Serious Incident

Aircraft Type and Registration:	Airbus A320-214, G-EJCI
No & Type of Engines:	2 CFM56-5B4/3 turbofan engines
Year of Manufacture:	2011 (Serial no: 4581)
Date & Time (UTC):	30 July 2023 at 1653 hrs
Location:	After departure from Toulouse-Blagnac Airport, France
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 176
Injuries:	Crew - None Passengers - None
Nature of Damage:	None reported
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	62 years
Commander's Flying Experience:	16,488 hours (of which 12,992 were on type) Last 90 days - 132 hours Last 28 days - 32 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot, interviews and investigation reports

Synopsis

This investigation was delegated to the AAIB by the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) of France.

During pre-flight preparations, both pilots completed a takeoff performance calculation from intersection N2 of Runway 32R at Toulouse-Blagnac Airport in France. During taxi, the aircraft was cleared to line up and take off from intersection N2 with 2,300 m takeoff distance available. However, the crew entered the runway via the N4 intersection, reducing the takeoff distance available by approximately 500 m. The Tower Controller did not monitor the aircraft visually and did not notice the error. The aircraft rotated with 500 m of runway to go and passed the upwind end of the runway at a height of 180 ft.

The operator, Toulouse ATC and the Direction des Services de la Navigation Aérienne (DSNA)[1] implemented safety actions to strengthen their respective procedures to prevent reoccurrence.

Footnote

[1] The Direction des Services de la Navigation Aérienne is the agency in charge of air traffic control, communication and information for France

History of the flight

The aircraft was making a return flight to London Gatwick Airport from Toulouse-Blagnac Airport having arrived at Toulouse 1 hour 30 minutes behind schedule. The passengers were disembarked and the crew prepared the aircraft for its return flight for which the commander would be the pilot flying.

On completion of the walkaround, the co-pilot returned to the flight deck to prepare for departure while the commander monitored activity in the cabin. When the commander returned to the flight deck, the crew discussed the choice of takeoff points on Runway 32R referencing the operator's FlySmart+ application, which presented two options: full length (N1) and the intersection N2. The crew checked the displayed takeoff distance against the Airport Ground Chart (AGC) (Figure 1 left) and selected intersection N2 as the distance was sufficient at 2,300 m. Both pilots completed the performance calculations from this intersection.

The crew carried out a performance validation of critical data and a takeoff data crosscheck, following which they conducted a departure briefing. They discussed the taxi routing and noted that it was short and uncomplicated. However, they did not discuss the location of the N2 intersection and it was not visible from stand V10 (Figure 1 right). The operator provided a '*Threat Matrix*' to assist crews in identifying potential threats, but it did not include intersection departures as an example of a potential threat.

The turnaround took 38 minutes. The weather was reported as CAVOK.

