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COMISIÓN DE
INVESTIGACIÓN
DE ACCIDENTES
E INCIDENTES DE
AVIACIÓN CIVIL

Report IN-016/2014

Incident involving a Boeing 737-800, registration OO-JLO, operated by JetAirfly, and a Boeing 737-800, registration D-AHFH, operated by TuiFly, at the Palma de Mallorca Airport (Balearic Islands) on 13 June 2014

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Foreword

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1.4 and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

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Abbreviations

ADI	Aerodrome control instrument rating
AIP	Aeronautical information publication
AIR	Air control endorsement
ATC	Air traffic control
ATPL (A)	Airline transport pilot license (airplane)
ATZ	Aerodrome traffic zone
CIAIAC	Spain's Civil Aviation Accident and Incident Investigation Commission
CPL (A)	Commercial pilot license (airplane)
CVR	Cokpit voice recorder
EBBR	Designator for the Brussels Airport (Belgium)
EDDL	Designator for the Düsseldorf Airport (Germany)
FDR	Flight data recorder
ft	Feet
ICAO	International Civil Aviation Organization
IR	Instrument rating
km	Kilometers
kt	Knots
LEPA	Designator for the Palma de Mallorca Airport (Spain)
m	Meters
METAR	Aerodrome observation report
MHz	Megahertz
min	Minutes
NM	Nautical miles
RAD	Aerodrome radar control endorsement
RCA	Spain's Air Traffic Regulations
sec	Seconds
TACC	Terminal area control center
TWR	Control tower
UTC	Coordinated universal time
VMC	Visual meteorological conditions

Synopsis

Date and time of incident:	Friday, 13 June 2014 at 09:24:54 local time[1]
Site of incident:	Palma de Mallorca Airport (Balearic Islands)
Aircraft 1:	
Owner and operator 1:	JetAirfly
Aircraft 1:	Boeing 737-800, registration OO-JLO, callsign JAF7WJ
Persons onboard 1:	179 passengers, uninjured
	8 crew, uninjured
Type of flight 1:	Commercial air transport-scheduled-international-passenger
Phase of flight 1:	Final approach
Aircraft 2:	
Owner and operator 2:	Tuifly
Aircraft 2:	Boeing 737-800, registration D-AHFH, callsign TUI1FX
Persons onboard 2:	109 passengers, uninjured
	6 crew, uninjured
Type of flight 2:	Commercial air transport-scheduled-international passenger
Phase of flight 2:	Taxi to runway
Date of approval:	29 march 2016

Summary of the incident

On Friday 13 June 2014, at 09:24:54, a runway incursion occurred at the Palma de Mallorca Airport. Aircraft JAF7WJ landed on runway 24L while aircraft TUI1FX was 60 m away from the runway centerline, meaning it was inside the runway protection zone, despite not having entered the runway. The position of TUI1FX resulted from a cancelled clearance

[1] All times in this report are local, as obtained from air traffic control services. On the date of the incident, local time was two hours ahead of UTC.

to enter the runway that had been issued earlier. This incident has been classified as a type-D runway incursion, in keeping with the ICAO's Manual on the Prevention of Runway Incursions.

The investigation determined the lack of coordination of an appropriated separation distance in order to allow an aircraft to depart in between arrivals when most traffic is inbound and separations had previously been reduced. The distance separating aircraft entering the ATZ (formally the transfer point) was 5.5 NM. This separation would have allowed for the operation intended by the controller to take place, if he had:

- reduced the approach speed of JAF7WJ to a minimum so as to maintain this 5.5-NM separation for as long as possible;

- instructed the preceding aircraft to exit the runway as quickly as possible.

The unexpected closing of runway 24R, the change in the runway configuration, the delays in departing and arriving aircraft and the change in the traffic pattern minutes before the incident are all regarded as contributing factors that could have influenced the decisions made by the controller involved in this incident.

The report does not contain any safety recommendations.

1. FACTUAL INFORMATION

1.1. History of the flight

On Friday 13 June 2014, at 09:24:54, aircraft OO-JLO (callsign JAF7WJ) landed on runway 24L at the Palma de Mallorca Airport with aircraft D-AHFH (callsign TUI1FX) having taxied past the H10 holding point for runway 24L.

Operations at the airport had been relying on a single runway since 08:20 following the temporary closure of runway 24R due to a fuel spill. As a result, traffic control measures were put in place but there was considerable traffic and both arrivals and departures were being handled on runway 24L.

Aircraft TUI1FX, which was taxiing, was stopped at holding point H10 for runway 24L. There were ten inbound aircraft on the approach sequence and the intention of the local controller at the Palma de Mallorca Airport was to allow the aircraft holding at H10 to take off between the 4th and 5th (JAF7WJ) arrivals. When the 4th aircraft was on short final, the waiting aircraft was cleared to enter and hold after said aircraft landed. This clearance was cancelled a few seconds afterward, however, since separation with the 5th aircraft (JAF7WJ) was not guaranteed.

By the time the clearance to enter and hold was cancelled, the waiting aircraft (TUI1FX) had already started moving toward the threshold and had crossed the holding point. Even though it had not entered the runway proper, it was 60 m away from the runway centerline (Figure 1).

