

FINAL REPORT

**BOEING B767-300ER, REGISTRATION JA-606J
ATTEMPTED TAKE-OFF ON TAXIWAY**

12 JULY 2015

AIB/AAI/CAS.114

**Air Accident Investigation Bureau of Singapore
Ministry of Transport
Singapore**

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The Air Accident Investigation Bureau of Singapore

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GLOSSARY OF ABBREVIATIONS

AOM	: Aircraft Operating Manual
ATC	: Air Traffic Control
FCTM	: Flight Crew Training Manual
FO	: First Officer
GMC	: Ground Movement Controller
PF	: Pilot Flying
PIC	: Pilot-in-Command
PM	: Pilot Monitoring
RWC	: Runway Controller

SYNOPSIS

On 12 July 2015, at about 02:25 hours local time, an aircraft attempted to take-off at Singapore Changi Airport from a taxiway parallel to the runway.

The aircraft was instructed by Changi Control Tower to taxi on the green taxiway centerline lights to Runway 20C for departure. The flight crew was instructed to take off from runway 20C but instead lined up the aircraft on taxiway EP and began the take-off roll. The runway controller saw the aircraft gathering speed and instructed the crew to stop. About the same time, the flight crew realised their error, retarded the thrust levers, and brought the aircraft to a stop smoothly. There was no danger to other aircraft, vehicle or personnel whilst the aircraft was on taxiway EP. After confirming with the flight crew that they could continue with the flight, the runway controller re-cleared the aircraft back to the holding point for departure. At 0235 hours, the flight departed to its planned destination.

The Air Accident investigation Bureau of Singapore classified this occurrence as a serious incident.

AIRCRAFT DETAILS

Aircraft type	:	Boeing 767-300ER
Operator	:	Japan Airlines
Registration	:	JA606J
Engine details	:	2 X GE CF6-80C2B7F
Date and time of incident	:	12 July 2015, 02:25 hours local time
Location of occurrence	:	Singapore Changi Airport
Type of flight	:	Scheduled passenger flight
Persons on board	:	208

1 FACTUAL INFORMATION

All times used in this report are Singapore Local Time. Singapore Local Time is eight hours ahead of Coordinated Universal Time (UTC).

1.1 Sequence of Events

1.1.1 On 12 July 2015, a Boeing B767-300ER aircraft was scheduled to depart at 01:50 hours from Singapore Changi Airport to Tokyo Haneda Airport. Prior to the departure, the flight crew met at the company's flight operations office for a pre-flight briefing. During the briefing, the flight crew discussed operational information that included, among other things, the possible time restriction at the boundary waypoint (AKMON)¹.

1.1.2 The aircraft was parked at parking bay C22. At 01:37 hours, the flight crew requested flight clearance from the air traffic control (ATC). The crew was informed by the ATC to expect a delay to their departure due to the bad weather condition enroute. The flight crew was aware of the ATC restriction to cross the waypoint AKMON between 03:55 and 04:05 hours.

1.1.3 The First Officer (FO) was the Pilot Flying (PF)² and the Pilot-in-Command (PIC), the Pilot Monitoring (PM). The FO, as the PF, performed the take-off briefing, and he told the PIC that he expected the taxi route from the parking bay to be U1-WA-NC3-EN-R20C (see **Figure 1**).



Figure 1: Taxiways NC2 and NC3 leading to R20C via EN

¹ A specified geographical location along the flight path of an aircraft between two ATC centres.

² Before the commencement of each flight, the aircraft commander decides which pilot will take direct responsibility for flying the aircraft as Pilot Flying. The other pilot is then designated as Pilot Monitoring for that flight.

- 1.1.4 At 02:14 hours, the flight crew requested permission for pushback of the aircraft. At 02:20 hours, the aircraft was ready to taxi after completion of the pushback. The ground movement controller (GMC) instructed the flight crew to 'taxi on the greens' to the holding point of Runway 20C. ATC did not mention the specific taxi route, as this was not required by its operating procedure, but turned on the green taxiway centerline lights along U1-WA-NC2-EP-EN³ to guide the aircraft to Runway 20C. Three other aircraft had earlier used the same taxi route for departure.
- 1.1.5 At 02:22 hours, while the aircraft was still taxiing along NC2, the GMC asked the flight crew what the latest time would be that they had to depart to meet the AKMON time restriction. The PIC replied and gave a time of 02:33 hours.
- 1.1.6 At 02:24 hours, as instructed by the GMC and while the aircraft was still on NC2, the flight crew contacted the runway controller (RWC) and reported that they were ready for departure. The RWC asked the flight crew to expedite taxiing. The RWC also gave the clearance for the flight crew to line up on Runway 20C and take off. The RWC's intention was to have the aircraft depart ahead of an arriving aircraft⁴ (which later landed at 02:31 hours). The PIC told the investigators that he found the RWC's instruction rather puzzling (see paragraph 1.6.2(d)). However, he did not query the ATC but merely confirmed the instruction to take off, which the ATC affirmed. The PIC encouraged the FO to speed up, which the FO did.
- 1.1.7 When the aircraft was moving forward from NC2 and crossing Taxiway A7 before entering EP, the PIC received confirmation from the controller that he was cleared to line up and take off from Runway 20C. After the aircraft had turned onto EP, the PIC heard the FO calling out "runway heading check". The PIC took this to mean that the FO had verified that the aircraft was lined up on the runway in accordance with the take-off procedure in the operator's Aircraft Operating Manual (AOM)⁵.
- 1.1.8 After the aircraft had turned onto the straight part of EP, the FO commenced the take-off. Take-off thrust was applied and the aircraft crossed the lighted red stop bar lights along EP. The RWC noticed that the aircraft did not turn left onto EN but appeared to be accelerating on EP. She immediately instructed the aircraft to stop. The aircraft decelerated and stopped safely on EP before Taxiway A3.