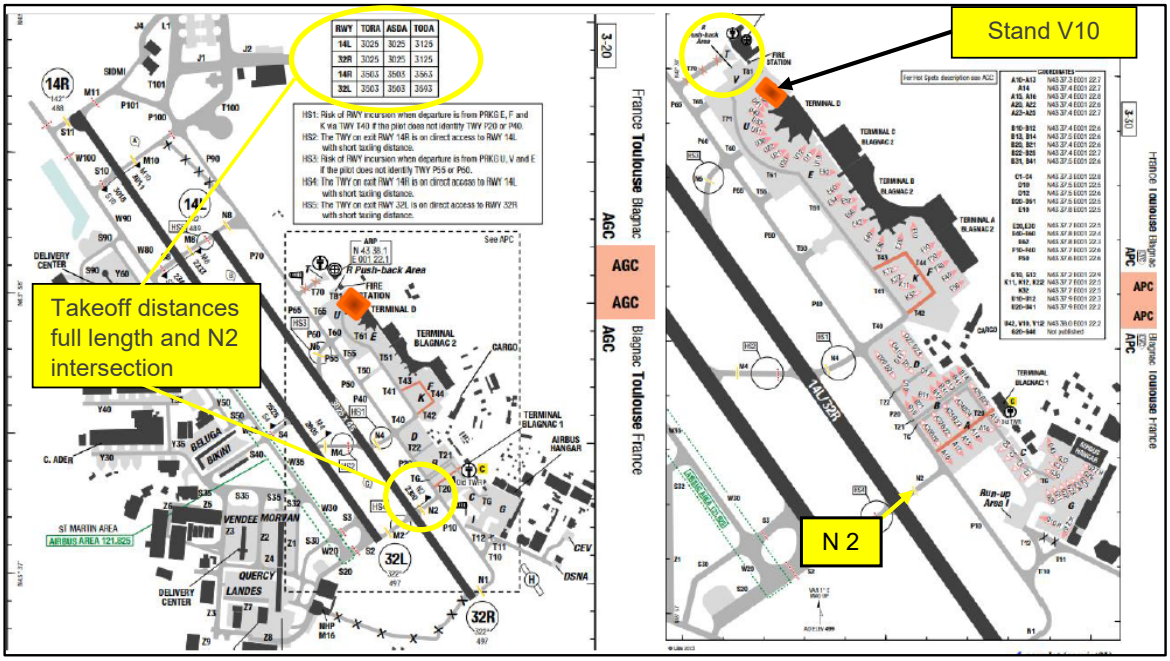

Figure 1

Toulouse AGC and Airport Parking Chart (used with permission)

The ATC Ground Controller cleared the aircraft to pushback and start[2] at 1652 hrs and, at 1657 hrs, for taxi to holding point N1 for Runway 32R. As the aircraft approached the apron exit point of T65, the commander asked the co-pilot to inform Ground that they could accept the intersection N2 for departure in accordance with their departure brief and performance calculations. Ground cleared the aircraft to N2 and instructed them to contact the Tower when ready at N2. The aircraft was on the main taxiway, paralleling Runway 32R. Following a control check the crew performed a PEDS brief[3] from memory, the first part of which is '*performance*', where the pilot monitoring stated the actual takeoff position to be used and the computed takeoff position. However, there was no discussion of where N2 was in relation to their position on the taxiway and it was not a requirement of the checklist in the Operations Manual. The crew could not recall if the commander had the Toulouse AGC displayed on his Electronic Flight Bag (EFB) device but believed it likely that a Standard Instrument Departure (SID) chart was selected in anticipation of the short and non-complex taxi routing.

Following the PEDS brief the co-pilot informed Tower that they would be "READY FOR DEPARTURE UPON REACHING N2" (Figure 2). Tower replied, "BONJOUR FROM N2 2,300 M CLEARED FOR LINE UP TAKE OFF 32R WIND 310 DEGREES 12 KT". As the co-pilot read back the takeoff clearance the aircraft was approaching the N4 intersection where the commander turned the aircraft right, towards the holding point N4 for Runway 32R.

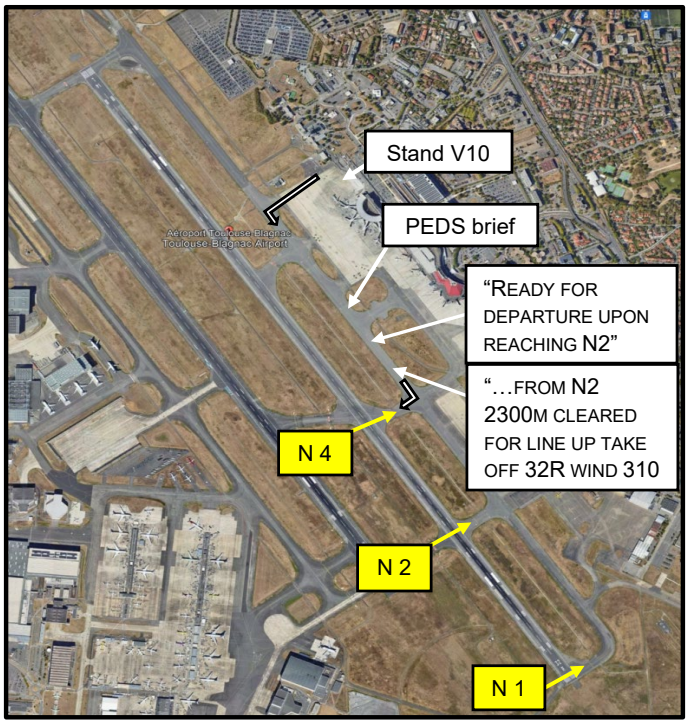

Figure 2

Toulouse-Blagnac Airport showing relevant intersections and actions taken by the crew and ATC

Footnote

[2] Both engines were started during the pushback.