The controller informed the aircraft on approach (JAF7WJ) that it would have to go around due to the position of the aircraft on the ground. The crew assessed the situation and proposed a visual landing to the controller. The controller confirmed the approaching crew's appraisal of the situation, that they had the aircraft on the ground in sight and that they accepted landing under those conditions.

In light of the crew's acceptance, the controller cleared them to land, which they did without incident at 09:24:54. There were no injuries or damages in either aircraft.

1.2. Injuries to persons

There were no injuries during the incident.

Injuries	Crew	Passengers	Total	Others
Fatal				
Serious				
Minor				
None	8	179	187	
TOTAL	8	179	187	

Table 1. Injuries on approaching aircraft (1), OO-JLO, callsign JAF7WJ

Injuries	Crew	Passengers	Total	Others
Fatal				
Serious				
Minor				
None	6	109	115	
TOTAL	6	109	115	

Table 2. Injuries on taxiing aircraft (2), D-AHFH, callsign TUI1FX

1.3. Damage to aircraft

There was no damage to either aircraft.

1.4. Other damage

None.

1.5. Personnel information

1.5.1. Aircraft on approach (1), registration OO-JLO, callsign JAF7WJ

The captain was a 33-year old Belgian national. He had an airline transport pilot license (ATPL(A)) issued by the Belgian civil aviation authority. He also had a B737 300-900 rating

and an instrument flight (IR) rating, both of them valid[2] at the time of the incident. He had 4352 total flight hours, of which 3142 had been on the type.

The first officer was a 25-year old Dutch national. He had a commercial pilot license (CPL(A)) issued by the Dutch civil aviation authority. His aircraft and instrument flight ratings were valid[3]. At the time of the incident he had 236 hours on the type. He was new at the airline and this flight was the first officer's line check.

The third pilot onboard, seated in the jump seat, was a 44-year old Belgian national. He was in the cockpit as the examiner conducting the first officer's line check. He was a captain and had an ATPL(A) license issued by the Belgian civil aviation authority. He had valid[4] aircraft and instrument flight ratings at the time of the incident. He had 3947 total flight hours, 2409 on the type.

1.5.2. Aircraft taxiing (2), registration D-AHFH, callsign TUI1FX

The captain was a 42-year old German national. He had an ATPL(A) license issued by the German civil aviation authority. His aircraft and instrument flight ratings were valid[5]. He had 12082 total flight hours, 11354 on the type.

The first officer was a 36-year old German national. He had a CPL(A) license issued by the German civil aviation authority. His aircraft and instrument flight ratings were valid[6]. He had 9101 total flight hours, 8824 on the type.

1.5.3. Executive controller in the local position at the Palma TWR

The controller, a 52-year old Spanish national, had had an air traffic controller license for 17 years, with an aerodrome control instrument (ADI[7]) rating. Of relevance to the incident, he had valid[8] AIR-RAD[9] ratings. He also had a valid medical certificate[10]. He had been working as a controller in Palma for 14 years.

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2 Valid until 28/02/2015.
3 Valid until 30/11/2014.
4 Valid until 31/01/2015.
5 Valid until 31/01/2015.
6 Valid until 31/05/2015.
7 Certifies that the license holder is qualified to provide aerodrome traffic control service at an aerodrome with published instrument departure or arrival procedures.
8 Valid until 24/05/2015.
9 Air control rating (AIR): certifies that the holder is qualified to provide said control. Aerodrome radar control rating (RAD): certifies that the holder of the license is qualified to provide aerodrome control services aided by surveillance radar equipment.
10 Valid until 13/10/2014.

On the day of the incident, the controller had the morning shift and had gone on duty two and half hours earlier. He had started his shift at the clearance desk, taken a break and then gone on duty at the local controller's post. The day before he had also worked the morning shift, and prior to that he had been off for eleven days.

1.6. Aircraft information

1.6.1. Aircraft on approach (1), registration OO-JLO, callsign JAF7WJ

The aircraft on approach was a Boeing 737-800[11] operated by JetAirfly. It was outfitted with two CFM56-7 engines. It was arriving from the Brussels (Belgium) Airport (EBBR).

1.6.2. Aircraft taxiing (2), registration D-AHFH, callsign TUI7FX

The aircraft taxiing was a Boeing 737-800 operated by Tuifly. It had a certificate of airworthiness issued by the German civil aviation authority that was valid until 15/01/2014. It was outfitted with two CFM56-7 engines. It is 39.5 m long. Its destination was the Dusseldorf Airport in Germany, (EDDL).

1.7. Meteorological information

The weather conditions at the Palma de Mallorca Airport 25 minutes before[12] and 5 minutes after[13] the incident were as follows: wind calm, maximum visibility, no clouds and no significant weather phenomena. These conditions were confirmed by the crew of both aircraft.

1.8. Aids to navigation

Radar and ground-air communications records made available by the air navigation services provider (ENAIRE) were used to reconstruct the sequence of events described below. Figure 1 shows the relative positions of the taxiing aircraft (in red) and the landing aircraft (in green) during the incident.

[11] For the purposes of wake turbulence effects when following another aircraft, this aircraft is categorized as medium.

