

# **Aviation Occurrence Investigation**

## **Final Report**

INCID/02/2018

Aircraft Took-off from Engaged Runway

Macau International Airport

12 November 2018

22 July 2019

## **Foreword**

The report is based on the investigation carried out by the Civil Aviation Authority, Macao, China (AACM) in accordance with Law no. 2/2013 *Civil Aviation Accident and Incident Investigation and Aviation Safety Information Protection Law*, the *Air Navigation Regulation of Macao* approved by Executive Order 62/2016, and Aeronautical Circular AC/GEN/003 *Mandatory Occurrence Reporting Scheme*.

The sole objective of the investigation of an aviation occurrence is the prevention of accidents and incidents. It is not the purpose of these activities to apportion blame or liability.

## Table of contents

Foreword.....	i
Table of contents .....	ii
Synopsis .....	iv
1 Factual Information.....	1
1.1 Event history .....	1
1.2 Injuries to persons .....	1
1.3 Damage to aircraft.....	1
1.4 Personnel information.....	1
1.4.1 Tower controller.....	1
1.4.2 ATC supervisor .....	2
1.4.3 ATC assistant .....	2
1.5 Aircraft information .....	2
1.5.1 General.....	2
1.6 Meteorological information .....	3
1.7 Communications .....	3
1.8 Aerodrome information (Macau International Airport).....	4
1.8.1 General.....	4
1.8.2 Airport operation and Air Traffic Control Services .....	4
1.9 Recorded data.....	4
2 Analysis.....	4
2.1 General.....	4
2.2 ATC procedures .....	5
2.3 Human factors.....	8

2.4	Training and competency check .....	9
2.5	Weather and environment influences.....	9
2.6	Airport facilities and equipment .....	9
3	Conclusion .....	11
3.1	Findings.....	11
4	Safety actions and safety recommendations .....	12
4.1	Safety actions taken by Macau International Airport .....	12
4.2	Safety recommendations .....	12
4.2.1	Safety recommendations to Macau International Airport.....	12

## **Synopsis**

On 12 November 2018, a Thai AirAsia Airbus A320-200 aircraft, (registration: HS-BBO and serial number: 6240) with flight number AIQ763 / FD763 took off from runway 34 at Macau International Airport which was engaged by a “Follow-me” vehicle.

## **1 Factual Information**

All times used in this report are in Coordinated Universal Time (UTC).

### **1.1 Event history**

At 06:24, vehicle with call sign Follow-me 5 requested to proceed to runway 34 for inspection via taxiway C1, C2 and C3 when it was at Apron.

Follow-me 5 requested to enter runway at holding point. After approved by tower, Follow-me 5 entered runway 34 for inspection at 06:30.

At 06:34, flight AIQ763 / FD763 reported ready to tower.

At 06:34, tower issued the departure clearance to flight AIQ763 / FD763, at this point, Follow-me 5 was still on runway 34 doing inspection and visual amber alert for Follow-me 5 was indicated on the display of Surface Movement Radar (SMR).

At 06:35, flight AIQ763 / FD763 was lined up on runway for departure, both visual alerts for Follow-me 5 and AIQ763 / FD763 were indicated on the display of SMR.

At 06:36, flight AIQ763 / FD763 was rolling for departure and triggered the SMR audio alarm. ATC assistant realized that Follow-me 5 was occupying the runway and instructed Follow-me 5 to vacate runway at 06:36.

Follow-me 5 vacated runway at 06:36 and flight AIQ763 / FD763 airborne at around 06:37. According to the positions of aircraft and vehicle indicated on the SMR, the estimated nearest distance between both moving objects was about 1,480 metres or 0.8 nautical miles.

### **1.2 Injuries to persons**

No fatal, serious or minor injury was reported as a result of this occurrence.

### **1.3 Damage to aircraft**

No damage to the aircraft occurred as a result of this occurrence.

### **1.4 Personnel information**

#### **1.4.1 Tower controller**

The tower controller held an Air Traffic Controller License with Aerodrome Rating issued by AACM on 21 December 2006.

### 1.4.2 ATC supervisor

The ATC supervisor held an Air Traffic Controller License with Aerodrome Rating issued by AACM on 30 July 1999. He started to work as an ATC supervisor since 1 January 2007.

### 1.4.3 ATC assistant

The assistant started to work as ATC assistant since 27 March 2009 after successfully completed the ATC assistant training.