[3] The PEDS brief normally precedes the taxi checks and comprises: Performance, Engine-out standard instrument departure, Departure runway and routing, Stop altitude and departure clearance.

The crew completed the line-up flow, part of which requires that *'each pilot silently verifies takeoff intersection'*. This was followed by the line-up checklist as the aircraft entered Runway 32R via N4. Runway signage and guard lights ('wig-wags') were installed on both sides of the taxiway at the N4 holding point for runway 32R, as shown in Figure 3.

Figure 3

Holding point N4 for Runway 32R at Toulouse-Blagnac Airport

The line-up checklist requires both pilots to '*confirm that the line-up is performed on the intended runway/intersection and confirm the ATC clearance received'*. The commander declared, '*cleared for takeoff, runway 32R, N2, 2,300 m'*, then initiated the takeoff run, rotating with approximately 500 m of runway length remaining. During the climb phase of flight, the crew discussed the remaining runway length observed during the takeoff and reviewed their performance calculations and taxi routing. They concluded that the takeoff had been initiated from N4 instead of the planned and cleared N2. The distance available from N4 was approximately 1,800 m.

FlySmart+ application design

The FlySmart+ application uses data drawn exclusively from the operator's fleet. When an intersection is selected it is displayed on a graphic (Figure 3) which will only display takeoff options available to the operator's aircraft: for Runway 32R at Toulouse, full length (N1) and intersection N2. The position of intersection N2 in relation to intersection N4 is not displayed as N4 is not available for use by the operator's aircraft. Departures from intersection N4 on Runway 32 R are prohibited for turbojets over 7 tonnes.

Figure 4

FlySmart+ takeoff application (used with permission)

Flight crew

Both flight crew held valid licences and medicals to operate the A320. Their total flight hours and recent experience are shown at Table 1.

Hours	Commander	Co-pilot
Total time	16,488	347
On type	12,992	135
Last 90 days	132	135
Last 28 days	32	15

Table 1

Flight crew experience

Fatigue

The commander was familiar with Toulouse but had not been there recently. He considered the operational environment at his home base as "demanding", with significant delays occurring on most duties, perceived as being due to a reduced availability of ground staff. He believed this had become accepted as the "new normal" and had led to a desire to be "efficient" to "keep the operation flowing" where possible. The co-pilot described the pace of operations as "quicker than expected from training". He completed his Line Check earlier in July and was on his eighth sector of operational flying. He had operated to Toulouse once during line training and had not flown with the commander previously. Neither pilot felt that the challenging operational environment had produced a culture of taking shortcuts or rushing.

Both pilots believed they were current and well rested prior to the flight. The operator conducted a fatigue risk management analysis of the crew and assessed that for the commander the risk of roster-related fatigue was medium; the risk for the co-pilot was assessed as low. The analysis concluded that '*fatigue was not a direct cause for the crew having a loss of situational awareness and the aircraft taking off from the incorrect intersection'*.

Crew resource management

The co-pilot reported that the combination of the short taxi distance and early takeoff clearance required the aircraft checks to be conducted in a compressed timescale. This resulted in him being "heads down" for much of the time, cross-checking relevant checklist items. He believed that his mental capacity was fully engaged with this task and could not recall seeing the runway sign boards as they crossed the N4 holding point. His high workload as the aircraft entered the runway meant that his response to the commander's line-up checklist declaration was "disjointed".

The commander reported that as their pushback was late by over an hour, he was trying to be "efficient". He believed that the conduct of the checks "flowed promptly" but were not unduly rushed. He recalled that the first point he was aware that the co-pilot might be task saturated was when he asked for the taxi checks promptly followed on by the line-up checks. He reported not seeing the runway sign boards, possibly due to his monitoring of the actions of the co-pilot.

The operator stated that all its pilots are trained to manage risks associated with workload management by using a '*traffic light'* risk model. This includes '*discussion of the risk associated with each traffic light level and how to recognise what level they are in. It then discusses how to return to the green from amber or red levels, by communicating their situation with their colleagues; buying more time; reducing workload and changing the plan'*. They concluded that although the co-pilot recognised he was in the amber ('*feeling overwhelmed'*) he did not communicate this to the commander. His relative inexperience was cited as a likely contributing factor to the outcome.

