicle ELEC8 contacted the GND controller to advise that the snowploughs were going to clear snow from taxiway A4 and asked if they could "do the junction" between the taxiway and runway 35L. The GND controller asked them to hold short of taxiway A4 due to an inbound aeroplane (point ❶).

At 22:29, the GND controller told the crew of flight AH1157 that the braking conditions were poor on runway 35L.

At 22:32, the GND controller asked the crew of flight AH1157 to remain at the holding point and to contact the TWR frequency (point ❷❷). On making first contact, the LOC controller asked them to advance to the stop bar.

At 22:33:11, the LOC controller informed the crew of flight AH1157 that they could line up and cleared them to take off from runway 35L (point ❸).

At the same moment, the driver of lead vehicle ELEC8 contacted the GND controller again. The GND controller cleared them to remove snow from taxiway A4 and to make the junction with the runway. The driver of the lead vehicle read back and indicated that they were starting and entering runway 35L (point ❸).

At 22:34:15, the lead vehicle of the snowploughs entered the runway safety area (point ❹).

[2] ICAO code: LFLL.

[3] Procedures at an aerodrome to ensure safe operation during Category II and III precision approaches and low visibility take-offs.

[4] Take-offs are performed on the inner runway 17R/35L and landings on the outer runway 17L/35R.

[5] The manoeuving area is composed of the runways and taxiways.

At 22:34:43, the crew of flight AH1157 applied TOGA thrust (point ❹). Five seconds later, the LOC controller asked the crew of flight AH1157 to reject the take-off (point ❺). Two seconds later, the crew reduced thrust and read back.

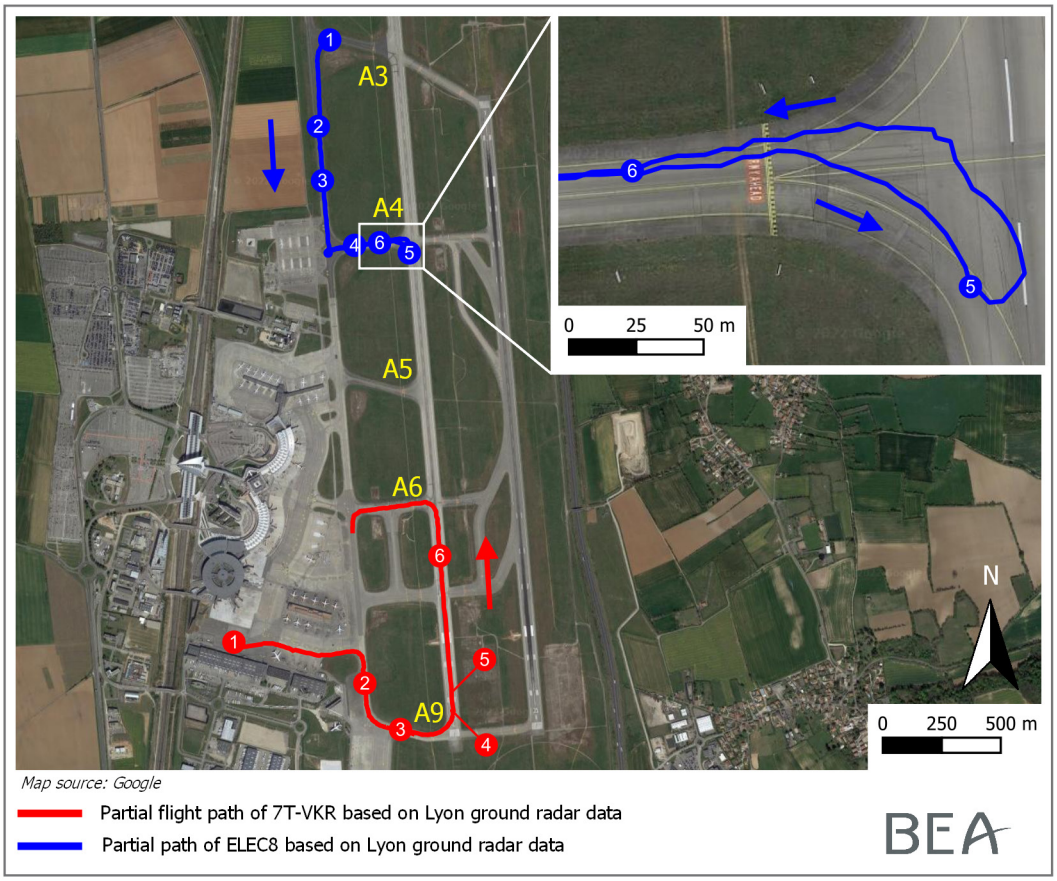
At 22:34:51, the GND controller asked the lead vehicle of the snowploughs to vacate the runway (point ❺). The lead vehicle driver read back and asked the snowploughs to vacate the runway.

The Boeing 737-800 reached a maximum speed of 63 kt, the V1 speed for the conditions of the day calculated by the crew being 118 kt.

At 22:35:14, the Boeing 737-800 was travelling at a ground speed of less than 10 kt. The crew contacted the LOC controller who asked them to vacate the runway via taxiway A6 (point ❻).

At 22:35:22, lead vehicle ELEC8 told the GND controller that the runway was vacated (point ❻).

At 22:42, the crew of flight AH1157 coming from A9, lined up again on runway 35L and took off; wheel lift-off occurred at taxiway A5.



Source: BEA

Figure 1: Partial paths of Boeing 737-800 registered 7T-VKR and of lead vehicle of snowploughs

1.2 Injuries to persons

Not applicable.

1.3 Damage to aircraft

Not applicable.

1.4 Other damage

Not applicable.

1.5 Personnel information

1.5.1 Air traffic controllers

At the time of the event, four people were on duty in the control tower:

- GND controller. The GND controller supplied the:
  - information and alert services on the apron[(6)];
  - control, information and alert services in the manoeuvring area, except for the runway strip.

  The GND controller was also in the pre-flight position where tasks included:
  - giving the initial clearance;
  - confirming the ATIS in force;
  - approving the start up;
  - assisting crews with the flight plan.

  The GND controller on duty at the time of the event had arrived at Lyon Saint-Exupéry in 1999 and was qualified in 1999 for the ground position and in 2001 for the tower and approach positions. He had worked in the tower supervisor position since 2012. His shift started at 15:00. He began in the pre-flight position where he stayed until 15:45. He held the tower supervisor position from 16:00 to 19:30. He then held the LOC controller position until 20:30. He had been in the GND controller position since 21:45.

- The tower position was manned by a LOC controller (also called local or tower controller) and an assistant. The LOC controller was responsible for the landing area and its runway safety area (runway strip) and the airspace between the ground and 2,500 ft in the Control Traffic Region (CTR[(7)]).

  The LOC controller also held the approach position.

  The LOC controller on duty at the time of the event had arrived at Lyon Saint-Exupéry in April 2005 and was qualified in 1999 for the ground position, in 2006 for the tower position and in 2007 for the approach position. On the day of the event, he had taken up his position at 15:00 exclusively in the tower. During his shift, he mainly occupied the LOC and GND positions. While holding the LOC position, he took back the approach position at 22:20.

[(6)] The apron is composed of the ramp and parking areas; it is used by aircraft during stop-over operations.

[(7)] Regulated airspace, intended to protect flights arriving at or departing from an aerodrome.

- Tower supervisor. The tower supervisor was responsible for organizing and supervising the real time operational functioning of the air navigation services. This included maintaining flight safety, complying with operational directives and optimizing the capacity while complying with the environmental constraints.

  The tower supervisor on duty at the time of the event had been a controller for 17 years and was qualified in 2003 for the ground position, in 2004 for the tower position and in 2005 for the approach position. He had worked in the tower supervisor position since 2010. He had taken up his position at 19:30 after a shift handover with the previous tower supervisor lasting ten minutes.

The controller and assistant who had occupied the approach position prior to the LOC and approach frequencies being grouped together were also present in the tower.

1.5.2 Ground personnel manoeuvring in the manoeuvring area

The Aéroports De Lyon (ADL) personnel manoeuvring with their vehicles in the manoeuvring area at the time of the event were the following:

- Driver of the lead vehicle and two snowplough drivers.

The driver of the lead vehicle was responsible for runway maintenance and lighting, he frequently manoeuvred in the manoeuvring area. The snow clearance mission was one of his duties. He had worked at ADL since 2004. He had followed a specific Snow Control training course and a training course to assess the condition of the pavements. He held the authorizations to drive on the apron and in the manoeuvring area. He was one of the team on-call the day of the event and had returned to the aerodrome at 19:00 due to the activation of the Snow Crisis Plan.

The driver of snowplough A1 was responsible for the maintenance of the lighting. He held a heavy goods vehicle driving licence and the authorizations to drive on the apron and in the manoeuvring area for Lyon Saint-Exupéry airport.

The driver of snowplough A2 was responsible for runway cleaning and sweeping. He held a heavy goods vehicle driving licence and the authorizations to drive on the apron and in the manoeuvring area for Lyon Saint-Exupéry airport.

- A manoeuvring area coordinator to measure the runway surface conditions.

The manoeuvring area coordinator arrived at ADL in 2018. He held the authorizations to drive on the apron and in the manoeuvring area for Lyon Saint- Exupéry airport. He had followed a training course to assess the condition of the pavements. This was the first episode of snow in which he measured the runway surface condition. He had come on duty at 22:00 after a briefing with the previous coordinator which covered in particular, the quantity of snow on the runways.

1.6 Ground vehicle information

The vehicles likely to partake in the snow clearance operations on the runway were the following:

- Ice clearance vehicles (fire fighting vehicles);
- Snow clearance vehicles (lead vehicle and snowploughs);
- Measurement vehicles (manoeuvring area coordinator).

1.6.1 Snow clearance vehicles

The two snowploughs which operated on the runways were equipped with a 6.40 m wide blade on one vehicle and a 8.40 m wide blade on the other vehicle.

The snowplough lead vehicle was a light vehicle equipped with a transmitter so that it could be monitored on the ground radar screens. When the snow clearance vehicles operated on the runway, only the lead vehicle appeared on the ground radar screens.

Source: ADL

Figure 2: Snow clearance vehicles

1.6.2 Measurement vehicle

The measurement vehicle was a light vehicle provided with a transmitter so that it could be monitored on the ground radar screens. It was equipped with a measuring instrument attached to the rear of the vehicle.

Measurement vehicle

Measuring instrument

Source: ADL

Figure 3: Measurement vehicle

1.7 Meteorological information

1.7.1 Meteorological conditions on day of event

On 14 November, an “amber” severe weather warning was current in the Lyon region. A disturbance was moving up from the south of France with heavy precipitation. This heavy precipitation cooled the atmosphere, causing an isothermal phenomenon (temperature at 0°C from a given altitude down to the ground) which resulted in snowfall. During heavy precipitation, in light wind conditions, snowfall can cool the atmosphere as it melts and evaporates bringing the freezing level down to the ground. This means that there can be a snowfall and a temperature of 0°C on the ground when a few hours before the temperatures were positive.

At the time of the event, the wind was light, visibility was 2 km, with continuous moderate snow and mist, the sky was overcast with a low ceiling (200 ft). The measured ground conditions gave a temperature of 0°C and 99% humidity. Wet snow of a depth of 60 mm was measured at the aerodrome outside the runways, in the areas where the snow had not been cleared.

The METAR indicated 1 mm of wet snow on the runways at the time of the event. The METAR at 23:00, i.e. 30 min after the event, indicated 15 mm of wet snow on the runways.

1.7.2 Communication of information

An aerodrome warning message[8] valid from 14 November at 18:00 to 15 November at 06:00, was issued by the French met office, Météo-France, at 12:38; it forecast 5 to 10 cm of snow with a probability of more than 15 cm.