## 1.5 Aircraft information

### 1.5.1 General

The aircraft information is summarized in Table 1.

**Table 1: Aircraft information**

Aircraft manufacturer	Airbus
Aircraft type	A320-200
Aircraft serial number	6240
Operator	Thai Airasia
Nationality	Thailand
Year of manufacture	2014

The Follow-me 5 vehicle information is summarized in Table 2.

**Table 2: Follow-me 5 vehicle information**

Vehicle manufacturer	Toyota
Vehicle model	Prius 1.8 Hybrid A/T
Registration	MP-97-46
Year of manufacture	2011

**Figure 1: Follow-me 5 Vehicle**



### **1.6 Meteorological information**

According to METAR published at 06:30, the weather for Macau International Airport included 8 knot of wind in direction 040, visibility 4 Km, Few (1 - 2 oktas) clouds at a height of 2,500 feet. The temperature on the ground was 28 °C.

### **1.7 Communications**

The following communications playback for the time of this occurrence were reviewed and transcripts were provided by Macau International Airport:

- Ground frequency 121.725 MHz between Macao Ground Controller and aircraft
- Tower frequency 118.000 MHz between Macao Aerodrome Controller and aircraft
- Trunk Mobile Communication – Tower Channel

All reviewed communications and ATC phraseology between the control tower to the Follow-me 5 vehicle and flight AIQ763 / FD763 during the occurrence were normal and clear, no misunderstanding from the communications were identified.

## **1.8 Aerodrome information (Macau International Airport)**

### **1.8.1 General**

Macau International Airport had one runway oriented north-north-west to south-south-east on magnetic headings of 164°/344°. Those runways were designated 16/34 indicating their relative position when looking along the runway. The runway with declared distance (Take-Off Runway Available, TORA) of 3,300 metres concrete surface.

### **1.8.2 Airport operation and Air Traffic Control Services**

Macau International Airport Company Limited (CAM) holds the Aerodrome Certificate for the Macau International Airport and responsible to maintain respective airport systems with a team and dedicated engineers, and is authorized to provide the ATC services.

Macau International Airport was equipped with a SMR to detect principal features on the surface on an airport, and to present the image on a radar indicator console in the control tower. It is used by air traffic controllers to supplement visual observations. It provides warning in the event of potential conflicts between aircraft on the runway.

## **1.9 Recorded data**

The investigation team had reviewed the following auto-captured data:

- Air traffic control audio communications
- Recordings from the Surface Movement Radar (SMR)
- Weather data

## **2 Analysis**

### **2.1 General**

All involved duty controllers were properly licensed and qualified under relevant regulations. The ATC assistant was qualified to work at the ATC control tower of Macau International Airport to provide assistance service as per operation procedures. No evidence indicated any pre-existing medical or physical condition that might have adversely affected duty personnel's performance during the occurrence.

## 2.2 ATC procedures

### Control of vehicle

According to paragraph 14.3.2 of Runway Safety Programme of Macau International Airport, positive ATC clearance is required before access to runway. ATC operation procedure OP-ATC-07 paragraph 4.3.1 and 4.3.2 prescribed that the vehicle on maneuvering area is controlled by ATC assistant after coordinating with either ground controller or tower controller depends on the moving area of the vehicle. ATC Tower communicates with vehicle by using trunk mobile radio.