Investigation by operator

An investigation conducted by the operator concluded that the operational environment at the home operating base at the time of the occurrence could be considered '*challenging*'. This was attributed to a combination of the application of calculated takeoff times and a perceived shortage of ground staff adding pressure to meet scheduled departure times. However, this '*did not result in unsafe shortcuts or inappropriate rushing but did result in an expeditious mindset for the commander'*.

Additional factors that influenced the outcome were identified as:

- **Mental model** - the crew calculated and correctly inserted performance figures for intersection N2. A focus on finding the correct numerical value for the intersection on the AGC for performance calculations, in combination

with the depiction of the runway layout on the FlySmart + application showing only one intersection for Runway 32R, may have contributed to the inaccurate mental model that there was only one runway intersection.

- **Briefing** - Using the Threat Matrix for the departure briefing, the crew did not identify the non-complex taxi routing as a potential threat that required to be discussed in detail. Addressing the taxi routing visually was effective on briefing how to leave the apron but as the terminal building blocked the view of the airport layout, it was not effective in identifying the location of N2.

- **Time pressure and workload** - The time from taxi to takeoff was recorded to be 3 minutes, 55 seconds during which the co-pilot was mainly '*heads-in*' to focus on tasks as the crew completed SOPs for taxi and takeoff. This workload reduced his situational awareness. The commander '*plausibly*' had the SID displayed on his EFB during taxi instead of the AGC as the routing was not identified as being complex. However, as the aircraft approached the perceived correct intersection, not having the AGC displayed may have reduced his situational awareness.

- **CRM** - as the co-pilot completed his tasks in accordance with SOPs, the commander did not notice the increase in his workload. By not verbalizing the perceived increase in workload and reduced situational awareness ("feeling overwhelmed") to the commander, the co-pilot '*did not enable the crew to reduce the pace of actions*'.

- **Lack of explicit position confirmation** - the PEDS brief was performed from memory, which involved a verbal confirmation that the crew had calculated performance for N2 and were cleared to taxi to N2. It did not involve a confirmation of where N2 was in relation to the aircraft's actual position, and SOPs do not require this.

- **Confirmation bias from ATC clearance** – following the early clearance from ATC, completing the taxi checklist through to the line-up checklist as the aircraft approached N4, entered the intersection and passed the runway holding point, resulted in the crew not observing the external runway signage. The increased workload reduced the effectiveness of confirming the actual intersection and increased the likelihood of the crew being vulnerable to confirmation bias.

Air traffic service information

Investigation

An analysis of the serious incident was conducted by the DSNA and interviews of ATC personnel were conducted by the BEA. The analysis found that when the shift was manned at 1700 hrs there would normally be five personnel on duty to cover the positions of Ground, Tower, Tower Assistant, Approach and Tower Supervisor. However, at the time of the incident only three were at their stations covering Pre-flight and Ground combined, Tower and Approach combined and the Tower Supervisor. There was no Tower assistant on duty due to the expected low traffic volume.

After starting, the aircraft was cleared to N1 (full length) which was a standard procedure at Toulouse for Runway 32R. It is not unusual for aircraft to request a departure from N2 as there is 2,300 m of runway available from this intersection. When the aircraft lined up on the runway there were two other aircraft on the approach frequency so traffic density was very light. The Tower Supervisor was engaged on a phone call with Marseilles Approach. The Ground Controller requested that the crew contact the Tower on reaching N2, believing they were being helpful in expediting the departure, but did not then follow the taxiing aircraft visually. This was reported as being in part due to the low density of traffic observed on displays[4] in the Tower control room, and a belief that the crew knew where they were going. When the Tower Controller issued the clearance to line up and take off from N2, stating that the remaining distance was 2,300 m, the aircraft was approaching the N4 intersection. The controller did not visually follow the aircraft so missed the opportunity to observe that it entered the runway via the wrong intersection. The controllers attributed this to a lack of concentration at the beginning of a shift and low traffic density rather than being fatigue induced. Mitigations cited by controllers were that the Ground Controller's position in front of the Surface Movement Guidance & Control System radar screen could obscure the view of N4. They recommended that the addition of a controllable stop bar at N4 could assist with preventing a future runway incursion.

The controllers only became aware of the event when the BEA contacted them following the operator filing an Air Safety Report.