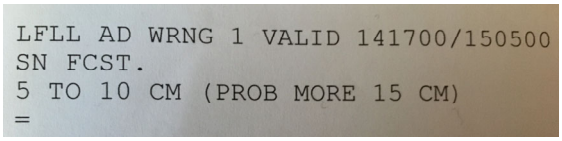


Figure 4: Copy of aerodrome warning message issued on 14 November 2019

The Météo-France officers in charge of meteorological information at Lyon Saint-Exupéry airport indicated that this was the first day of snow of the year and that it was an early episode.

They explained that on the day of the event, they had contacted the aerodrome operator at 09:00 to advise of the episode of snow. Their contacts were sceptical because of the temperature. They specified that the isothermal phenomenon is not well known. A telephone meeting with the tower supervisor and the aerodrome operator was held in the early afternoon, in which it was specified that a substantial amount of snow was expected between 19:00 and 21:00. Telephone contact was then regular and information was updated on the aerograms (see Figure 5) at least every hour.

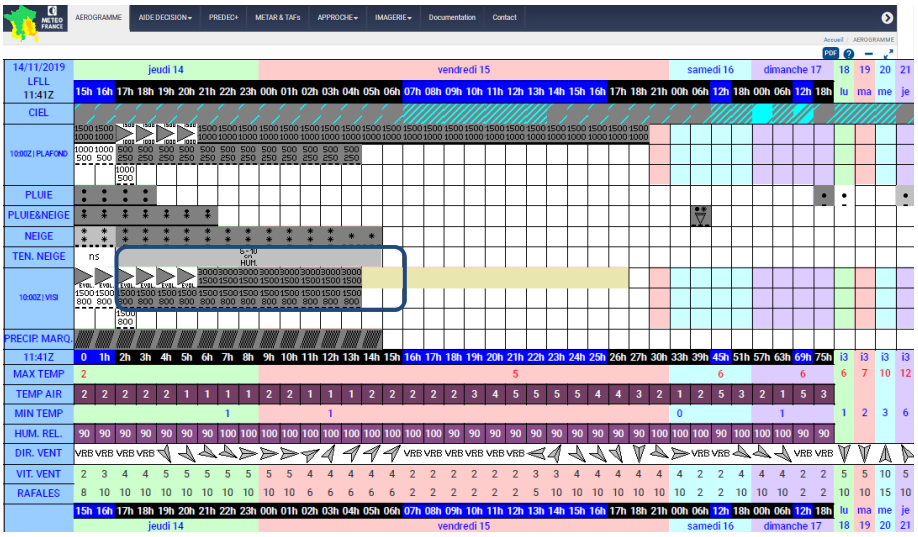


Figure 5: Example of aerogram issued on 14 November 2019

[8] Message containing information about observed or forecast weather conditions that may adversely affect aircraft on the ground, including parked aircraft, and aerodrome facilities and services. The aerodrome warning messages for the local aerodrome are part of the information provided to operators and crew members for flight planning.

In the afternoon, there was a malfunction with respect to the software that transmitted the aerograms. The aerograms were thus transmitted without taking into account the corrections made in relation to the model forecasts. These corrections particularly included a rise in the re-evaluation of the expected snowfall. As a result, for one hour, from 14:45 to 15:45, the forecasts displayed were not accurate and underestimated the quantities of snow expected. ADL and the Air Navigation Services (ANS) were informed of this by telephone.

This malfunction thus did not have any direct consequence on the activation of the Snow Crisis Plan.

Those consulted, the aerodrome operator and the Lyon control centre (SNA-CE), indicated that the forecasts proved to be relevant and relatively accurate both in terms of strength and timing.

1.8 Aids to navigation

Not applicable.

1.9 Communications

The following information was provided by SNA-CE and analysed in the scope of the investigation:

- Communications on the GND (121.830), TWR (120.450) and VEHICLE GND (121.905) frequencies from 21:00 to 23:30.
- The recorded telephone exchanges on the lines between the tower and the exterior between 21:00 and 23:30.

The lead vehicle of the snowploughs was identified on the ground radar (call sign ELEC8) and the driver was in communication with the control units. The snowplough drivers listened to the exchanges with the control on the frequency used by the lead vehicle and communicated with the lead vehicle via an internal frequency. The internal frequency was solely for all the measurement and snow clearance vehicles operating on the aerodrome. On 14 November, as this frequency was often saturated, communications between the lead vehicle and the snowplough drivers were also made via the drivers' mobile phones.

The driver of ELEC8 was in communication with the control on the VEHICLE GND frequency, then on the TWR or GND frequencies when he was driving on the runways or taxiways. During the runway closure, ELEC8 alternated between the parking area and the runway, with the driver passing from the TWR frequency to the VEHICLE GND frequency, sometimes remaining on the VEHICLE GND frequency while driving on the runway.

The driver of the measurement vehicle (call sign LA2) was in communication with the control on the VEHICLE GND frequency, then mainly on the TWR frequency when he was driving on the runways or transmitting the results of the measurements. The TWR frequency was busy for 16 minutes between 21:00 and 22:30 with respect to the runway surface condition measurements.

A transcript of the main exchanges is give in the Appendix.

The telephone line exchanges between the control tower and the exterior between 21:00 and 23:30 are detailed in paragraph 1.17.4.3.

1.10 Aerodrome information

1.10.1 General

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*": take-offs are performed on the inner runway 17R/35L and landings on the outer runway 17L/35R.

The following figure shows the movement area of Lyon Saint-Exupéry airport, i.e. the part of the aerodrome used for take-offs, landings and taxiing. It includes the manoeuvring area and the aprons.

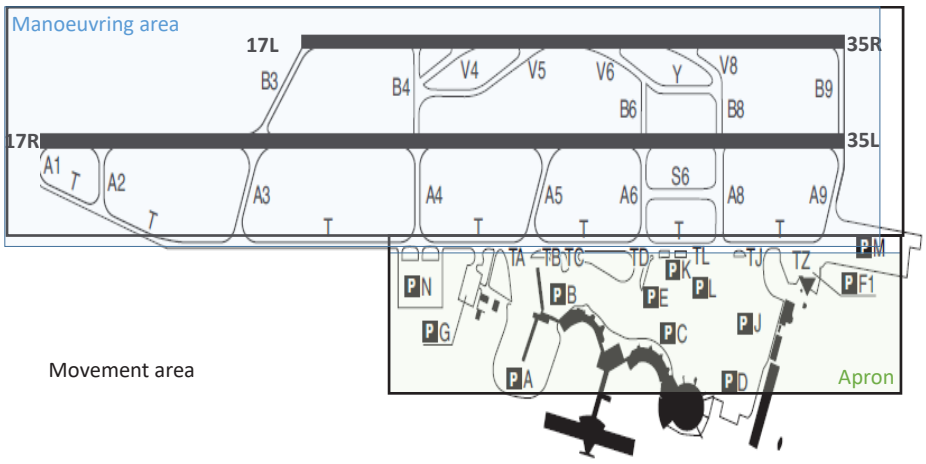
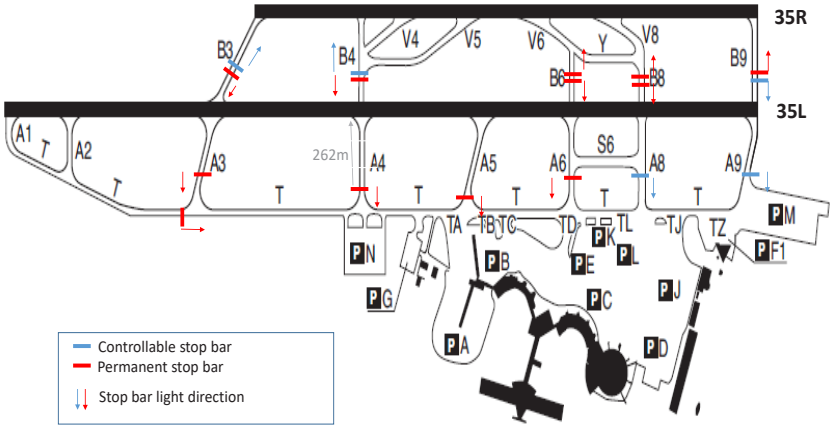


Figure 6: Movement area of Lyon Saint-Exupéry airport

1.10.2 Stop bars

A stop bar system was installed to protect runways when LVP were in force. The stop bars were composed of unidirectional red lights positioned across the taxiway. They are shown in the following figure.



Source: BEA/DSNA

Figure 7: Position of stop bars in manoeuvring area

The stop bars protecting the entrance to runway 35R were located on taxiways B3, B4, B6, B8 and B9. The stop bars protecting the entrance to runway 35L were located on taxiways B3, B4, B6, B8, B9 and T, A3, A4, A5, A6, A8, A9.

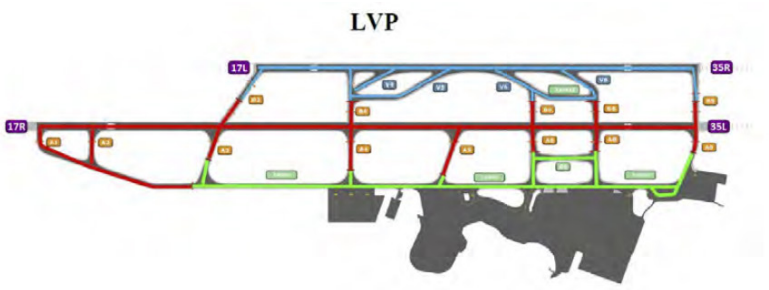
The stop bars shown in red in Figure 7 were so-called permanent stop bars, i.e. when the system was activated, they were continuously lit. There were no detectors to detect when these permanent stop bars had been crossed.

Five stop bars could be controlled (they are shown in blue in Figure 7). These were stop bars A8 and A9 for access to runway 35L, stop bar B9 for access to runway 35R, and stop bars B3 and B4 for vacating runway 35R and crossing runway 35L. Only taxiways equipped with controllable stop bars could be used in LVP conditions. The controller manually deactivated the controllable stop bar he wished to use via a control panel. The stop bar was then temporarily switched off. The loops detecting that the controllable bars had been crossed were removed in 2019 due to technical issues. As a result, the controller was not alerted by the system when a vehicle or aircraft crossed an activated stop bar.

When the runways were used as a nominal twin runway, the controller could act on stop bar A9 giving access to runway 35L, and on stop bars B3 and B4 to vacate runway 35R. The stop bars A8 and B9 remained illuminated.

When in single-runway operations using runway 35R, the only action was on B9. A9, B3 and B4 were inactivated i.e. extinguished.

To avoid permanent stop bars being crossed in case of LVP, except under exceptional operating circumstances, vehicles were requested to follow the following route for scheduled runway inspections.



Source: DSNA

Figure 8: Route for inspection vehicles in LVP

1.11 Flight recorders

Air Algérie, via its civil aviation authority, provided data excerpts, recovered from the flight data analysis programme, for the rejected take-off run of aircraft AH1157.

The ground radar data between 21:00 and 23:30 was provided by SNA-CE and made it possible to plot the paths of aircraft AH1157 and vehicle ELEC8 which are shown in Figure 1.

1.12 Wreckage and impact information

Not applicable.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

Not applicable.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

Not applicable.

1.17 Organizational and management information

1.17.1 Management of operations in winter conditions - Snow Plan

The European regulations on aerodrome operations[9] required that the aerodrome operator ensures that the means and procedures are defined and in place to provide safe conditions for operations in winter conditions. The aerodrome operator must ensure that the accumulation of contaminants is minimized. The operator must prepare a Snow Plan with the ANS and other relevant partners that includes the snow clearance criteria, surface assessment methods and suspension of operations criteria (see paragraph 1.17.3).