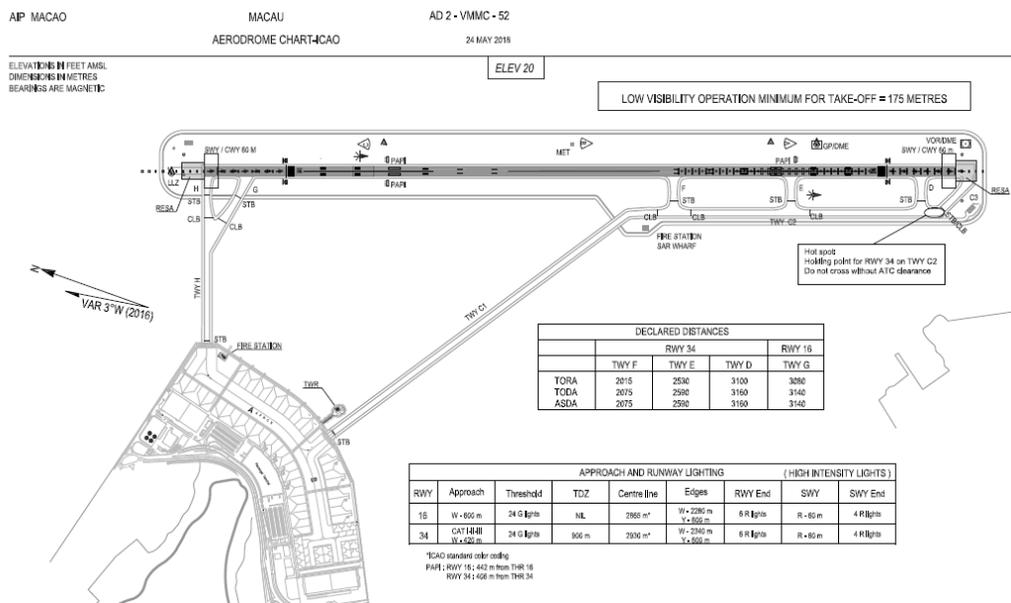
At 06:25, Follow-me 5 requested to proceed to runway for inspection via Taxiway C1, C2 and C3. Tower assistant cleared Follow-me 5 to enter Taxiway C and passed the red Flight Progress Strip (FPS) to tower controller. At 06:30, Follow-me 5 requested to enter Runway 34 when approaching holding position at Taxiway C2. ATC assistant issued the clearance to enter runway with the approval from tower controller and the clearance was read back by Follow-me 5. The amber alert tag attached to Follow-me 5 after it entered runway was shown on the Surface Movement Radar (SMR) display. The tower controller marked the time of Follow-me 5 entering runway and put the FPS in the flight progress board to indicate the runway was occupied, as per procedure of ATS Manual Chapter 14 paragraph 14.2.12 and OP-ATC-07 paragraph 4.3.2 and 4.4.3.

### Control of departing aircraft

At 06:29, AIQ763 / FD763 called tower controller when turning from Taxiway A to Taxiway C1. At 06:33, AIQ763 / FD763 reported ready for departure at the intersection of Taxiway C2 and Taxiway E, tower controller issued take-off clearance immediately. The tower controller stated that she did not check the FPS at the flight progress board before issued the clearance. At this moment, Follow-me 5 was on runway moving from south to north at abeam Main Fire Station. At 06:34, AIQ763 / FD763 crossed the runway holding position on Taxiway C2 when Follow-me 5 was on the touch down zone of Runway 16. The audible alarm was triggered after AIQ763 / FD763 started take off run, while Follow-me 5 just passed the threshold of Runway 16. ATC assistant instructed Follow-me 5 to vacate runway immediately. AIQ763 / FD763 was airborne at about 1,500 meters from the runway end of Runway 34 while Follow-me 5 was still on runway near Taxiway H. Follow-me 5 reported runway vacated in 20 seconds after instructed by ATC

assistant. The flight crew of AIQ763 / FD763 claimed that they received clearance to taxi, lineup, takeoff as normal. Refer to Figure 2 for layout of Macau International Airport.

**Figure 2: Aerodrome chart of Macau International Airport**

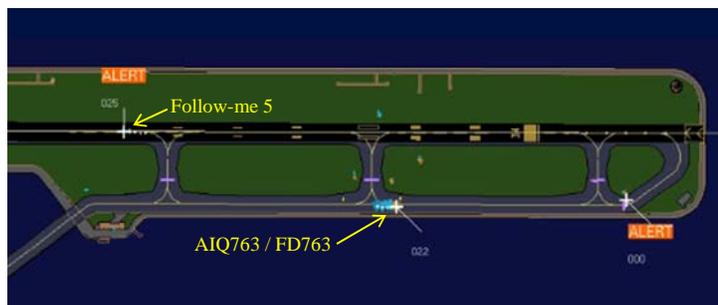


Source: Macau AIP Section AD

### Runway incursion

Tower controller issued take off clearance to AIQ763 / FD763 when Follow-me 5 was on the runway, refer to Figure 3. The status of Follow-me 5 was indicated on the SMR display and flight progress board. Follow-me 5 and AIQ763 / FD763 were moving in the same direction on runway after AIQ763 / FD763 entered runway. The closest distance between Follow-me 5 and AIQ763 / FD763 before airborne was 1,480 meters, refer to Figure 4. According to ICAO Runway Incursion Severity Calculator, the runway incursion is rated as Severity Category C.