[12] 09:00 METAR: METAR LEPA 130700Z VRB1KT CAVOK 25/12 Q1018 NOSIG=

[13] 09:30 METAR: METAR LEPA 130730Z 21003KT 170V250 CAVOK 25/17 Q1018 NOSIG=

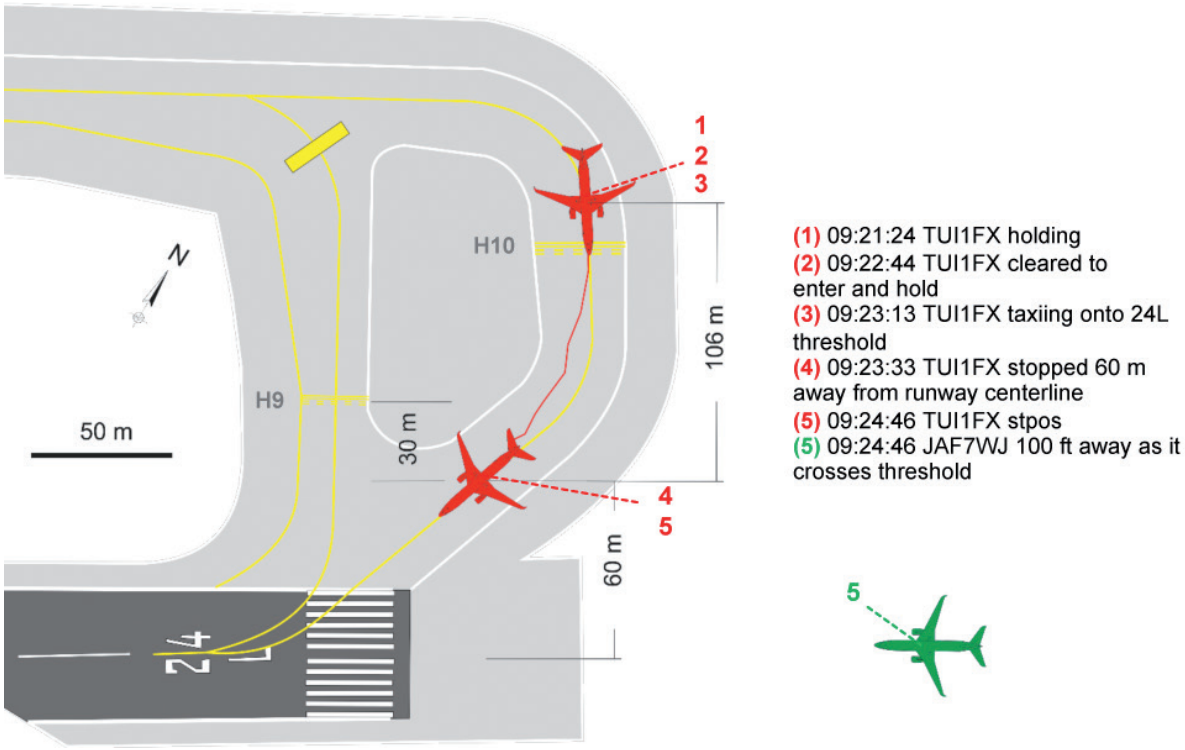

Figure 1. Relative positions[14] of the taxiing (TUI1FX, red) and landing (JAF7WJ, green) aircraft

Separation of inbound traffic on approach:

09:18:02: The aircraft on approach (JAF7WJ) intercepted the runway 24L localizer at 230 kt, 5300 ft and 20.6 NM out. It was the last of five aircraft on the runway heading preparing to land at Palma de Mallorca. Five additional aircraft would follow it. It was 6 NM behind the aircraft in front of it, which was fourth in the sequence[15].

09:21:24 (point 1): The aircraft on approach switched to the Palma TWR frequency (118.3 MHz). It was 9 NM out at 180 kt and 2900 ft. Its separation with the preceding aircraft had fallen to 5.5 NM. At this point, the aircraft taxiing (TUI1FX) was stopped at holding point H10.

Coordination to insert a departure between two arrivals and clearance to enter the runway:

09:22:44 (point 2): To insert the departing traffic between the 4th and 5th (JAF7WJ) arriving aircraft, ATC asked the crew of the waiting aircraft how long they needed to take off[16], informed them that the next aircraft was a Boeing 737-800 that was 5 NM out and

[14] The aircraft are displayed taking into account their actual dimensions.
[15] This aircraft was a Boeing 757, classified as heavy for the purposes of wake turbulence.
[16] These calls were started at 09:22:29, 15 seconds before giving the clearance to enter the runway.

requested confirmation that they were fully ready for takeoff. After receiving confirmation from the crew, ATC cleared them to line up and wait after aircraft number 4 landed, which by then was on short final.

09:23:04: ATC also asked the approaching aircraft (JAF7WJ) to reduce speed to the lowest possible in order to clear an aircraft for takeoff. Thirteen seconds later, the aircraft had reduced its speed from 160 to 150 kt, which it would maintain until it landed. The aircraft behind JAF7WJ (6th in the sequence) was also requested to maintain the lowest possible speed.