The Snow Plan[10] drawn up by ADL and in force at the time of the event defined the criteria for triggering the Snow Crisis Plan[11], the organization of snow clearance and specified the roles and responsibilities of the various participants.

The plan specified the ADL, Météo-France, Civil aviation safety directorate (DSAC) and SNA-CE missions.

The ADL's main contacts were the operations manager, the winter services manager and the snow cell manager. The operations manager was the interface with SNA-CE.

SNA-CE's main contacts were the operational duty manager and the tower supervisor. The plan specified that the operational duty manager represented the head of SNA-CE. When the Snow Plan was implemented, he coordinated all the actions relating to the opening and closing of runways, in liaison with the operations manager and the tower supervisor.

[9] Part-ADR.OPS.B.035 Operations in winter conditions and corresponding AMC.

[10] The exact title of the document is *"Guide opérationnel PC neige/PC verglas"*.

[11] The Snow Plan designates the document, the Snow Crisis Plan are the measures implemented.

There were different procedures to be followed on the activation of the Snow Crisis Plan, according to the reasons for its activation:

- If there was information indicating an imminent risk of snowfall, the technical centre called the on-call winter services manager. The latter contacted the operations manager and informed him of his arrival and/or the preventive activation of the Snow Crisis Plan.
- The activation of the Snow Crisis Plan could be accompanied by the setting up of a crisis unit called the airport coordination unit[12]. The Snow Plan referred to this but did not define the criteria for opening it or its prerogatives.
- The Snow Plan set out the coordination procedures for an intervention and gave a pivotal role to the winter services manager who led the work. The winter services manager contacted the tower supervisor or the operational duty manager to define and modify priorities.

[12]The ADP crisis management manual indicates that the airport coordination unit can be armed in case of a critical event. There are no criteria to determine whether an episode of snow should be considered a critical event.

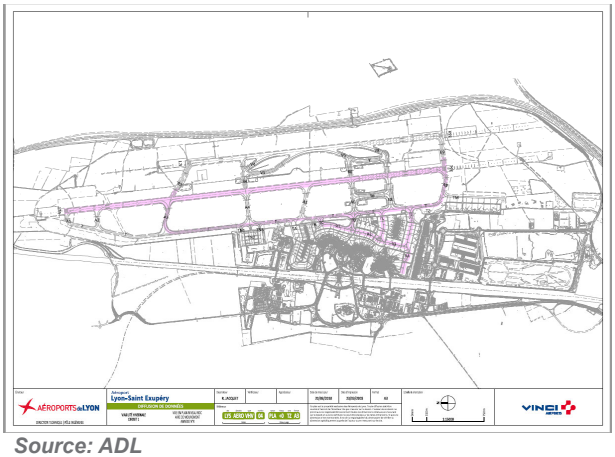
Snow clearance

There were three planned snow clearance circuits:

- Circuit 1[13]: snow clearance of runway 35L, taxiway T, and entrance and exit taxiways A3 and A9.
- Circuit 2: snow clearance of runway 35R and entrance and exit taxiways B3 and B9.
- Circuit 3: snow clearance of remaining entrance taxiways.

[13]Circuit 1 corresponds to the snow clearance from the runway and what is commonly referred to as the "CAT III circuit" by the people in charge of snow clearance on the day of the incident.

Four vehicles were assigned to these circuits. The remaining resources were dedicated to snow clearance in the parking areas and on the aprons. The duration of the snow clearance operation varied according to the depth of the snow and the precipitation in progress.



Source: ADL

Figure 9: Snow clearance circuit 1

Measurements

The measurements to characterize the surface condition of the runways were carried out by the manoeuvring area coordinator at the request of the tower, the operations manager or the winter services manager. The following information was transmitted to the tower as soon as it was assessed:

- The type of contamination and the average thickness per third of the runway.
- The estimated braking conditions using the table defined by the regulations: "good/average to good/average/average to poor/poor/nil".

The thickness of the snow or slush was given in millimetres. Measurements were taken with a vertical gauge at intervals of between 300 m and 400 m.

The Snow Plan specified that, as a general rule, measuring the friction and determining the nature of the contaminant took about 15 minutes for a pavement measuring around 4,000 m

1.17.2 Management of vehicle traffic by SNA-CE control services

1.17.2.1 Management of frequencies and areas of responsibility

The management of the frequencies and areas of responsibility for vehicles driving in the manoeuvring area was described in the SNA-CE Operations Manual (OM)[(14)].

[(14)] The TWR-APP OM of the SNA-CE control centre which concerns the tower and approach is called the OM in the rest of the report.

Any vehicle wanting to drive in the manoeuvring area had to contact the VEHICLE GND frequency. The tower supervisor coordinated the vehicle's desired path with the GND controller or the LOC controller according to the position of the vehicle, and transferred the vehicle to the GND or TWR frequency. The GND sector was responsible for the manoeuvring area except for the runways, their safety areas and taxiways situated between the runways. The LOC sector was responsible for the runways, their safety areas and the taxiways between runways.

The GND controller coordinated any request to enter the runway safety areas with the LOC sector. If the request was accepted, the GND controller transferred the vehicle to the TWR frequency. The LOC controller had radio contact with all the vehicles driving on the runways and in the runway safety areas.

If runway 35L was closed and marked with a St Andrew's cross, it was considered a taxiway. In this case, the LOC sector and GND sector coordinated the management of the crossing of runway 35L with the approval of the tower supervisor.

1.17.2.2 Indication of runway use by vehicles

If a runway was closed for an anticipated time of more than one hour:

- The St Andrew's cross had to be installed. It was installed on the tower supervisor's request and took about 20 minutes.
- On his strip board, the LOC controller had to put the magnetic "runway closed" strip in the runway bay.

If a runway was closed for an anticipated time of less than one hour:

- The LOC controller put a "work" strip on his strip board, in the corresponding runway area, indicating on the strip, the reasons for the closure and/or equipment and vehicles on the runway. The magnetic "runway closed" strip could also be used to show the runway was "busy".

If the runway was kept open:

- The LOC controller showed the presence of a vehicle on a runway or in its safety areas by:
  - placing the vehicle strip in the runway bay on his strip board;
  - closing the wind indicator for the runway concerned;
  - displaying the static map showing the runway is in use on the flight radar screen.

The GND controller filled in a "work" strip for all vehicles in the manoeuvring area and for all vehicles on the apron which might interfere with the movement of aircraft.

1.17.3 Operating restrictions and suspension of operations

1.17.3.1 DSAC procedures for deciding to suspend flight operations on a runway in degraded meteorological conditions

The DSAC procedure dated 22 July 2010, in application since 1 September 2010, specified the responsibilities and the transmission of information for the suspension of flight operations on a runway in degraded weather conditions. In particular, it was mentioned that:

If the aerodrome operator was aware of a danger or "serious inconvenience", likely to hinder the continued operation of the aerodrome, it was to transmit this information (together with the factual elements which it held), and suggest a modification of the aerodrome operating conditions (which could go as far as the suspension of flight operations) to the control service provider.

When the air navigation service provider was aware of a danger or "serious inconvenience", likely to hinder the continued operation of the aerodrome, it could take the decision to suspend flight operations in compliance with 5.2.2 of RCA3, if necessary in coordination with the aerodrome operator. It was then to inform the aerodrome operator and the DSAC IR[15] duty manager of this and make sure that a NOTAM was published.

If arbitration was necessary, the DSAC IR duty manager transmitted his decision to the air traffic control service provider and the aerodrome operator.

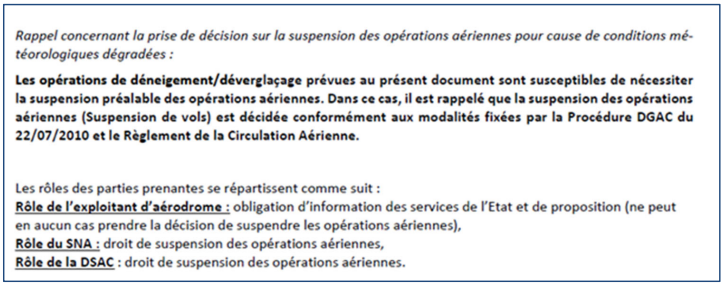
1.17.3.2 Adoption of DSAC procedure in Snow Plan, Lyon Saint-Exupéry Aerodrome Manual and SNA-CE TS OM[16]

The Snow Plan, the Lyon Saint-Exupéry Aerodrome Manual and the SNA-CE TS OM referred to the DSAC procedure for deciding to suspend flight operations.

The Snow Plan indicated that if the snow or ice clearance operations required the prior suspension of flight operations, then it was decided on in compliance with this procedure (see Figure 10).

[15] Direction de la Sécurité de l'Aviation Civile Inter Régionale (Civil aviation safety directorate - Regional office).

[16] The SNA-CE OM specifically for the tower supervisor will be called TS OM.



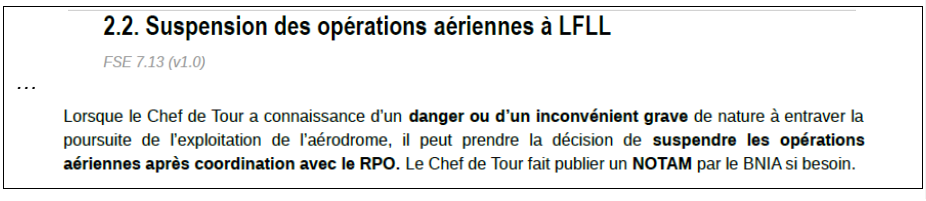
Rappel concernant la prise de décision sur la suspension des opérations aériennes pour cause de conditions météorologiques dégradées :

Les opérations de déneigement/déverglaçage prévues au présent document sont susceptibles de nécessiter la suspension préalable des opérations aériennes. Dans ce cas, il est rappelé que la suspension des opérations aériennes (Suspension de vols) est décidée conformément aux modalités fixées par la Procédure DGAC du 22/07/2010 et le Règlement de la Circulation Aérienne.

Les rôles des parties prenantes se répartissent comme suit :
Rôle de l'exploitant d'aérodrome : obligation d'information des services de l'Etat et de proposition (ne peut en aucun cas prendre la décision de suspendre les opérations aériennes),
Rôle du SNA : droit de suspension des opérations aériennes,
Rôle de la DSAC : droit de suspension des opérations aériennes.

Figure 10: Excerpt from Snow Plan concerning suspension of flight operations

The DSAC's initial procedure did not explicitly state who locally, within the ANS, had the power to suspend operations. The SNA-CE TS OM specified that the tower supervisor, after coordination with the operational duty manager could take the decision to suspend operations (Figure 11).



2.2. Suspension des opérations aériennes à LFLL

FSE 7.13 (v1.0)

…

Lorsque le Chef de Tour a connaissance d'un **danger ou d'un inconvénient grave** de nature à entraver la poursuite de l'exploitation de l'aérodrome, il peut prendre la décision de **suspendre les opérations aériennes après coordination avec le RPO.** Le Chef de Tour fait publier un **NOTAM** par le BNIA si besoin.

Figure 11: Excerpt from SNA-CE TS OM

The Lyon Saint-Exupéry Aerodrome Manual indicated that the decision to suspend operations was taken when the reported conditions were such that the estimated risk level, regardless of the aircraft likely to land on the runway, justified such a decision. The manual detailed the conditions for which the DSAC IR had to suspend the use of a runway. These included water, slush, wet snow and dry snow if the depth of the contaminant warranted it.

1.17.3.3 Closures, regulation and suspension of traffic not covered by DSAC procedure

It was indicated in the introduction to the DSAC procedure mentioned above that this procedure dealt with decisions to suspend flight operations on a runway that could be anticipated, based on weather forecasts or given the progressive deterioration of runway operating conditions. It did not deal with decisions to suspend flight operations for a limited period of time linked to actions on the runway (a runway inspection, a snow clearance operation, etc.)