**Figure 3: Position of AIQ763 / FD763 and Follow-me 5 when Take-off clearance was issued**



*Source: SMR recording*

**Figure 4: Closest distance between AIQ763 / FD763 and Follow-me 5**



*Source: SMR recording*

The tower controller stated that she forgot the vehicle on runway when she issued take-off clearance to AIQ763 / FD763. She checked neither the flight progress board nor the SMR display before issued the take-off clearance.

The ATC supervisor stated that when he heard the audible alarm of the SMR system, he approached the tower controller working position and noticed that AIQ763 / FD763 got airborne at about mid runway. He also noticed that the sequence of FPS showed that the runway was occupied by Follow-me 5 but not sure where was Follow-me 5 at that time. The tower controller stated that she told the ATC supervisor that she forgot that Follow-me 5 was still on the runway before she was alerted by the audible alarm of SMR.

The FPS of AIQ763 / FD763 indicated that the departure slot was before 06:43, the tower controller issued the take-off clearance at 06:34 and airborne at 06:37. The departure time was 6 minutes before the expiry time of the departure slot.

The tower controller considered the traffic volume and complexity were light. The ATC supervisor considered that the traffic volume was light to moderate and complexity was very light. The tower controller, ATC supervisor and ATC assistant claimed that there was no distraction during incident.

### **2.3 Human factors**

According to ATC Service roster for September, October and November 2018, man power were consistent throughout the three months, rostering and shift record were normal, no overtime for the involved ATC controllers was required during the occurrence. The duty time of the ATC supervisor and tower controller met the requirements of Scheme of Working Hours of Air Traffic Controller (AC/ATS/001R00) within 30 days before the occurrence. Although there were no fatigue avoidance requirements stipulated for ATC assistant, the duty ATC assistant also met the above-mentioned requirements in the same period.

The tower controller had a day off before the day of occurrence. The tower controller stated during the interview that her medical or emotional conditions were fit for work as a controller.

The duty shift of the tower controller was from 00:00 to 08:15 UTC. The controller worked at the tower, ground and assistant positions after reported duty. The change of operation positions met the requirements of Scheme of Working Hours of Air Traffic Controller (AC/ATS/001R00).

The tower controller (who issued clearance to flight AIQ763 / FD763) stated during the interview that she was not distracted during the occurrence, except she was planning the training helicopter flight request for Route L back to Macao and was also thinking about the training she would deliver to vehicle driver on the next day of the occurrence.

The ATC Supervisor heard the SMR audible alert at 06:36 and approach the tower controller working position. He notice that the departing traffic got airborne at about middle of runway and a vehicle was still on the runway. He collected some information from the tower controller and ATC assistant. The tower controller continued to work at the tower position to provide

control service to following aerodrome traffic until 07:03.

According to the shift record, there were total 2 ATC supervisors, 4 ATC officers and 1 ATC assistant were scheduled during the occurrence. Among these personnel, 1 ATC supervisor and 1 ATC officer took the recurrent competence check in the morning as examiner and candidate, respectively. During the occurrence, the tower, ground and assistant positions were manned individually. The ATC supervisor stated that he was at the lower level of the control room for water. Same as another ATC related runway incursion occurrence happened in May 2018, the duty supervisor was also not at the working position. The absent of supervisor have correlation in both occurrences.

#### **2.4 Training and competency check**

Training record for the involved controllers were review and confirmed in accordance with training programme. Their annual ATCL Competency check were conducted as scheduled and overall performance were recorded with satisfactory.

#### **2.5 Weather and environment influences**

According to the interview statement of tower controller interview, the controller could see clearly outside the control room, could visual the AIQ763 / FD763 but need to search for the Follow-me 5 vehicle as the distance was quite long.

#### **2.6 Airport facilities and equipment**

There are several means for the tower controller to identify the Follow-me vehicle was at the runway:

1. Flight Progress Strip (FPS)
2. Surface Movement Radar (SMR)
3. Visual observation (the distance from the Follow-me to tower station is about 2,000 metres).

Flight Progress Strip (FPS)

Macau TWR has been using paper progress strip as flight strip management since the TWR in operation. Paper progress strip were all human activities without active monitoring. One of the limitations related to this occurrence

was that it could not provide alert like the electronic flight progress strip system with automated memory aids to inform controller of the runway situation.