09:23:09: The 4th aircraft flew over the threshold, in front of the waiting aircraft. The 5th aircraft on approach was 4.3 NM behind at 1400 ft and 160 kt.

Cancellation of clearance to enter runway and cancellation of landing:

09:23:13 (point 3): the 4th aircraft had just touched down on the runway. The waiting aircraft (TUI1FX) was already taxiing (the radar return showed movement with respect to earlier returns) and the inbound aircraft (JAF7WJ) was 4.2 NM out at 160 kt. At that moment ATC decided to cancel the takeoff clearance for TUI1FX. The conversation, during which the controller asked for information on its position, lasted 20 seconds:

> 09:23:13: …break break TUI1FX. (At this point the aircraft was taxiing toward the runway).
>
> 09:23:19: Go ahead TUI1FX.
>
> 09:23:27: Stop stop stop and please confirm that the runway is clear.
>
> 09:23:27: Do you want us to hold position?
>
> 09:23:29: Hold position, the other traffic is only at three miles[17].
>
> 09:23:33 (point 4): TUI1FX we are beyond the holding point, we are beyond the holding point. By this point they were 106 m past holding point H10, 60 m away from the runway threshold and 30 m forward of holding point H9.

In light of the information provided by the taxiing aircraft, ATC decided to cancel the landing of the approaching traffic:

> 09:23:39: Roger, in this case stop, the other traffic is 2.9 miles on final, stop, break break JAF7WJ prepare to be a go around. (JAF7WK was at 3 NM, 1000 ft and 150 kt).

[17] It was in fact 3.2 NM away from the threshold.

Acceptance of visual landing:

09:24:01: Even though the crew of the approaching aircraft stated having received the instruction to go around, eight seconds later they informed ATC that they would accept a visual landing. The controller requested confirmation that they had the waiting traffic in sight and that they accepted the situation. The crew responded in the affirmative and ATC cleared the pilot to land "at your discretion".

09:24:01: JAF7WJ we can accept visual landing.

09:24:04: JAF7WJ Roger. Confirm you have the traffic at the holding point completely in sight and you accept that.

09:24:12: I affirm, JAF7WJ.

09:24:17: JAF7WJ at your discretion, if you can, wind is 240/04 kt, at your discretion[18], clear to land runway 24L.

09:24:27: At this time the 4th aircraft was leaving the runway via rapid exit taxiway S2, and the 5th aircraft was 0.9 NM out.

09:24:32: The waiting aircraft did not interrupt the communications between ATC and the aircraft on approach, but after the landing clearance was acknowledged, its crew told ATC that they should have been consulted on the decision.

09:24:46 (point 5): The aircraft on approach (JAF7WJ) passed 100 ft in front of the waiting aircraft. Two seconds later it flew over the threshold and landed without further incident. It exited the runway via rapid exit taxiway S2. ATC then cleared TUI1FX to take off.

1.9. Communications

The communications with ATC of most relevance to the investigation were given in their entirety with the radar information provided in section 1.8. The cockpit communications were not available to investigators, as indicated in section 1.11.

1.10. Aerodrome information

The Palma de Mallorca Airport[19] (LEPA) is at an elevation of 27 ft. It has two parallel runways, designated 06L/24R and 06R/24L. The access to the runway 24L threshold has

[18] The term "at your discretion" is not part of the standard terminology defined in Spain's Air Traffic Regulations.
[19] ICAO code 4-E.

two holding points designated H9 and H10, which are 90 and 150 m away from the runway centerline, respectively[20]. The layout of these two holding points is shown in Figure 1.

Section 2 of the AIP on the local regulations at the airport included the following:

- Preferred runways in west configuration: arrivals on runway 24L and departures on runway 24R.

- Minimum runway occupancy time for arrivals: in order to maximize the use of the runway, reduce its occupancy time and lower the number of go-arounds, it is important that pilots exit the runway quickly. The rapid exit taxiway to be used by all aircraft[21] shall be S2, located 1950 m away from the runway 24L threshold.

- Minimum runway occupancy time for departures: ATC will assume that all aircraft reaching the holding point are fully ready to taxi into position on the runway and start the takeoff roll immediately upon receiving the corresponding clearance.

At 08:20 on the day of the incident, a fuel spill at several points along the runway 24R taxiway caused the runway configuration to be changed, with runway 24R being closed and single-runway operations going into effect with runway 24L in use. As a result, the aircraft waiting to depart on runway 24R had to be transferred to 24L. Traffic flow measures were applied, restricting inbound traffic. This situation persisted until 09:52, when the airport returned to the preferred runway configuration (west configuration with departures on 24R and arrivals on 24L).

1.11. Flight recorders

The time that elapsed between the date of the incident and when it was reported to the CIAIAC made it impossible to preserve the FDR and CVR data.

1.12. Wreckage and impact information

Not applicable.

[20] To protect the runway, the minimum distance between the runway centerline and a runway holding point must be 90 m for aerodromes with code number 4 and category I, II or III precision approaches (as is the case of LEPA).
[21] Turboprop or light aircraft shall leave the runway via an earlier exit, S1, located 1540 m away.

1.13. Medical and pathological information

Not applicable.

1.14. Fire

Not applicable.

1.15. Survival aspects

Not applicable.