For these decisions, SNA-CE used various options for closing a runway and regulating traffic during snow clearance operations.

Runway open

The runway surface condition measurements did not lead to the closure of the runway. The measurement vehicle could drive on an open runway even in LVP conditions.

Temporary closure of runway

The Snow Plan specified that the runways could not be used while they were being cleared of snow. The SNA-CE OM indicated that snow or ice clearance from a runway could take around 30 minutes. Any interruption for an aeroplane manoeuvre increased this time by around 10 minutes. Except in the event of an emergency, the snow clearance vehicles had priority over all other traffic.

The snow clearance operations gave rise to the temporary closure of a runway with operation changing to single runway operation.

Zero capacity

In exceptional and critical operating conditions, the SNA-CE TS OM specified that the tower supervisor could ask for zero capacity when he considered that the arrival of other aircraft could aggravate the situation and cause a safety problem. Zero capacity fixed the volume of traffic at zero. When zero capacity was applied to incoming aircraft, only the aircraft already programmed and accepted in the CTR could land.

Closure of aerodrome

Lastly, in addition to the suspension decisions linked to actions on the runway and the operation suspension measures described in the DSAC procedure, the SNA-CE TS OM specified that it was possible to close the aerodrome. Only the aerodrome operator, ADL or the prefect could decide this.

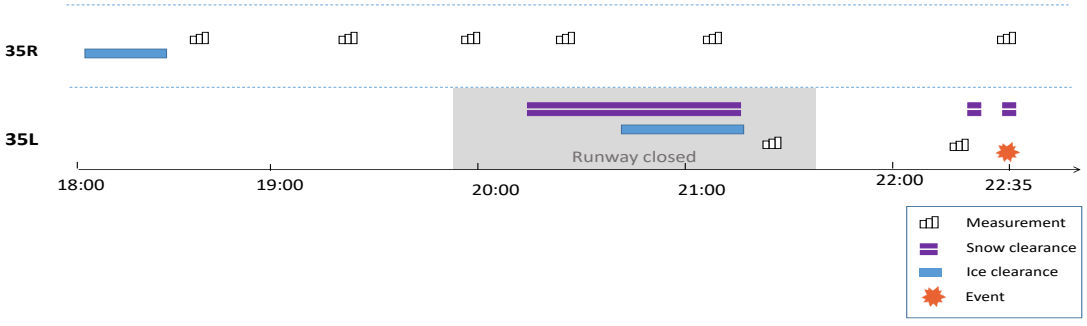
The suspension of operations as defined in the DSAC procedure came between zero capacity and closure of the aerodrome.

1.17.4 Management of snow clearance day of event

1.17.4.1 Chronology of snow clearance

Synthesis based on statements made by the winter services manager, and the drivers of the lead vehicle and snowploughs, the snowplough radar tracks, the radio communications and the ATIS messages.

Figure 12 shows the chronology of the snow clearance, ice clearance and runway surface condition measurement operations between 18:00 and 22:35.



Source: BEA

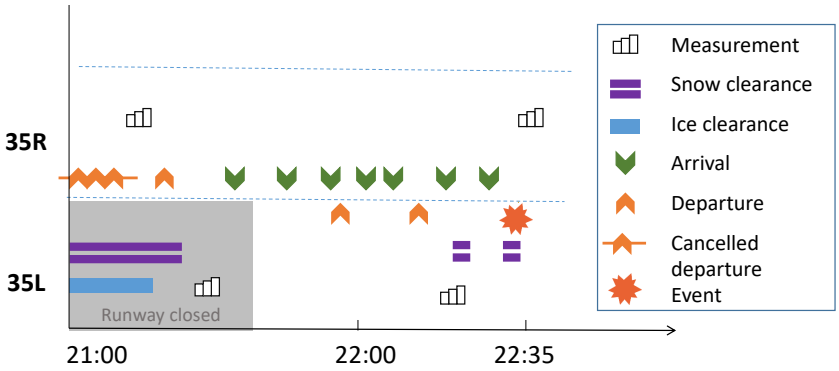
Figure 12: Snow clearance operations between 18:00 and 22:35

At around 17:00, the teams who had been on duty since the morning were released and most of those on-call had returned home. At around 18:00, at the start of the evening, ice clearance operations were carried out on runway 35R as a preventive measure. Ice clearance operations were only carried out on runway 35R so as to keep runway 35L open for the departures in progress. This preventive treatment was carried out in order to start acting on the runways pending the arrival of the snow clearance team. The on-call teams were then called back to the aerodrome.

The runway team, activated at 19:00, started by testing the snowplough blades and ground contact in the parking area. Runway 35L was closed shortly before 20:00. The possibility of installing the St Andrew's crosses was not mentioned as the snow clearance operation was supposed to last less than an hour (45 minutes had been mentioned). Two snowploughs started the actual snow clearance work 20 minutes later. The third snowplough whose settings were incorrect, remained in the parking area.

The snow clearance was difficult, requiring several passes, the runway quickly turned white again, the snow being heavy and wet. The snowploughs continued to clear snow from the edges while the fire fighting services started clearing the ice. The runway was freed after the runway surface condition measurements at 21:25. All that remained was for the runway to be joined to the taxiways which implied the vehicles entering the runway again to remove the remaining mounds of snow. The lead vehicle and the snowploughs resumed the snow clearance operations, after a 30 minute, wait on taxiway T, followed by A3 and then A4.

Figure 13 shows the snow clearance operations and the traffic between 21:00 and 22:35.



Source: BEA

Figure 13: Mix of operations between 21:00 and 22:35

Up until 21:38, the aeroplanes had taken off from runway 35R. Three cancelled take-offs due to aeroplane de-icing problems had led to the runway being crossed or backtracked while the snow clearance operations were in progress.

In the hour preceding the event, the arrivals and two departures took place without interfering with the snow clearance except on taxiway T. In the minutes preceding the event, there were several simultaneous operations: measurements on runway 35L, snow clearance to join A3 and the runway and an arrival on runway 35R. At the time of the occurrence, measurements were being made on runway 35R, snow was being cleared from taxiway A4 and there was a take-off from runway 35L.

1.17.4.2 Runway surface condition measurements day of event

The ATIS recorded data indicated around ten runway surface condition measurements between 18:40 and 22:30. The results of these measurements are shown in the table below. Measurements were carried out after the runways had been treated. Additional measurements were requested by the tower supervisor. The latter explained that it was difficult to follow the condition of the runways. The two runways had not been treated in the same way and the measurements, in particular the thickness of the contaminant, differed from the information reported by the pilots. A pilot who took off at 20:50 from runway 35R reported on the frequency that the runway surface conditions were not those announced. A pilot who taxied to the beginning of the runway and then cancelled the take-off due to de-icing problems, called the tower to indicate that the announced contaminant measurements were inexact.

The LOC controller asked six of the seven crews which had landed prior to the event (between 21:40 and 22:30) to report the runway surface conditions on landing in order to forward this information to the aeroplanes on final. The pilots indicated medium braking conditions and some of them reported that there was more snow than announced. The controller indicated that a pilot's opinion, even if it was subjective, was the most reliable estimation.

Time	Runway	ATIS runway surface conditions and pilot reports
18:40	35R/35L	Good braking
19:18	35R/35L	Presence of wet snow
19:30	35R/35L	Average braking, wet snow
20:03	35R	Average braking, 1 cm of wet snow
20:30	35R	Average braking, 1 mm of wet snow
20:50	35R	Pilot report: *conditions moins bonnes qu'annoncées*
21:10	35R	Average to poor braking, 1 mm of wet snow
21:25	35L	Average to poor braking, 5 mm
21:31	35R	Pilot call: *épaisseur de neige beaucoup plus importante qu' 1mm*
21:40	35R	Pilot report: *moyen tendance pas bon*
21:55	35R	Pilot report: *medium*
22:00	35R	Pilot report: *medium*
22:06	35R	Pilot report: *moyen*
22:15	35R	Pilot report: *moyen, quantité de neige bien supérieure à 2 mm*
22:20	35R	Pilot report: *medium - medium*
22:32[17]	35L	Poor, 15 mm, wet snow
22:35[18]	35R	Average, Average to good, average, 10 mm/15 mm/20 mm

Source: BEA

Table 1: Measurements made and conditions reported between first treatment and event

[17] Measurements reported by the manoeuvring area coordinator recorded in the ATIS at 22:50.

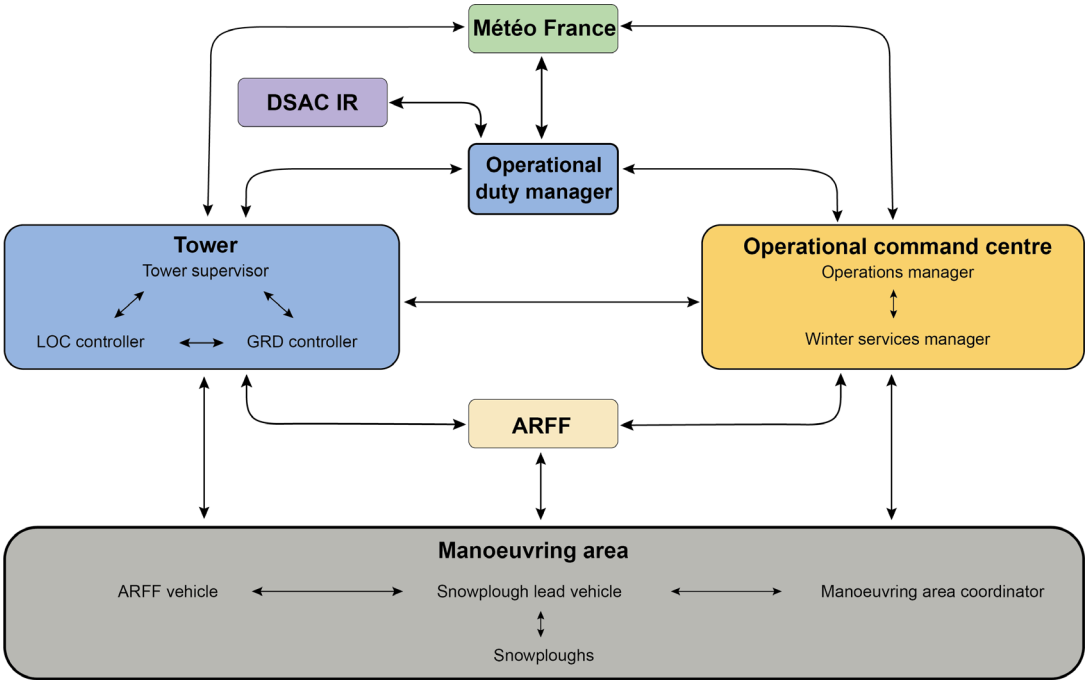
[18] Measurements reported by the manoeuvring area coordinator recorded in the ATIS at 22:50.

The manoeuvring area coordinator on duty at the time of the event explained that he had come on duty at 22:00. He considered that at this time, runway 35R was covered with a relatively thick layer of snow, however the thickness given by the measuring instrument was constant and indicated 5 mm[19]. In view of this inconsistency, he stopped using the measuring instrument. He indicated that it was only used to supplement the manual measurements. It was possible to visually assess the type of contaminant and to measure its thickness using a slide gauge. The friction measurements could be carried out by means of braking tests using a vehicle travelling at around 50 km/h.

[19] In hindsight it was found that the instrument was not calibrated for the vehicle used.

1.17.4.3 Coordination of operations and impact on work in tower on day of event

Figure 14 shows the main contacts and their interactions with respect to the snow clearance strategy and the implementation of zero capacity.