#### Surface movement radar (SMR)

The SMR was unserviceable from March 2018 to October 2018 due to gear box technical problem. On 30 October 2018, the SMR gear box was replaced and the SMR was under monitoring. At the time of occurrence, the SMR was operating but still under the condition of monitoring.

It was observed from the SMR playback that the system generated the first visual amber alert on the display when the Follow-me 5 vehicle passed through the taxi-holding position at Taxiway C2, but instead of having the visual amber alert moving with the Follow-me 5 vehicle travel path, it kept staying at the same location and the system generated a second visual amber alert. The second visual amber alert was actively moving in accordance with the Follow-me 5 travel path. So, instead of to having one moving alert to present the Follow-me 5 vehicle, the system generated an extra alert staying at the C2 taxi-holding position. Although there is an extra alert shown on the SMR display, if the controller refer to the SMR before giving clearance to AIQ 763 / FD763, the controller should had identified the present of the Follow-me vehicle.

When AIQ763 / FD763 started take-off run for departure, the SMR audible alarm was triggered as designed. Once the alarm was triggered, duty staff realized that Follow-me 5 was occupying the runway and informed Follow-me 5 to vacate runway.

The controller had mentioned during interview that the location of SMR display was a bit far from the tower working position. The controller console (tower position) was setup with total 5 displays being placed horizontally in front of the controller, the controller sat in front of the first and second displays as the flight progress strip was placed there, the SMR display was placed farthest to the right (the 5<sup>th</sup> display).

**Figure 5: Controller console (tower position)**



#### Visual observation

At the time of occurrence, the weather was good and visibility was clear, the controller could see clearly outside the control room. At the time the tower controller issued the departure clearance to flight AIQ763 / FD763, the Follow-me 5 was in the middle of the runway and can be identified by visual scan from the control room.

### **3 Conclusion**

#### **3.1 Findings**

The tower controller momentarily forgot about the Follow-me 5 vehicle was on the runway when issuing clearance to flight AIQ763 / FD763.

Both the tower controller and ATC supervisor considered that traffic volume and complexity during the incident were light to moderate. The tower controller was thinking of the training she would delivered on the day after the incident.

The tower controller did not check the flight progress strip before giving clearance to flight AIQ763 / FD763.

During the occurrence, the ATC supervisor was not present at the working position in the visual control room.

The flight strip management system in Macau International Airport had no active monitoring function.

The SMR in Macau International Airport had been unserviceable for over six months. Until October 2018, the SMR was resumed operations under the condition of monitoring by technicians. At the time of the occurrence, false alert was found presenting at the holding position even the vehicle has left the area. Moreover, the SMR display was being placed a bit far from controller working position. All these situations of the SMR would had affected the intention of the controllers in utilizing the SMR as supplement safety measure.

## **4 Safety actions and safety recommendations**

### **4.1 Safety actions taken by Macau International Airport**

The involved duty ATC controller had been suspended from working as ATC license holder after the occurrence until further OJT and competence check.

An internal investigation was performed by Macau ATC service provider.

All ATC staff were reminded to keep visual contact with all traffic under their control and be well concentrated when working in the position at all time.

Duty ATC Supervisor was reminded to report any abnormal situation to their superiors without delay.

Decided to use this occurrence as case study and lesson-to-learn at ATC monthly working meeting and / or refreshment training.

### **4.2 Safety recommendations**

#### **4.2.1 Safety recommendations to Macau International Airport**

1. Implement measures or procedures to minimize distractions / memory lapse for air traffic controllers on duties, particularly

covering the following aspects:

- Supervisor or its delegate is required to be present at visual control room all the time during operations.
- Controllers shall not engage in non-operational activities when manning at controller working positions; restrictions on non-operational activities, such as those defined in paragraph 1 of Attachment 3 “Code of Conduct” in Operational Procedure Document OP-ATC-08, shall be clearly specified and strictly followed.

[Recommendation AR-2018-006]

2. Always maintain the SMR system in good conditions to ensure the ground movement surveillance system is reliable for ATC operations without any adverse effect such as false alert and take into consideration of Human-Machine Interface of controller work stations. Or consider upgrade to a more advance SMR such as Advanced-Surface Movement Guidance and Control system (A-SMGCS).

[Recommendation AR-2018-007]

3. Implement the safety actions proposed by Macau International Airport for using electronic flight progress strip system with alert function for better planning and handling of the ground and air traffic.

[Recommendation AR-2018-008]

-End-