1.16. Tests and research

1.16.1. Traffic sequences before and after the incident

The radar records for the Palma de Mallorca Airport between 08:30 and 09:30, during which times it was in single-runway operations with runway 24L in use, showed that:

- Between 08:30 - 09:18, the traffic sequence was as follows:

  – Arrival-departure-arrival: The prevailing traffic sequence was alternating arrivals and departures. The minimum separation[22] between two arriving aircraft (with medium wake turbulence), during which an aircraft departed, was 6 NM. In one case involving a heavy aircraft, the separation between it and the next departing aircraft was 9 NM.

  – Arrival-departure-departure-arrival: This sequence took place four times. The separation between arrivals that allowed two departures before the next arrival was 9 NM.

- Between 09:18 and 09:30 there was a change in the traffic pattern, with fewer departures and more arrivals. At 09:11 the first of a group of ten inbound aircraft captured the localizer, forcing the controller to intersperse the departure of TUI1FX, which was the only aircraft that departed during this period:

  – The first aircraft in this sequence reached the runway threshold at 09:18. The 4th aircraft in the sequence was heavy, and the 5th aircraft in the sequence was JAF-7WJ.

[22] Average separation with the first aircraft over the threshold.

  - The first eight arriving aircraft captured the localizer more clustered. Only after the 8th aircraft did the separation increase from 6 NM to 11 NM (at mile 12 on the localizer).

  - At mile 9 on the localizer, the gap between the 4th and 5th aircraft (between which the controller wanted to insert the departure) was manifestly greater than the rest (6.0 NM, in comparison to 3.7, 4.2 and 5.4 NM for the rest of the sequence).

  - In every case, the distance separating the aircraft fell as they approached the runway. Even so, the gap between the 4th and 5th aircraft was larger than the rest.

  - At the runway threshold, the separation between the first 8 arriving aircraft was between 3 and 4.6 NM. Between the 8th and 9th aircraft it was 7.5 NM.

- The average time used[23] to travel the final 9 NM before landing was 3 min 50 sec. Aircraft JAF7WJ needed 3 min 25 sec.

- The average speed of the aircraft during the approach was:

  - On landing, an average of 134 kt. The speed of aircraft JAF7WJ was 150 kt, and of the preceding aircraft 130 kt.

  - At mile 6 an average of 161 kt. The speed of JAF7WJ was 170 kt.

  - At mile 9 an average of 187 kt. The speed of JAF7WJ was 180 kt.

1.16.2. Separations at hand-off between TACC and TWR

Section D.2.1[24] of the letter of agreement between the Palma TACC (LECP) and the Palma de Mallorca TWR (LEPA) in effect at the time of the incident defined the separation to maintain between two consecutive aircraft when the first was within the ATZ[25] limit in visual meteorological conditions (VMC) and only runway 24L was operational:

- 6 NM when the number of arrivals and departures is similar.

- To facilitate hub[26] traffic operations, the following apply:

[23] Calculated using the 22 arrivals that landed between 08:30 and 09:30. Minimum time: 3 min 14 sec. Maximum time: 4 min 26 sec.

[24] Annex D: Coordination procedures. D.2: runway configurations, separations. D.2.1: flights from Palma TACC to Palma TWR.

[25] Aerodrome traffic zone. The Palma ATZ extends out to 4.5 NM (8 km) from the airport.

[26] Hub traffic means that there are more operations of one type than another; that is, airport operations with hub arrivals means there is more inbound than outbound traffic.

- If the prevailing traffic is inbound (arrivals hub) and the number of departures is eight per hour or fewer, separation can be reduced to the minimum radar separation[27] after coordinating with the TACC. If there are takeoffs, a request will be made with the TACC to create an 8-NM gap between arrivals (if in VMC).

- If the prevailing traffic is inbound (arrivals hub) and the number of departures exceeds 8 per hour, inbound traffic will be separated by 6 NM, but the TACC will coordinate with the TWR so that during periods with no takeoffs, separation can be reduced to the radar minimum (VMC), in anticipation of wake turbulence conditions[28].

- If the prevailing traffic is outbound (takeoffs hub), arriving traffic will be separated by 8 NM.

1.16.3. Statement by the crew of the aircraft on approach (1): registration OO-JLO, callsign JAF7WJ

The crew of the aircraft on approach noted in their statement that during their approach, they heard aircraft 2 being cleared to enter the runway and line up. Given the insufficient separation, this clearance to line up was cancelled, but the aircraft had already crossed the holding point. They were notified by ATC to prepare for a potential go around. They suggested making a visual landing since, from their point of view, such a maneuver was obviously unnecessary and the presence of TUI1FX did not pose a hazard to their operation. The decision to continue with the landing was made by the three pilots[29] who were in the cockpit. They underscored that at no time was the safety of either aircraft jeopardized by this decision. ATC cleared them to land at their discretion, which they did without further incident. Their decision to make a visual landing was not affected by any kind of time or fuel pressure, or by concerns about their passengers. As regards the position of the aircraft on the ground, they recalled that only the nose gear had crossed the holding point line. The main landing gear was still behind the line.