Source: BEA

Figure 14: Main contacts and interactions with respect to the snow clearance strategy and the implementation of zero capacity

On the activation of the Snow Crisis Plan, the winter services manager went to the ADL operational command centre. The centre's workload was very high, especially for passenger management and assistance to companies in managing hotels. The parking areas were displayed on all the command room screens in order to manage all the aeroplanes on hold. The ground radar which was usually displayed on one of the screens to monitor the vehicles manoeuvring in the manoeuvring area was thus not displayed. The operations manager indicated that on that day, the airport coordination unit had not been activated due to there being few planned departures.

A first call between the tower supervisor and operations manager had taken place to define both the strategy to be adopted and the priorities. The operational duty manager and the operations manager were in contact several time because the airline services were unable to effectively de-ice the aeroplanes. The de-icing problems created a high workload in the control tower, especially for flight plan updates and departure cancellations.

Zero capacity for incoming traffic was implemented at 21:18, initially Until Further Notice (UFN). At 22:20, zero capacity was modified to four incoming traffic per hour.

The operational duty manager called the DSAC duty manager when zero capacity was implemented. The DSAC IR personnel encountered in the scope of the investigation indicated that the DSAC duty manager did not monitor the evolution of the runways' surface condition as he did not have the expertise to decide on their closure based on the runway surface condition measurements.

The playback of the VEHICLE GND frequency and the tower's telephone calls showed that there were numerous discussions between the tower and lead vehicle as well as between the tower and operational command centre concerning the snow clearance and traffic management strategy to be adopted. Between 21:00 and 22:30, 44 calls were recorded on the tower supervisor's telephone and on the VEHICLE GND frequency, taking up 40 minutes of the 90 minutes of this period.

In addition to the calls concerning the technical problems, there were calls linked to the implementation of the regulation of traffic and snow clearance:

- Seven calls with the snowplough lead vehicle concerned the organization or snow clearance strategy.
  The calls especially concerned the advisability of clearing the snow from runway 35R after 35L and/or clearing snow from the CAT III circuit.
- Four calls with the operational command centre (operations manager or winter services manager) concerned the zero capacity and snow clearance strategy.
  During one call, the tower supervisor indicated to the operational command centre that he had serious doubts about the quantity of contaminant announced and that he did not know whether a decision would have to be made to suspend operations, specifying that the situation was going to become complicated.
- Three calls with the operational duty manager concerned the coefficients and the implementation of zero capacity.
- Three calls were made to the Flow Management Position (FMP) for the implementation of zero capacity and the regulation of traffic.

1.18 Additional information

1.18.1 Statements

1.18.1.1 Statements of drivers of lead vehicle and snowploughs

The lead vehicle driver explained that after clearing snow from runway 35L and the CAT III circuit (A9, T, A3), he wanted to go onto taxiway A4. This taxiway was often a priority after the CAT III circuit as a large part of the traffic used it.

The lead vehicle driver indicated that the GND controller had made them wait and then cleared them to clear snow from the taxiway and enter the runway to join it with the taxiway.

He entered the runway followed by the two snowploughs. On reaching the runway axis, he saw the headlights of an aligned aeroplane. He anticipated a departure and started turning around. At the same time, the GND controller asked him to vacate the runway. He felt the urgency in the message as the controller had cut short the message from a pilot.

The snowplough drivers explained that when they saw ELEC8 leave the runway, they immediately followed it.

The lead vehicle driver specified that he thought that the aeroplane was only aligned on the runway. When he then saw the aborted take-off, he thought it was due to a technical problem or the condition of the runway.

The lead vehicle driver explained that the GND controller had kept him on the GND frequency which happened from time to time. The two frequencies were often grouped, especially at night. The snowplough drivers indicated that when they manoeuvred in the manoeuvring area, if the runway was closed, the controller did not necessarily ask them to change to the TWR frequency. They never took the initiative to change the frequency.

The lead vehicle driver indicated that snow clearance was the only situation where they had to drive on the runway in LVP conditions; to do this, they had to cross the illuminated stop bars.

1.18.1.2 LOC controller statement

The LOC controller indicated that at the time of the accident, he was in the LOC and approach positions. He specified that the positions were usually grouped at 22:00 but that given the workload, this was deferred to 22:20. The volume of traffic was starting to decrease, the two controllers who had previously been in the approach position were still in the tower. At least seven people were in the tower with comings and goings.

He indicated that when the Boeing 737 performing Air Algérie flight AH1157 arrived at the stop bar, he "opened" it and cleared the crew to line up and take off. He monitored the aeroplane in the outside environment, visibility was good.

He explained that he saw on the ground radar and then outside, that the snowplough lead vehicle was exceeding the stop bar. There was no alert on the ground radar. At the same time, he saw the aeroplane performing Air Algérie flight AH1157 start the take-off run. He first questioned his assistant and then turned to the GND controller to ask him what were the snowploughs' intentions.

He indicated that he then asked to crew to reject the take-off using the emergency phraseology.

He explained that previously, he and the GND controller had directly coordinated with each other. The GND controller had told him that they were "going to do the junctions". In his mind, this only concerned the taxiways. He had first replied in the negative as an incoming aeroplane was going to vacate the runway via this taxiway.

He explained that the GND controller coordinated either with him or with his assistant. The two frequencies were busy and the two controllers (LOC and GND) were not necessarily simultaneously available for each quick exchange.

The LOC controller explained that a paper strip was used for each vehicle. There was a flexible plastic strip for the measurement vehicle. For a vehicle such as ELEC8, the controllers had to make a strip. According to the duration of the work, either the paper strip was passed from the GND controller to the LOC controller or each controller created a paper strip for himself.

He indicated that that evening, there were also difficulties in connection with the stop bars to be managed. In particular, on taxiway B4, several pilots had told him that the inter-runway stop bar was closed whereas it was open. The light from the stop bar shed in the opposite direction was reflected in the snow. Moreover, it was not possible to control this stop bar in this direction.

He explained that they continuously roughed out strategies according to the weather, the runway surface condition measurements, and the high or low volume of traffic in coordination with the tower supervisor. Their aim was to give the best possible service.

1.18.1.3 GND controller statement

The GND controller indicated that he came on duty at 15:00. At the beginning of his shift, he was in the preflight position, and then in the tower supervisor position from 16:30 to 19:30. He then held the LOC controller position until 20:30.

He indicated that he took the GND controller position at around 21:40. At this time, the airport was using only one runway, the 35R, there was less traffic and the infrastructures had been correctly cleared of snow. He remembered that there were between six and seven people in the tower.

The GND controller explained that when ELEC8 started joining the runway to the taxiways, the driver asked for clearance to remove snow from taxiway A3 and to enter the runway. The GND controller thought that he had then coordinated the movement of the snow clearance vehicles with the LOC controller assistant.

He explained that when ELEC8 asked for clearance to remove snow from taxiway A4, he looked at the air radar, shared his action plan with the LOC controller and indicated that they allowed the incoming plane to pass. He then cleared them to remove snow from the taxiway and to make the junction with the runway. The two runway thresholds were visible and there were no ground movements. He did not watch the ground radar, he no longer had Air Algérie (AH1157) in mind. He was in discussions with the tower supervisor about the surface conditions at this point.

The LOC controller turned to him and asked what the snowploughs were doing, indicating that there was a departing aeroplane. The GND controller asked the snowploughs to vacate the runway and saw the aeroplane carrying out the Air Algérie flight (AH1157) decelerate.

The GND controller explained that there were around 25 aeroplanes on his strip board and that his board was cluttered. The ELEC8 strip was positioned in the middle of the board. He indicated that the GND controller strip board was used more as a notepad and that it was not possible to show that a runway was occupied.

1.18.1.4 Tower supervisor statement

The tower supervisor came on duty at 19:30. He indicated that the handover was complicated, a monitor was faulty.

The tower supervisor explained that the meteorological information had been precise very quickly, with snow forecast until 04:00 in the morning. When they implemented the LVP, they consulted the OM which indicated limiting the movement of vehicles in LVP conditions to the maximum.

The tower supervisor indicated that initially he called the operations manager about the snow clearance to define the strategy to be adopted and to define the priorities: large runway (inner runway), small runway (outer runway) or taxiways. However, ELEC8 soon explained that the runway was turning white behind the snowploughs and that this prevented them from moving on to another surface. When ELEC8 told them that he was handing back the runway, the junctions had not been cleared. He explained that the snowploughs could not do otherwise as the runway would have been covered in snow the time needed to do the junctions and the runway would never have been handed back.

He indicated that the regulation of traffic was in place, taking into account various hypotheses: keeping twin runway operations or changing to single runway operations and the implementation of LVP. They had to continuously adapt: they were on the front line for managing and taking decisions. The tower supervisor explained that he continued to exchange with the previous tower supervisor [GND controller at the time of the event] to take the decisions, and with another controller colleague who also carried out the tower supervisor duties. There were thus three of them to take decisions. He explained that at one point they had thought above privileging single runway operations but that the operations manager had told them that he wanted an aeroplane to take off from the long runway. It was an Emirates flight which had landed during the day and had to leave.

He considered that on that evening, ADL's role could have been to stop the snow clearance, acknowledging that it was not possible, after the snowploughs had made their fast pass and ELEC8 had indicated that snow was covering the runway as fast as it was cleared. In his opinion, each person was waiting for a decision from another entity.

He explained that at the time of the event, the workload was lower than it had been previously. As soon as the event occurred, he called the operational duty manager to notify him and the conversation had rapidly evolved into an assessment of the situation. The GND controller was relieved immediately after the event.

1.18.2 Similar events

The DGAC database includes at least 14 occurrences between 2015 and 2019 relating to runway or taxiway incursions by snow-clearance vehicles.

The main safety topics identified were the following:

- Risk of collision with an aircraft (7);
- No radio or no radio contact between the snow clearance vehicle and the control unit (6);
- Communication problem between the lead vehicle and the snowploughs (4);
- Snow clearance from a runway (3), intersection or along the runway (4), manoeuvring on the taxiways (4) or entering a runway (3).

The Transportation Safety Board of Canada published an investigation report[20] on a similar event which occurred on 2 February 2019: four snowploughs entered a runway leading to an aircraft flying a missed approach. The main findings were:

- At the time of the incursion, the LOC controller was exchanging with the aircraft flight crew and the GND controller was exchanging with the team leader of the snowplough convoy.
- The convoy team leader was at the back of the convoy. After following a long route, the lead vehicle forgot to stop and was followed by three snowploughs.
- The runway incursion automatic detection system on the runway was not activated.
- The GND controller was busy carrying out other tasks, and was in a telephone conversation.
- The LOC controller observed the runway incursion by means of the ground radar.

[20] https://www.tsb.gc.ca/fra/rapports-reports/aviation/2019/a19q0015/a19q0015.html

1.19 Useful or effective investigation techniques

Not applicable.

2 - ANALYSIS

2.1 Scenario

On 14 November 2019, there was a substantial snowfall in the Lyon region. This episode of snow was early in the season. It was forecast and the quantity of snowfall given. However, the relatively high temperatures during the episode of rain in the afternoon led all the actors at Lyon Saint-Exupéry airport to underestimate the coming phenomenon.

The snow clearance operations were activated relatively late; only one of the two runways, runway 35R, had been treated as a preventive measure at around 18:00. The runway snow clearance team composed of a lead vehicle and two snowploughs was operational approximately two hours later.

Runway 35L was closed to clear snow shortly before 20:00. This proved difficult as the runway directly turned white again behind the snowploughs. It was cleared 1 h 45 min later, however the taxiways still had to be cleared of snow and joined to the runway.