The DSNA's analysis concluded that the serious incident was caused by a '*lack of effective verification by the crew of the line-up intersection*'. The lack of visual monitoring of the taxiing aircraft by controllers was recorded as a contributing factor due to,

- a lack of concentration at the start of the shift;
- this was the first occurrence of this type of routing error at Toulouse-Blagnac, and
- the controllers' confidence placed in the crew knowing where they were going and the need for '*traffic fluidity*'.

Footnote

[4] The Collaboration Human Machine Interface display provides a graphical interface in the control room for flight planning, air traffic flow and capacity management, and airspace management.

The DSNA proposed the distribution of the following information note to controllers at Toulouse:

> *'following the event of July 30, 2023… it is strongly recommended to the Ground controllers at Blagnac to adopt the following measures: wait at the N - 1 ramp before transferring the pilot in frequency to the TWR controller or if for operational reasons he cannot apply this procedure, the Ground controllers are reminded of the importance of maintaining particular attention on the progress of this aircraft throughout the taxiing phase. The Global Action Plan for the Prevention of Runway Incursions (GAPRI)[5] is expected to rule on this situation in the near future. The operations manual will then be amended accordingly and the [Toulouse] Blagnac controllers will be informed'.*

Additionally, the DSNA requested that the airfield operator consider installing controllable stop bars at N4.

Previous BEA investigation

The BEA carried out an investigation into a serious incident at Bordeaux-Merignac airport in 2022 in which a controller issued a landing clearance onto an occupied runway. It was concluded that high controller workload, an absence of supervision in the control tower and, probably, insufficient awareness of the risk posed by an inadequate number of controllers contributed to the event.

Following its investigation, the BEA recommended that the DNSA took action to monitor the number of controllers on duty at ATC units and use the information to ensure the adequacy of staffing levels. See Appendix A for more detail of the Safety Recommendation made by the BEA.

Tests and research

The operator analysed the performance calculations used by the crew for a departure from the N2 intersection of Runway 32R and the actual takeoff position of N4. The analysis concluded that in the event of a rejected takeoff above the calculated V_1 speed of 134 kt and below the V_R speed of 142 kt, a runway excursion was a likely outcome.

Analysis conducted by the aircraft manufacturer confirmed that G-EJCI was at a height of approximately 180 ft at the end of Runway 32R. Had an engine failure occurred at V_1, the continued takeoff profile would have ensured a clearance of at least 45 ft from obstacles. With an accelerate stop distance available of 1,780 m, a rejected takeoff at V_1 could have resulted in an overrun of 102 m for an all engines operative condition, and 93 m with one engine inoperative.

Footnote

[5] Global Action Plan for the Prevention of Runway Incursions (GAPPRI) superseded the European Action Plan for the Prevention of Runway Incursions (EAPPRI) in December 2023.

Discussion

Analysis of the serious incident at Toulouse-Blagnac Airport conducted by the DSNA and the operator revealed several interconnected factors that led to the crew initiating takeoff from an incorrect intersection. These factors can be broadly categorized into three main areas:

- High Workload and expeditious mindset.
- Limited attentional capacity and suboptimal situational awareness.
- Confirmation bias[6].

The crew was operating with the background of a challenging operational environment for the operator which likely created an expeditious mindset. Perceived pressure to "keep the operation flowing" can leave crews vulnerable to incorrect management of priorities and task saturation, potentially causing task overload.

A high mental workload is a significant stressor in aviation that can negatively affect situational awareness through attentional tunnelling. When the volume of information and/or number of tasks becomes overwhelming, pilots may focus only on a subset of that information resulting in incomplete or erroneous perception and integration of information.

For the crew of G-EJCI, the high workload conditions led to limitations in attentional capacity, which in turn resulted in suboptimal situational awareness. This manifested as an inability to process all relevant environmental information and a failure to perceive and respond to external runway intersection signage. It is probable that the incomplete intersection information presented to the crew on the FlySmart+ app contributed to an inaccurate mental model of the runway layout.

The development of an inaccurate mental model, combined with high workload, made the crew vulnerable to confirmation bias. This bias was reinforced by the early takeoff clearance from ATC that was delivered at a point where it appeared consistent with their shared mental model of the location of the N2 intersection. It was therefore likely that the crew would focus on confirmatory information that aligned with their existing beliefs. Additionally, by ATC not visually monitoring the progress of the aircraft from the tower, an important barrier to prevent the aircraft from lining up at the wrong intersection was rendered ineffective.