1.16.4. Statement by the crew of the taxiing aircraft (2): registration D-AHFH, callsign TUI1FX

At 08:52, the aircraft's crew requested start-up clearance from ATC, but it was delayed 15 minutes since there were eight aircraft at the runway 24L holding point waiting to

[27] In this case, the minimum radar separation is 3 NM between medium wake turbulence aircraft. This distance is measured at the runway threshold.

[28] According to Spain's Air Traffic Regulations (RCA), the wake turbulence separation between a heavy followed by a medium aircraft is 5 NM.

[29] The captain, first officer and another captain in the jump seat.

take off. The crew noted that the frequency was very busy. After receiving their clearance, they removed the blocks at 09:06 and taxied to the runway 24L holding point. They were number 3 in the sequence. After the aircraft ahead of them took off, the tower informed them that three aircraft would land next, and that after the last one landed they would take off. ATC cleared them to "line up behind, be ready for immediate". They acknowledged the instruction and started taxiing to line up. When they were 10 m away from the runway, their clearance was cancelled ("stop, hold position"). The traffic on approach was asked if they would accept landing despite the position of the aircraft on the runway, but they were not asked. The crew stated that they remained stopped between holding point H10 and the right side of the runway threshold, at a 45º angle to the runway centerline.

1.16.5. Statement from the executive controller at the local position in the TWE

The text presented below is the most relevant information provided by the controller about the incident.

His assessment of the incident is that TUI1FX entered the runway too slowly, which caused the aircraft on approach, JAF7WJ, to get too close. In his opinion, TUI1FX was not ready for immediate takeoff, which is why it took longer than expected to move. It was this that made him change his mind and cancel the takeoff. It was all so fast that he did not have time to ask TUI1FX for its permission. He saw the position of TUI1FX on the radar and was aware of its position. If it had been completely on the runway, he would not have hesitated to instruct the approaching aircraft to go around. He also trusted the pilot's judgment to request to land only if it was safe to do so.

He had experience at the Palma Airport and knew the airlines and aircraft that normally operate there. He was surprised by how long it took the waiting aircraft to take off, because this airline has regular flights at Palma and knows the airport's operations.

They are used to single-runway operations, though it is true that 24R is normally used, not 24L. It is possible that having a taxi route that was different from normal could have affected the aircraft, and TUI1FX in particular.

They had a lot of traffic at the airport due to the closing of runway 24R. They usually arrange arrivals and departures into blocks. He went on duty at 07:00. He had been at the clearance desk, then he took a break and he went to staff the local position, but it "was a mess" because the closing of runway 24R meant they had traffic waiting to take off that had taxied from runway 24R to 24L. They also had all the arriving traffic.

1.17. Organizational and management information

Not applicable.

1.18. Additional information

Not applicable.

1.19. Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

On Friday, 13 June 2014 at 09:24:54, aircraft JAF7WJ landed on runway 24L at the Palma de Mallorca Airport while aircraft TUI1FX was 60 m away from the runway centerline, meaning it was inside the runway protection zone, though not on the runway. This incident is thus formally classified as a runway incursion, as defined by the ICAO.

The analysis of this incident considered the following aspects:

- The relative positions of the aircraft and the surrounding conditions so as to understand the reasons why one controller and three pilots accepted to continue with a maneuver that they knew did not comply with regulations.

- The prior decision-making process, from the decision to insert the takeoff into the traffic sequence to the cancellation of the clearance, so as to understand what the traffic situation was and what had changed in the scenario to make the controller change his mind.

- The separations that were present in this incident with respect to those present at similar times and to those specified in the letter of agreement.

The conclusions of this analysis reveal that the 8-NM separation distance did not exist, as required by the letter of agreement to allow a takeoff between arrivals when most of the traffic is inbound and the separations had already been reduced previously. The aircraft entered the ATZ (formally the transfer point) separated by 5.5 NM, which would have allowed the controller to carry out his intended operation if he had:

- reduced the approach speed of JAF7WJ to the minimum so as to maintain the 5.5-NM separation as much as possible, and

- instructed the preceding aircraft to exit the runway as quickly as possible.

The unexpected closing of runway 24R, the change in runway configuration, the delays in departing and arriving traffic and the change in the traffic pattern minutes before the incident are all factors that could have affected the controller's decision-making process during this incident.

2.1. Acceptance of runway incursion by the controller and crew

From the point of view of the decision that must be made in real time by a controller or a pilot, who may not know the theoretical protection distance of a runway or have time to measure it in real time, and whose reference is the holding points of a runway, the fact

that an aircraft is ahead of the holding point should indicate to them that the runway is occupied. This was the case in this incident when the controller, as soon as he had confirmation that the aircraft was beyond the holding point, immediately instructed the approaching aircraft to go around, which its crew accepted.

This initial decision, however, was later reconsidered by both parties. To understand why the crew's three pilots and one controller accepted to continue with the situation that would unfold, the relative position of the two aircraft must be put in the proper context.

After evaluating the position of the waiting aircraft, the three pilots on the approaching aircraft concluded that landing did not jeopardize the safety of either aircraft. For both the controller and the pilots, the fact that the aircraft on the ground was outside the runway and that weather conditions were perfect conditioned their initial decision. If the aircraft had been on the runway, if the weather conditions had been bad or if the aircraft's position could not have been confirmed visually, this situation would not have arisen and neither party would have opted for this solution.