When the snowplough lead vehicle asked for clearance to join taxiway A4 with the runway, the GND controller coordinated with the LOC controller. The latter requested that the snowploughs were asked to wait as there was an aeroplane on approach which was going to use the taxiway. A few minutes later, the GND controller was contacted by the lead vehicle again. After the arrival of the anticipated aeroplane, without new coordination, the GND controller cleared the snowploughs to enter the runway and kept them on the frequency.

At the same time, the LOC controller cleared the crew of Air Algérie flight AH1157 to line up and take off.

The GND controller did not follow the progression of the snowploughs and did not detect the conflict. He was discussing the surface conditions with the tower supervisor to help him set up a snow clearance strategy.

The LOC controller's monitoring of the ground radar screen and the outside environment enabled him to identify the snowplough lead vehicle's (cleared) entry into the runway safety area. The controller's request to reject the take-off run and the crew's immediate reaction meant that a potential ground collision or the possible consequence of a late avoidance manoeuvre were avoided.

2.2 GND controller – LOC controller coordination

The SNA-CE OM indicated that the GND controller coordinated any request to enter the runway safety areas with the LOC sector.

An initial coordination took place. However, it was unusual to have to manage snow clearance and the vocabulary used was not standardized. The expression, "do the junctions", contained an ambiguity as to the need, or not, of entering the runway. The driver of the lead vehicle had removed this ambiguity when making his request to the GND controller, but the ambiguity continued to exist in the coordination between the GND controller and the LOC controller.

After making the vehicles wait and having seen the arrival of the incoming aeroplane, the GND controller, without coordinating with the LOC controller again, cleared the snowploughs to enter the runway. However, six minutes later, the context had changed; there was a new departure and the instructions to wait for the incoming aeroplane before clearing the snowploughs to "do the junctions" were no longer adequate. The GND controller had not kept the departing aeroplane in mind once he had transferred responsibility for it to the LOC controller.

The GND controller did not initiate the exchange with the lead vehicle and probably wanted to reply quickly to the driver without coordinating again. In addition, the GND controller may have been prompted not to coordinate with the LOC controller again in order not to increase the latter's already high workload (see paragraph 2.5).

The effectiveness of the coordination between the GND and LOC controllers thus broke down due to the use of unusual and ambiguous vocabulary. Along with this, the first coordination carried out several minutes previously was not updated.

This coordination was all the more important in that the LOC and GND controllers did not have a shared support showing runway occupancy.

2.3 Frequencies used for manoeuvring vehicles

The OM indicated that on accepting a request to enter the runway safety area, the GND controller was to transfer the vehicle to the TWR frequency (managed by the LOC controller). However, the GND controller kept the vehicle on the GND frequency.

This had also been the case when snow was cleared from the previous junction. When the lead vehicle driver asked for clearance to do the first junction between taxiway A3 and the runway, the GND controller cleared the driver after coordinating with the LOC controller assistant. Measurements were being made, vehicles on different frequencies were manoeuvring on the runway while being aware of each other. The fact that the vehicle was kept on the GND frequency was of no consequence at this point.

In practice, it was unusual to keep a vehicle on the frequency despite it entering the safety areas. If a runway was closed with St Andrew's crosses for example, the LOC sector and GND sector coordinated with each other to manage the crossing of runway 35L, with the approval of the tower supervisor.

On that evening, the St Andrew's crosses had not been positioned as it was initially thought that the snow clearance operation would not take more than an hour. However, the runway stayed closed for over one and a half hours. During this closure, the vehicles had travelled back and forth between the runway and the parking area, alternating between the TWR frequency and the VEHICLE GND frequency managed by the tower supervisor. Given the duration of the closure, it is possible that the runway was managed in an intermediate way: the logic was neither totally that of a runway closed for a short period with vehicles managed on the LOC frequency, nor totally that specified for the closure of a runway for more than one hour with St Andrew's crosses.

The GND controller had had the snowplough lead vehicle on his frequency when he held the LOC controller position and when he assisted the tower supervisor (he was then on a break for one and a half hours prior to taking the GND controller position). He had exchanged with the snowplough lead vehicle on the VEHICLE GND frequency when it was manoeuvring on the runway.

The previous exchanges might have resulted in the overlapping of roles in the tower, and the distinction between the frequencies to be used lacking clarity.

The lead vehicle driver was aware that he was not on the correct frequency. The need to change frequency may not have been clarified due to frequencies usually being grouped together at night and due to drivers never taking the initiative to change frequency.

2.4 Stop bars and snow clearance circuits

In LVP conditions, the stop bar system protects against runway incursions. The stop bars are lit to avert an unauthorized vehicle entering the runway. Opening the controllable stop bars allows the LOC controller to control entry into the runway safety areas and have an accurate idea of all the vehicles in this area.

The fact that the stop bar lights were reflected in the snow increased the LOC controller's workload. He had to specify to aeroplanes taking taxiway B4 that the red light did not come from the stop bar which concerned them but was the reflection from the stop bar intended to prevent manoeuvres in the opposite direction.

The vehicles' manoeuvres were limited in the manoeuvring area in LVP conditions. There was a specific route for measurement vehicles designed to minimize the number of times stop bars were crossed. The routes intended for the runway inspection vehicles were not intended for the snow clearance vehicles.

On the day of the incident, when runway 35L was closed, no stop bar was crossed to enter 35L via the access taxiway at the end of the runway. However, when runway 35L was reopened and the stop bars on taxiways A3 and A4 were lit and permanent, manoeuvring on these taxiways to enter runway 35L (and not to vacate it) necessarily meant that they would be crossed making this barrier against runway incursions ineffective.

2.5 Control tower workload

The statements, analysis of the frequency and playback of the telephone conversations show a substantial workload for the control tower the evening of the event (see paragraph 1.17.4 and 1.18). The following points were brought to light:

- The fairly ineffective de-icing operations led to numerous flight plans having to be updated and the management of cancelled departures of aeroplanes already engaged on the taxiways.
- The LOC frequency was particularly congested by the transmission of measurements by the manoeuvring area coordinator, requests for pilot reports concerning the condition of the runways and the management of the stop bars. The LOC and approach positions had been grouped together shortly before the event, with the LOC controller also managing the approach frequency.

- The tower supervisor was widely called upon to discuss the organization of the snow clearance. There were numerous exchanges with the snowplough lead vehicle concerning the choice of runways or taxiways to be cleared of snow and the condition of the runways. The decisions concerning the regulation of the traffic also led to numerous exchanges, notably with the operational duty manager and the operations manager. The telephone line and the VEHICLE GND frequency taken together were busy for more than 45% of the time in the hour and a half preceding the event.
- The controllers who were no longer on duty had remained behind to provide help in this unusual context. There were seven people in the tower at the time of the event, only four of them had an assigned role.
- The LOC controller continued to carry out certain tasks assigned to the tower supervisor which directly impacted the attention he paid to the vehicles and aircraft for which he was responsible.

The episode of snow on 14 November 2019 - of a rare magnitude - resulted in the controllers taking on tasks and concerns linked to this unusual context. Snow clearance operations require cooperation as the control units and aerodrome operator services mutually depend on each other. This cooperation, being out of the ordinary, requires coordination, i.e. a set of rules organizing the various tasks to be carried out. Some of these rules were described in the Snow Plan which gave a key role to the winter services manager, the operations manager and the operational duty manager. However, the analysis of the various interactions shows that these differed from the formal, specified channels. The coordination was dictated by the context rather than an exact reproduction of previously determined coordination actions. In this context of self-organization, it was the front-line actors who had to establish short- and medium-term strategies without real support. Thus, those who were directly in contact with each other on the radio frequencies - the tower supervisor and the driver of the snowplough - naturally coordinated together resulting in a high workload in the tower, and in turn, reactive management in real time with sometimes, unclearly defined tasks and a relative overlapping of roles.

2.6 Runway surface condition measurements in episode of snow

The regulations require that the aerodrome operator ensures that the means and procedures are defined and in place to provide safe conditions for operations in winter conditions. One of the indicators of these safe conditions is based on the assessment of the surfaces, i.e. the type of contamination, the average thickness of the contaminant and the estimated braking conditions.

These measurements are decisive in the crews' decisions. The Lyon Saint-Exupéry airport manual specified that the pilot always had the primary responsibility for the decision to land, based on the information at his disposal. These measurements are also one of the inputs to adjust the snow clearance strategy. Finally, these measurements are the key element in deciding whether there is a danger or "serious inconvenience" likely to hinder the continued operation of the aerodrome, triggering the suspension of flight operations.

On the evening of 14 November 2019, the measurements taken by Aéroports De Lyon (ADL) were clearly different to the actual condition of the runways. Inaccurate measurements were thus transmitted to the tower, ATIS and on the frequency. While this inaccuracy did not directly contribute to the runway incursion, the fact remains that it did contribute to the difficulty of establishing a snow clearance strategy, resulted in a congested frequency and gave rise to a substantial workload for the LOC controller and the tower supervisor.

2.7 Operating restrictions and suspension of operations

The day of the occurrence, the snow clearance operations had given rise to the temporary closure of a runway with operation changing to single runway operation. The different tower supervisors on duty had started regulating the traffic from the beginning of the afternoon. The controllers in the tower had long discussions about what traffic management strategy to adopt, pending the possible decision to suspend flight operations.

During one call, the tower supervisor indicated to the Aéroports De Lyon operational command centre that he had serious doubts about the quantity of contaminant announced and that he did not know whether a decision would have to be made to suspend operations, specifying that the situation was going to become complicated. It was the tower supervisor who decided whether traffic had to be regulated. However, the operational command centre could influence certain decisions. That evening, for example, the centre wanted to re-open the inner runway to allow an aeroplane whose performance required the longest runway, i.e. the inner runway, to take off.

Continuing operations while clearing the snow meant that there were mixed operations in the airport manoeuvring area, notably when arriving aeroplanes had to cross the runway or when aeroplanes whose departure had been cancelled had to back track the runway. The most salient element of this mix was the re-opening of the inner runway when snow still had to be cleared from the taxiway and the junctions had to be made between the taxiways and the runway. In the minutes preceding the occurrence, there were arriving aeroplanes crossing the runway, as well as departing aeroplanes, the measurement vehicle, the lead vehicle and the two snowploughs manoeuvring in the vicinity or on the inner runway.

It does not seem to the purpose to evaluate, in hindsight, the appropriateness of more extensive traffic regulation or of a decision to suspend operations. However, the hesitations regarding the strategy to be adopted for the joint management of traffic and snow clearance raise the following question: Who could really take the decision to suspend flight operations, on what grounds or criteria, when and for how long?

The DSAC suspension of operations procedure was based on knowledge of a danger or “serious inconvenience” likely to hinder continuing aerodrome operation. The suspension of operations as envisaged in the procedure was linked to the current or future condition of the runways. As specified in the Lyon Saint-Exupéry Aerodrome Manual, it concerned the cases where the reported conditions were such that the estimated risk level, regardless of the aircraft likely to land on the runway, justified such a decision.

As the situation was one which gradually deteriorated, at what point could one judge that there was "a danger [...] likely to hinder continuing aerodrome operation"? Likewise, how thick did the contaminant have to be to justify the decision? This question is all the more relevant in that the measurements were not reliable.

The procedure, as specified in its introduction, did not deal with the decisions to suspend flight operations for a limited period of time linked to actions on the runway (a runway inspection, a snow clearance operation, etc.). It would thus seem that it was not intended that this procedure cover cases where traffic must be reduced or suspended to permit effective snow clearance from surfaces or even cases where the control work load is such that a restriction of operations is required to continue to ensure the safe movement of vehicles and aircraft.