Footnote

[6] Confirmation bias is the tendency to pay attention to information that fits prior experience or expectation and to disregard information that does not fit.

Safety action

As a result of this serious incident, the following safety action was taken:

The operator:

- Formed a working group to review the risk of runway incursions and related flight crew procedures.
- Updated the Operations Manual Part A – Ground Operations Procedures to require all taxi intentions to be announced by the PF to the PM.
- Published a Safety Focus to all company pilots to highlight the risks associated with intersection takeoffs.
- Amended the Company and Crew Information route manual entry for Toulouse Blagnac to include a note that a number of intersections are not available for takeoff.
- Updated the Threat Matrix to include the risk of using intersections for takeoff.
- Undertook to automatically and appropriately share the overall context of Fatigue Safety Reports with company lead investigators to more effectively assess any broader impact of psychosocial factors in safety events.
- Undertook to include within the scope of future EFB project developments a review of the design of the FlySmart+ takeoff module to include representation of all runway intersections.

Toulouse ATC published a ‘Safety Flash Broadcast’ on 25 August 2023, which reminded controllers that:

- Controllers must constantly monitor the manoeuvring aircraft by visual observation, as per ICAO DOC 4444.
- The Ground Controller's responsibility for monitoring the progress of aircraft via the correct taxiways extends to the holding points.
- The Tower Controller only gives alignment or takeoff clearance when the aircraft is at or nearing the runway holding point, as per EAPPRI V3 – 1.5.2.h.
- The radar screen at the assistant position can obscure the view of the intersection N4/32R from the Tower Controller’s position.

Additionally, in recognition of the ‘lack of clarity’ on the staffing of ATC positions, Toulouse ATC Launched a working group to consider ATC workforce requirements and roster patterns.

Appendix A

Previous serious incident involving ATC staffing levels in France

Summary of the event

On 31 December 2022 a serious incident occurred between an Airbus A320, registered OE-INE, and a Robin DR400, registered F-GTZY, on 31 December 2022 at Bordeaux-Merignac airport.

The A320 was cleared to land while the DR 400 was lined up at the runway threshold. The pilot of the DR 400 felt that the situation was abnormal and called the controller who immediately ordered the A320 to go around. The lowest point of the A320 trajectory was at a height of 103 ft, at a distance of approximately 290 m from the runway threshold. The A320 then flew over the DR 400 at a height of 178 ft. The conflict had not been detected by the ATC staff.

The BEA identified the following factors that had contributed to the issuance of a landing clearance on an occupied runway:

- *'The reduction in the on-duty staff leading to the grouping of positions, thereby creating a high workload for the controller on position; this situation led the controller to forget the presence of the DR400 on the runway;*
- *The absence of supervision in the control tower by the 'supervisor', who was also performing the role of TWR assistant;*
- *A probably insufficient awareness of the risk posed by an inadequate number of controllers present at their workplace, especially in the case of an unexpected traffic increase'.*

BEA Safety Recommendation

In its report, the BEA concluded that,

> *'The situation that caused the incident in Bordeaux on 31 December 2022 was made possible by the latitude implicitly given to tower supervisors to manage staffing levels without complying with the duty roster, and without any means of outside verification by management.*
>
> *A social consensus, which has been in place for many years at the DSNA, has allowed a situation to persist in which the teams of controllers organise for a number of staff to be present that is generally lower than the number theoretically determined as necessary. This situation, which is outside of any legal framework but known of and implicitly tolerated, is such as to bar any official collection of information that would lead to the identification of safety issues generated by these differences.*

> *These practices, are widespread at national level, have been in place for many years and are implicitly tolerated in the quest for social peace, mean that it is not possible to rely on a declaration system to reliably determine the manning of the control positions and the controller's presence at work'.*

Therefore, the BEA recommended that:

> *'The DSNA equips the Air Traffic Control centres with an automated and nominative system for recording the presence of controllers on position and at the workplace, and ensures that this information can be used by the ANSP services, particularly to ensure the adequacy of staffing and to enable the analysis of safety events.' (Safety Recommendation FRAN-2023-023, issued on 19/12/2023)*

Status of the safety recommendation

The DSNA informed the BEA that they are going to take the necessary actions to implement the principles stated in the BEA safety recommendation, and that work is ongoing.