The communications between the crew and the controller showed that the situation that was going to occur was known and had been accepted by both parties. The fact that it was the crew that proposed to make a visual landing could have helped change the controller's decision since, as he himself stated, he trusted the pilot's judgment.

In light of these factors, it is understandable how both parties, the controller and the pilot, accepted to continue landing on a runway that was officially occupied.

Landing clearance

The controller's use of the term "at your discretion" suggests he was cognizant of the fact that he was authorizing an unusual situation and that he was transferring the final decision to the pilot.

The traffic situation at the time, with five aircraft in the sequence, complicated the situation, since if he had insisted that JAF7WJ execute a go-around maneuver, he would have had to interrupt the sequence and put the aircraft in holding patterns until he resolved the incorrect presence of the aircraft within the runway protection zone. This situation forced the takeoff of TUI1FX with a separation of 4.6 NM immediately after the landing of JAF7WJ, since the next largest gap in the sequence was between the 8th and 9th aircraft.

2.2. Decision-making process in the incident

In order to understand how a situation arose in which a landing was cleared with an aircraft inside the minimum required distance, the decision-making process and the traffic situation at each of the following times was analyzed:

- At 09:22:29, when the controller decided to insert the takeoff between the landings of the 4th and 5th aircraft and called the crew to ask if they were ready.

- At 09:22:44, when the controller cleared the aircraft to line up and wait.

- At 09:23:13, when the controller decided to cancel the takeoff and called the aircraft on the ground to stop.

When the controller made the decision to insert the takeoff, there were four aircraft in the landing sequence, with a fifth about to join the sequence at the localizer. The separation between the aircraft between which he wanted to insert the takeoff was 4.6 NM, with the leading aircraft 1.4 NM away from the threshold.

By the time he gave the clearance to line up and wait, the separation between the aircraft had fallen to 4.5 NM and the leading aircraft was 0.8 NM out.

When the controller decided to cancel the clearance, the scenario was as follows: the aircraft had just landed, the next one was 4.2 NM out and approaching at 160 kt, and the waiting aircraft was still at H10, though it was moving.

At that time the controller did not know how long the aircraft that had just landed would remain on the runway, meaning the runway occupancy time did not influence his decision. The decision to cancel the takeoff is believed to have been affected by the distance and speed of the approaching aircraft and by the fact that the taxiing aircraft, though it had already started moving, was still some distance away from the runway. In fact, this is the aspect that was mentioned by the controller, who thought the incident occurred because the taxiing aircraft was not fully ready to take off. Perhaps the controller expected the taxiing aircraft to start moving sooner, and for it to be almost entering the runway as the arriving aircraft landed. The radar records show, however, that the landing aircraft passed in front of the waiting aircraft almost five seconds before the latter started moving. This amount of time is considered fast and reasonable, and the crew do not seem to have been unprepared for takeoff. Instead, the controller's assessment of the situation is thought to have resulted more from his desire to execute the takeoff as quickly as possible, in light of the proximity of the next aircraft in the sequence.

The subsequent evolution of the traffic showed that the controller's decision to cancel the takeoff had been correct, since there would not have been enough time for the aircraft to take off. The time spent by the landing aircraft on the runway (1 min 17 sec) and the distance and approach speed of the next aircraft meant that by the time the runway was completely clear, the next aircraft was 0.9 NM out, leaving no time for an aircraft to depart under these conditions.

Regardless of the distance values specified in the letter of agreement, which are analyzed in section 2.3, and while the separation values between the aircraft fell from 4.6 NM to 4.2

NM during the decision-making process, this aspect is not considered important enough to have altered the scenario in question. Neither aircraft's speed changed in magnitude or trend. The amount of time needed to cover the final 9 NM was within normal values, and while JAF7WJ took a little less time than the rest, it was still within the normal range. In other words, an unexpected change in the trend or speed of the approaching aircraft can be ruled out as having influenced the change in the controller's decision. In fact, for the most part the traffic situation did not change, since the traffic's progression remained constant and similar between the time the controller decided to insert the takeoff until he cancelled it.

The maneuver planned by the controller (to insert a takeoff between two arriving aircraft separated by 4 NM at the threshold) would have been viable if he had prepared and informed the aircraft. In this case, the separation between the aircraft at the threshold was 4.2 NM, but:

- The preceding aircraft had not been instructed to exit the runway quickly. This resulted in a runway occupancy time that was long in comparison to other aircraft using the same exit taxiway (40 sec). Even if the waiting aircraft had been at the threshold, it would not have been able to start its takeoff run with the preceding aircraft still on the runway, meaning the conflict would have occurred just the same.

- The waiting aircraft was at H10, the point furthest away from the runway (compared to H9). This meant that despite starting to move five seconds after the preceding aircraft flew over the threshold, it required extra time to reach the runway.

- The incoming aircraft was approaching the runway at 160 kt, since it had been instructed very late to reduce its speed as low as possible. Despite its crew's reduced ability to react given the phase of the approach and their proximity to the runway, they still managed to lower their speed by 10 kt. It is possible that if the crew of JAF7WJ had been instructed to maintain the lowest possible speed earlier in the approach, the separation would have been greater later in the approach, making it possible for TUI1FX to take off.