In the same chapter of the SNA-CE OM, the decision to suspend operations as defined by the DSAC procedure, the implementation of zero capacity or the closure of the airport could be found. The OM specified that it was the tower supervisor's responsibility to request the suspension of operations in the scope of the DSAC procedure. However, the decision-making processes in case of traffic regulation (or even suspension) for the organization of snow clearance or management of the capacity are less clear. As for the Snow Plan, it is exclusively based on the DSAC procedure.

It would thus seem that while the procedure clarifies the responsibility of the various organizations when the runway is unusable, it does not constitute an aid in making operational decisions about traffic regulation during snow-clearance operations. This assistance may be necessary.

The representatives of the aerodrome operator must manage the many impacts linked to the disruptions in air traffic and can be under substantial operational pressure. The actors who are not in the "field", such as the DSAC duty managers or the operational duty manager, may have difficulties comprehending the actual operational situation.

As for the front-line actors who manage the situation in real time, they may not have enough distance to make decisions about regulating or temporarily suspending traffic. When a decision has to be made, there is sometimes a preference bias that leads those on the front line to only share information about the chosen solution (in this case, continuing operations). An external viewpoint would put arguments for alternative solutions in the balance.

3 - CONCLUSIONS

3.1 Findings

The heavy snowfalls were forecast and had been announced via an aerodrome warning message.

Runway 35L was closed for 1 h 45 min in order to clear the snow. When the runway was freed, there was still snow to be removed to join the runway and the taxiways.

The crew of flight Air Algérie AH1157 were cleared to line up and take off from runway 35L by the LOC controller on the TWR frequency.

The lead vehicle and the snow-clearance vehicles were cleared to enter runway 35L by the GND controller on the GND frequency.

The coordination between the GND and LOC controllers broke down due to the use of unusual and ambiguous vocabulary. Along with this, the first coordination carried out several minutes previously, authorizing the snow to be cleared from the taxiway after the last inbound aeroplane had passed, was not updated.

The lead vehicle of the snowploughs was kept on the GND frequency by the GND controller although the vehicle was entering the runway safety area. This practice existed though it was uncommon.

Driving on taxiways A3 and A4 to clear snow and join them to runway 35L inevitably meant that the permanent stop-bars would be crossed by the snow-clearance vehicles.

The LOC controller identified the cleared entry of the lead vehicle of the snowploughs into the safety area because he was monitoring the ground radar screen and outside environment.

The LOC controller asked the crew of flight AH1157 to reject the take-off using the immediate action phraseology.

The Boeing 737-800 reached a maximum speed of 63 kt before decelerating to 10 kt and continuing taxiing via taxiway A6.

Inaccurate runway surface condition measurements contributed to a high workload in the control tower and to difficulties in choosing the snow-clearance strategy to be implemented.

The snow-clearance operations were principally coordinated between the tower supervisor and the driver of the lead vehicle of the snowploughs resulting in a very high workload in the control tower.

The interactions were dictated by the context rather than an accurate reproduction of those formally set out in the Snow Plan, as the actors used more direct communication channels than those specified.

Zero arrivals, i.e. no more additional arrivals being accepted at Lyon, had been set up for an hour.

The possibility of suspending operations had been discussed. No decision had been taken to this effect. A mix of traffic operations and snow-clearance operations had been maintained throughout the night.

3.2 Causes of serious incident

The runway incursion was linked to an erroneous clearance to enter the runway as a result of a coordination failure between the GND and LOC controllers and keeping the vehicles cleared to enter the runway on the GND frequency.

The following factors contributed to the conflictual clearance and to keeping the use of an inappropriate frequency:

- A high workload in an unusual context where the roles in the tower were sometimes poorly delimited.
- The reopening of the inner runway after snow clearance although the snow clearance of the taxiways to join them to the runway required the snow-clearance vehicles to enter the runway.
- Practices without a clear framework regarding the use of frequencies for the vehicles during temporary runway closures.
- A stop bar configuration incompatible with the snow-clearance paths taken by the vehicles.

The runway incursion, while it can be considered as a failure in itself, is above all else symptomatic of the confusion and disorganization generated by the management of the episode of snow.

The following factors contributed to the confusion and disorganization:

- A Snow Plan whose definition was too formal and in part, disconnected with operational realities.
- Inaccurate measurements of the runway surface condition resulting in a high workload and difficulties with the snow-clearance strategy to be implemented.
- Rules for regulating and suspending operations which were difficult to apply by the persons directly involved in traffic management and snow clearance.

4 - MEASURES TAKEN SINCE OCCURRENCE

4.1 Actions taken by SNA-CE

Following the occurrence, the Lyon control centre (SNA-CE) issued a directive concerning the frequency used when entering the runway safety areas, specifying that the clearance to enter the runway safety areas must be given on the TWR frequency.

This directive was updated on 10 September 2020 to include the following exceptions:

The clearance to enter the runway safety areas must be given on the LOC frequency except in the following cases:

- The runway in question is closed for more than one hour and the St Andrew's crosses at each end of the runway are lit.
- The tower supervisor has told the ARFF chief that they have freedom of movement. In this case, the ARFF vehicles are free to manoeuvre in all of the movement area, including the runways, without compulsory radio contact.

The occurrence was analysed by the local safety commission on 12 December 2019. The causes identified were the differences in the mental pictures between the LOC and GND controllers, the partial compliance with the stop bars and keeping the frequency.

The snow clearance from taxiways while the runway was open, the number of vehicles operating in the manoeuvring area, the lack of strategic crisis management and the absence of a coordination cell were identified as contributing factors.

Local measures were planned with a deadline of April 2020. They included the management of vehicles in the manoeuvring area, the management of the stop bars, the consolidation of the Snow Plan and the creation of a collective decision-making platform.

The following list gives these various measures as set out in the local safety commission's minutes:

- Note 2019-061 specifying that any clearance to manoeuvre in the runway safety areas can only be given on the LOC frequency.
- Consolidation of ATC management of vehicles manoeuvring in the manoeuvring area.
- Consolidation of management of Low Visibility Procedures (LVP).
- Consolidation of operation and management of stop bars.
- Standardization of vocabulary used for communicating with the vehicles manoeuvring in the manoeuvring area.
- Taking the occurrence into account in the work methods of the new ground radar ASMGCS.
- Creation of a strategic crisis plan in SNA-CE.
- Consolidation of the Snow Plan with Aéroport de Lyon (ADL).
- Creation of a platform dedicated to Collaborative Decision Making (CDM) to ensure the coordination between all the stakeholders and decision making in cooperation with the front-line actors.

On the date of publication of this report, only the first measure with respect to the directive had been implemented.

4.2 Actions carried out by the aerodrome operator ADL

4.2.1 Feedback

The aerodrome operator obtained feedback concerning the management of the episode of snow. One of the areas of improvement concerned the presence of a person from the air navigation services in the operational command centre during an episode of snow. The presence of a representative of the major flight operators in the command centre was also mentioned.

4.2.2 Runway surface condition measurements

Major changes were planned concerning runway surface condition measurements. From the summer of 2021, the Global Reporting Format (GRF) for Runway Surface Conditions was implemented at Lyon Saint-Exupéry airport.

The GRF meets a requirement which will be implemented worldwide and uses a new matrix to assess and report the runway surface condition. This change involved the aerodrome operator, the air navigation services concerned, the Aeronautical Information Service (AIS), flight operators and manufacturers.

The GRF implies a change in paradigm, the runway surface condition is based on aeroplane performance rather than on the assessment made by various ground measuring instruments. The surface contaminants are indicated to the AIS and air navigation services concerned when a change in the runway surface condition has been detected that may affect aeroplane performance and operations in the movement area. For winter operations, there is a loop between the air navigation services and the pilot, which will allow the latter to transmit via a formalized report (AIR REPort) his impression of braking on the runway. The air navigation services forward these reports to the aerodrome operator.

The implementation of this new system should make the data provided more reliable and formalize the transmission of this information.

5 - 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 issuing authority in charge of safety investigations, on the measures taken or being studied for their implementation, as provided for in Article 18 of the aforementioned regulation.

5.1 Regulation and suspension of operations in degraded meteorological conditions

Even though the snow-clearance operations were difficult and serious doubts remained about the measurements transmitted, a mix of snow clearance and air operations was maintained throughout the night.

The suspension of air operations defined by the DSAC procedure of 2010 is based on knowledge of a danger or "serious inconvenience" likely to hinder continuing aerodrome operation. The suspension of operations as envisaged in the procedure is linked to the actual or future condition of the runways. It concerns the cases where the reported conditions are such that the estimated risk level, irrespective of the aircraft likely to land on the runway, justifies such a decision.

The Snow Plan and the Lyon control centre's (SNA-CE) OM are largely based on this procedure. However, the latter does not cover the cases where traffic must be reduced or suspended to permit effective snow clearance from surfaces or even the cases where the control work load is such that a restriction of operations is required to continue to ensure the safe movement of vehicles and aircraft. The fact that the aerodrome is also equipped with two runways makes the distinction more complex between suspension prior to operations, temporary closure for snow clearance, the implementation of zero arrivals or a temporary suspension during the snow clearance operations.

While the procedure clarifies the responsibility of the various organizations when the runway is unusable, it does not constitute an aid in making operational decisions about the regulation of traffic during snow-clearance operations. The doubts and questions raised the evening of the occurrence at Lyon Saint-Exupéry airport illustrate the fact that this aid can prove necessary.

Consequently, the BEA recommends that:

- **whereas the concerns expressed during the episode of snow on 14 November 2019;**
- **whereas the DSAC procedure to suspend air operations may be difficult to apply when there is a doubt about the condition of the runway surface and high operational pressure;**
- **whereas the procedure is insufficiently explicit for aerodromes with several runways;**

  the SNA-CE, in coordination with Aéroports De Lyon, define the decision-aid criteria of operation restriction measures in degraded situations (these restrictions may cover the reduction in traffic to the extended closure of a runway or the suspension of operations). [Recommendation FRAN 2021-008]

❍ **whereas the DGAC database includes at least 14 occurrences between 2015 and 2019 regarding runway or taxiway incursions by snow-clearance vehicles;**

the DGAC study whether the decision processes to restrict operations in degraded situations at French aerodromes present similar difficulties to those observed at Lyon Saint-Exupéry airport.
[Recommendation FRAN 2021-009]

5.2 Snow Plan

The analysis of the different interactions found that the actual coordination differed from that specified and that it was dictated by the context rather than an accurate reproduction of a coordination decided in advance. The people directly in contact on the radio frequencies naturally started coordinating with each other, resulting in a very high workload, in particular for the control tower.

In this context of self-organization, it was the front-line actors who had to establish short- and medium-term strategies without real support.

This leads to questions about the appropriateness of the rules specified by the Snow Plan in the dynamic context of snow-clearance operations.

Consequently, the BEA recommends that:

❍ **whereas the difference between the organization specified in the Snow Plan and the actual organization during the snow-clearance operations on 14 November 2019;**

❍ **whereas the impacts of this difference on the workload for the personnel of the Lyon control centre (SNA-CE);**

Aéroports De Lyon, in coordination with the SNA-CE, ensure, in a consolidation of the snow/black ice control operational plan, that the conditions are defined for activating a coordination unit to group the decision-makers, to limit the number of information messages and to reduce the workload of the people directly involved in managing the operations.
[Recommendation FRAN 2021-010]

❍ **whereas the DGAC database includes at least 14 occurrences between 2015 and 2019 regarding runway or taxiway incursions by snow-clearance vehicles;**

the DGAC ensure that the Snow Plans of French aerodromes do not have similar failings to those brought to light in the occurrence with respect to the planned coordination scenarios, and that these take into account the operational constraints and communication channels actually brought into play.
[Recommendation FRAN 2021-011]

6 - APPENDIXES

6.1 Transcript of ATC exchanges

6.1.1 Transcript of TWR frequency

Time (UTC)	Source	Message
21:29:08	LA2	Tour du Lutte Aviaire deux?
21:29:10	LOC	Oui Lutte Aviaire deux?
21:29:12	LA2	C'est pas bon du tout j'suis en médiocre j'ai des coefficients de frottement qui sont à zéro douze sur les deux parties les deux tiers nord de la piste et zéro vingt-deux à peu près dans le premier tiers de la piste donc c'est pas bon du tout
21:29:26	LOC	Zéro douze zéro douze zéro vingt-deux et médiocre alors
21:29:31	LA2	Oui
21:29:32	LOC	D'accord j'ai euh tu vois j'ai y'a un avion qui vient de se poser là à droite est-ce que tu pourrais faire la droite aussi?
21:29:41	LA2	Si j'attaque ben je vous rappelle sur Bravo neuf là ou je pénètre?
21:29:44	LOC	Non non rappelle moi sur Bravo neuf
21:29:48	LA2	Je suis sur Bravo neuf pour Lutte Aviaire deux
21:29:54	LOC	Et en fait donc la dénomination exacte du....du coefficient de freinage là c'est mauvais c'est ça?
21:30:02	LA2	Médiocre
21:30:03	LOC	C'est médiocre d'accord médiocre merci
21:30:06	LA2	Au-dessus en fait en... c'est le... le plus mauvais
21:30:09	LOC	Euh redis ton message en entier parce que à chaque fois je prends pas le... le début de ton message ne passe pas
21:30:15	LA2	Donc l'estimation de frottement donc sur les deux premiers tiers de la piste en partant du Nord sont de zéro douze après de zéro vingt-deux pour le premier tiers en partant du Sud et donc le coefficient de frottement est médiocre voilà avec hauteurs de contaminant de quinze millimètres
21:30:29	LOC	Quinze millimètres euh d'accord et c'est quel type de neige?
21:30:35	LA2	Neige mouillée
21:30:36	LOC	Neige mouillée reçu
21:30:38	LOC	Alpine four three Fox Charlie report just before the euh the stop bar
21:30:43	JU43FC	We stop before the stop bar Alpine Fox Charlie
21:30:45	LOC	Just report before the stop bar euh in order for me to open it euh at the right time
21:30:50	JU43FC	Ah Ok euh copy
21:30:53	LOC	Lutte Aviaire deux tu peux pénétrer sur la trente-cinq droite et rappelle trente-cinq droite dégagée
21:30:58	LA2	(*) pénètre la trente-cinq droite pour lutte aviaire deux et je rappelle dégagé
21:31:09	JU43FC	four three Fox Charlie just before the stop bar
21:31:12	LOC	(*) Alpine Fox Charlie cross three five left
21:31:16	JU43FC	Cross three five left Alpine Fox Charlie
21:31:49	LOC	Alpine Fox Charlie contact Ground one two one eight three bye
21:31:53		One two one eight three Alpine Fox Charlie bye
21:32:06	LOC	three Lima Yankee ten degrees left
21:32:10		LY/(*) left (*) three Lima Yankee

21:32:15	7T-VKR	Saint Ex bonsoir Air Algérie onze cinquante-sept on approche point d'arrêt Alpha neuf
21:32:25	LOC	Algérie onze cinquante-sept bonjour avancez-vous jusque juste devant la barre d'arrêt Alpha neuf et rappelez-moi devant la barre d'arrêt
21:32:33	7T-VKR	Rappelle devant la barre d'arrêt Air Algérie onze cinquante sept
21:33:08	7T-VKR	Algérie onze cinquante-sept barre d'arrêt Alpha neuf on est prêts
21:33:11	LOC	Algérie onze cinquante-sept d'Alpha neuf alignez-vous trente-cinq gauche autorisé décollage trente-cinq gauche le vent est calme
21:33:21	7T-VKR	Autorisé tr... décollage trente-cinq gauche Air Algérie onze cinquante sept
21:34:48	LOC	Air Alger.... Air Algérie onze cinquante-sept stoppez le décollage immédiatement
21:34:51	7T-VKR	On stoppe décollage onze cinquante sept
21:35:18	7T-VKR	Onze cinquante-sept on maintient sur la piste?
21:35:20	LOC	Euh affirm euh onze cinquante-sept euh... je...vous pouvez dégager euh là Alpha six?
21:35:30	7T-VKR	Reçu on prend à gauche Alpha six
21:35:34	7T-VKR	On peut avoir la raison du reject Madame?
21:35:38	LOC	Répétez onze cinquante-sept?
21:35:39	7T-VKR	On peut avoir la raison du reject ?
21:35:42	LOC	C'est qu'il y'a eu un véhicule qui a franchi le enfin qui est passé dans les servitudes de la piste trente-cinq gauche
21:35:52	7T-VKR	D'accord
21:35:54	LOC	Heu je suis désolé onze cinquante-sept du coup d'Alpha six enfin vous pouvez repartir tout de suite ou pas?
21:36:02	7T-VKR	On va remonter la piste
21:36:05	LOC	Oui alors dégagez Alpha six mais après vous roulez alors jusqu'en Alpha neuf ça sera bon pour vous pour refaire un décollage dans la foulée?
21:36:14	7T-VKR	Affirm onze cinquante-sept alors on repart sur Alpha (*)
21:36:18	LOC	Reçu alors sur Alpha six vous appelez le... Le Sol cent vingt et un quatre-vingt trois

6.1.2 Transcript of GND frequency

Time (UTC)	Source	Message
21:27:11	7T-VKR	Saint Ex Air Algérie one one five seven request taxi
21:27:15	SOL	One one five seven taxi holding point Alpha nine CAT three
21:27:19	7T-VKR	Taxi holding point Alpha nine CAT three Air Algérie one one five seven
21:27:38	ELEC8	Le Sol Electrique huit?
21:27:41	SOL	Oui?
21:27:43	SOL	(Electrique huit) oui je t'écoute?
21:27:45	ELEC8	Oui pour te dire qu'on a terminé la jonction là Alpha trois piste trente-cinq gauche et on aimerait faire Alpha quatre
21:27:51	SOL	Alors reçu et bien alors roule jusqu'à Alpha quatre
21:27:56	ELEC8	On roule Alpha quatre et on déneige là-bas on pourra faire la jonction sur la piste aussi?
21:28:00	SOL	Attends roule vers Alpha quatre et maintiens avant Alpha quatre là y'a une arrivée à une minute et tu feras après je pense
21:28:08	ELEC8	On roule vers Alpha quatre et on maintient avant Alpha quatre pour Electrique huit
21:29:37	SOL	Air Algérie onze cinquante-sept?
21:29:40	7T-VKR	J'écoute
21:29:41	SOL	Onze cinquante-sept donc on vient de finir la visite de piste trente-cinq gauche le freinage est médiocre
21:29:47	7T-VKR	Reçu Monsieur on poursuit pour la trente-cinq gauche
21:29:52	842	Ok pour (huit quarante-deux donc éventuellement) on peut envisager un décollage en trente-cinq droite?
21:29:57	SOL	On est en train d'en discuter ouais euh trente-cinq droite a priori tous ceux qui atterrissent annoncent un freinage moyen donc on a environ on va regarder à te passer en mono trente cinq droite éventuellement
21:30:07	842	Ok ben écoutez merci Monsieur on va voir si notre compagnie maintient le vol ou pas parce qu'on a toujours pas été chargé au moment où je vous parle
21:30:15	SOL	D'accord et ben euh de toute façon si vous voulez faire même si on est euh même si on garde gauche droite ouvert si vous voulez faire la trente cinq droite y a plus beaucoup d'arrrivées ça sera possible donc vous me rappelez quand ça vous serez prêts
21:30:26	842	Mais vous devez refaire des soins particuliers sur les des traitements particuliers sur les sur le (*) sur les trente-cinq ou pas d'ici vingt minutes?
21:30:35	SOL	Ah dans les vingt minutes je pense pas mais là le... ça a neigé fort ça a l'air de se calmer un peu et euh donc on a, j'sais pas on vient de faire des mesures sur la trente-cinq droite et on va voir c'qu'on fait euh (*) étonnamment la trente-cinq enfin la trente-cinq droite a été traitée pas la gauche alors euh je sais pas si c'est pour ça que l'état est bien meilleur mais c'est que la trente-cinq gauche peut-être qu'on va repasser voir si on peut faire repasser des camions là pour l'instant on est aussi train de traiter un peu les taxiways mais tant que la trente-cinq droite elle est le freinage est dans l'état qu'il est ben je pense qu'on va continuer trente-cinq droite
21:31:07	842	Vous annoncez un freinage médium poor c'est correct?

21:31:11	SOL	Sur la trente-cinq droite euh tous les derniers alors c'était pas des mesures mais tous les avions qui se sont posés ils ontannoncé moyen et sur la trente-cinq gauche médiocre
21:31:21	842	Très bien merci Monsieur
21:31:23	842	Médiocre en Anglais c'est poor?
21:31:25	SOL	Euh ouais ça doit être poor ouais
21:31:26	842	Merci
21:31:52	SOL	Air Algérie onze cinquante-sept maintenez point d'arrêt CAT III et la Tour cent vingt quarante-cinq au revoir
21:31:57	7T-VKR	…cinq maintiens point d'arrêt CAT III Air Algérie onze cinquante-sept au revoir
21:32:02	JU43FC	Bonjour Alpine four three fox charlie apha four
21:32:05	SOL	Bonsoir Alpine four three fox charlie taxi stand juliet three five via tango juliet
21:32:09	JU43FC	Juliet three five via tango juliet Alpine four three fox charlie
21:33:12	ELEC8	Le Sol Electrique huit?
21:33:16	SOL	Electrique huit oui?
21:33:17	ELEC8	Oui donc on va déneiger Alpha quatre est ce qu'on peut faire la jonction sur la piste trente-cinq gauche?
21:33:22	SOL	Ouais tu peux faire Alpha quatre et la jonction trente-cinq gauche
21:33:25	ELEC8	Donc on commence je te rappelle une fois terminé et on pénètre sur la trente-cinq gauche pour Electrique huit
21:34:14	ChallairCJ	La prévol du Challair (*) charlie juliette pour la mise en route s'il vous plaît
21:34:20	SOL	Challair Charlie Juliet euh reçu vous pouvez mettre en route rappelez prêts à rouler
21:34:25	ChallairCJ	et on rappelle le sol pour le repoussage
21:34:28	SOL	vous (*) rappelez pour repousser vous pouvez rappeler sur la même fréquence c'est tout groupé
21:34:32	ChallairCJ	pour pousser dès à présent euh Challair (*)Charlie Juliet
21:34:35	SOL	et reçu beh le push approuvé Challair Charlie Juliet
21:34:41	AF17WH	Le sol d'Air France dix sept Whisky Hotel
21:34:44	SOL	dix sept Whisky Hotel oui
21:34:45	AF17WH	vous avez reçu un nouveau plan de vol pour nous
21:34:47	SOL	Electrique huit?
21:34:50	AF17WH	Pardon ?
21:34:51	SOL	Electrique huit euh tu peux sortir de la piste?
21:34:54	ELEC8	Affirm
21:34:57	ELEC8	On dégage la piste les Boshung
21:35:22	ELEC8	La piste est libérée pour Electrique huit
21:35:25	SOL	Ok merci désolé y'avait un décollage j’ai oublié

BEA

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

10 rue de Paris
Zone Sud - Bâtiment 153
Aéroport du Bourget
93352 Le Bourget Cedex - France
T: +33 1 49 92 72 00 - F: +33 1 49 92 72 03
www.bea.aero

RÉPUBLIQUE
FRANÇAISE
Liberté
Égalité
Fraternité