In light of these factors, the decision to clear TUI1FX to take off between two arriving aircraft would have required more preparation ahead of time, such as:

- requesting the preceding aircraft, no. 4 in the sequence, to exit the runway as quickly as possible, and

- requesting the next aircraft in the sequence (JAF7WJ) to decrease its speed to the lowest possible at the start of the approach. This may have made it possible to minimize the reduction of the 6 NM distance that separated the two aircraft in the early stages of the approach.

The unexpected runway configuration change, the delays involving arriving and departing traffic, the desire to streamline traffic, the desire not to delay traffic even more, and the fact that the waiting aircraft was the only outbound traffic at the time could have influenced the decisions made by the controller in this incident.

2.3. Evaluation of the maneuver based on the letter of agreement

The arriving aircraft between which the controller wanted to insert the takeoff were 6 NM apart when they were 20 NM away from the airport. When they entered the ATZ, they were separated by 5.5 NM, a distance that fell to 4.2 NM at the threshold.

An analysis of the traffic in the hour before the incident, in the same operating conditions, revealed that the separation needed at the threshold to insert a takeoff between two arrivals was 6 NM. In one case, in which the leading aircraft was a heavy, as in this incident, the separation had been 9 NM. The traffic type present when these separations were used satisfied the separations specified in the letter of agreement.

However, 14 minutes earlier, the traffic pattern changed, with the prevailing traffic now being inbound and the only outbound traffic being the incident aircraft. In this situation ATC procedures indicate reducing the separation between arriving aircraft, which occurred in the incident according to the radar records. In this scenario, the required increased separation to insert the takeoff was not coordinated.

3. CONCLUSIONS

3.1. Findings

General:

- The documentation of the two aircraft was valid.
- The crews and the controller had the necessary licenses.
- The controller had gone on duty two and a half hours before the incident.
- The airport was using a single runway, 24L, for both landings and takeoffs.
- One hour and five minutes before the incident, the airport had switched from dual- to single-runway operations.
- Daylight VMC conditions were in effect.
- There were no problems transmitting, receiving or understanding the communications between the aircraft and ATC.

Before the incident:

- The type of traffic changed 14 minutes before the incident, going to mostly inbound traffic, with the only outbound traffic being the one involved in the incident.
- Seven minutes before the incident there were ten inbound aircraft, of which only 4 and 5, 8 and 9 and 9 and 10 were separated by more than 6 NM six miles from the threshold.
- The controller wanted to insert the departure of the taxiing aircraft between the 4th and 5th aircraft in the sequence of ten arrivals. The takeoff eventually took place between the 5th and 6th aircraft.
- The separation between the 4th and 5th aircraft decreased as they approached the threshold, going from 6 NM to 5.5 NM upon entering the ATZ and 4.2 NM at the threshold.
- The controller tried to arrange the sequence to allow the takeoff. He selected the largest gap, informed the affected crews of his intentions, requested speed reductions from the 5th (on final approach) and 6th aircraft, ensured the waiting aircraft was ready for immediate takeoff and informed its crew of the distance and type of aircraft on approach.

- The controller did not prompt the preceding aircraft to exit the runway as quickly as possible and he did not request the 5th aircraft (JAF7WJ) to reduce speed far enough in advance.

- There were no changes involving the traffic situation during the final phase of the approach. The speeds of both aircraft were average.

- During the incident:

- The taxiing aircraft was cleared to enter the runway and line up behind the 4th aircraft on short final, with the next aircraft (5th in the arrival sequence) 5 NM out.

- The clearance to enter the runway and line up was cancelled by the controller just after the 4th aircraft landed, with the 5th aircraft 4.2 NM out.

- By the time its clearance to enter the runway was cancelled, the taxiing aircraft was inside the runway protection zone (60 m away from the centerline), though it had not entered the runway proper.

- The aircraft on approach was informed to prepare for a go around.

- The aircraft on approach suggested the possibility of making a visual landing. All three pilots on the crew agreed to continue with the landing and confirmed their awareness of the situation.

- The controller did not consult with the holding aircraft as to the operation he was going to authorize.

- The controller cleared the aircraft on approach (5th in the sequence) to land.

- As part of the landing clearance, the controller used the term "at your discretion", which is not part of the standard phraseology.

- As the 4th aircraft was leaving the runway, the aircraft on approach (no. 5) was 0.9 NM out.

3.2. Causes/Contributing factors

The likely cause of the runway incursion involving aircraft JAF7WJ and TUI1FX was the failure to coordinate an appropriate separation between arriving aircraft so as to allow TUI1FX to take off before the arrival of JAF7WJ.

Contributing to the incident were:

- the workload at the local controller's position in the TWR resulting from the closing of runway 24R and the accumulated delays and waiting aircraft,

- the change in the traffic pattern minutes before the incident, with all aircraft being inbound with the exception of the sole departing aircraft, TUI1FX, and

- the decreased separation between arriving aircraft due to a late request to JAF7WJ to lower its speed.

4. SAFETY RECOMMENDATIONS

None.