³ The taxi route required the aircraft to turn left from EP into EN. The red stop-bar lights on EP before the next intersection on EP (intersection with Taxiway E1) were turned on to prevent aircraft from taxiing beyond the EP/E1 junction.

⁴ The RWC was trying to decide whether to let an arriving aircraft land before the departure of the incident aircraft. If the latter was not in a hurry, the arriving aircraft could land first. Since the flight crew indicated a time of 02:33 hours, the RWC decided that she would let the aircraft depart before the landing of the arriving aircraft. Hence she asked the flight crew to expedite.

⁵ The take-off procedure in the AOM states "before entering the departure runway, verify that the runway and runway entry point are correct", and "verify that the airplane heading agrees with the assigned runway heading".

- 1.1.9 **Figure 2** shows the selected “taxi on the greens” taxiway centerline lights (in green), the actual path of the aircraft towards EP (in red), and the taxi route (in yellow) expected by the flight crew.



Figure 2: Taxiway centerline lights (in green), ground path of aircraft (in red), and taxi route expected by the flight crew (in yellow).

- 1.1.10 After verifying with the flight crew that they could continue with the flight, the RWC cleared the aircraft to taxi to Runway 20C with a “follow the greens” route of A4-A7-A1-E1. As the RWC needed some time to select the green taxiway centreline lights, she verbally stated the key taxiway designators (i.e. A4, A1 and holding point E1) to guide the flight crew on the route to take. The aircraft eventually departed from Runway 20C without further incident.

1.2 Aerodrome

- 1.2.1 The airport had a “taxi on the greens” taxi guidance system for use during night operations or low visibility conditions. According to ATC, this system reduces radio communication over the air regarding the taxi route, provides flight crews with a clearer direction, and reduces the risk of making wrong turns. The ATC would switch on the green taxiway centreline lights corresponding to the assigned taxi route and instruct flight crews to “taxi on the greens”. The operating procedure did not require ATC to verbalise the taxiway designators when pilots are instructed to “taxi on the greens”. However, ATC may verbalise the taxiway designators if requested by the flight crew.

- 1.2.2 The aerodrome’s taxiway and stop-bar lights were inspected daily between

09:30 and 12:30 hours. Prior to the occurrence, the inspection was last performed on 11 July 2015. According to the records of the inspection, all the lights along the aircraft taxi route to Runway 20C, as well as the stop-bar lights near at the EP/E1 intersection, were operating normally. These lights were switched on at the time of the occurrence.

- 1.2.3 There are seven location signboards along WA-NC2-EP that could serve to remind users of this route that they are on NC2 (an example is shown in **Figure 3**). All the aerodrome's guidance and location signboards were inspected daily at about 19:30 hours. According to the records of the inspection on 11 July 2015, all the guidance signs along the aircraft taxi route to Runway 20C were operating normally. These lights were switched on at the time of the occurrence.



Figure 3: Location signs showing "NC2" along the taxiway

- 1.3 Personnel information
- 1.3.1 The PIC and FO held valid Air Transport Pilot Licence (ATPL) and Commercial Pilot Licence (CPL), respectively, issued by the Japan Civil Aviation Bureau. Both held English Language Proficiency Level 4 certification.
- 1.3.2 During the last six months before the incident, the PIC and FO had each operated in and out of Changi Airport four times.
- 1.3.3 All the air traffic controllers involved in this occurrence held a valid air traffic controller licence with the appropriate rating issued by the Civil Aviation Authority of Singapore. They held English Language Proficiency Level 6 certification.

- 1.4 Meteorological Information
- 1.4.1 At the time of the occurrence, there was no precipitation reported over the aerodrome and the visibility was 10km.
- 1.5 Flight recorder data
- 1.5.1 By the time Singapore investigators were made aware of the occurrence, the relevant data from the cockpit voice recorder (CVR) and flight data recorder (FDR) had been overwritten. However, the airline operator managed to retrieve raw data from the quick access recorder (QAR)⁶ and made the data available to the investigators. Recorded data from the QAR and ATC indicated that the RWC's instruction to stop was transmitted one second before the flight crew aborted the take-off.
- 1.6 Feedback from the flight crew
- 1.6.1 ATC made an inquiry to the operator 11 days after the occurrence. The operator obtained confirmation of the occurrence from the flight crew and facilitated the flight crew's return to Singapore to be interviewed by the investigators. The flight crew did not immediately report the occurrence to the operator or to the authorities. According to the operator, the PIC determined that this case did not need to be reported but he eventually submitted a report on 23 July 2015.
- 1.6.2 The flight crew shared the following with the investigators:
- (a) The FO expected the taxi route from the parking bay to be U1-WA-NC3-EN-R20C. While taxiing the aircraft on NC2 by following the green lights, he actually thought he was on NC3.
 - (b) The flight crew could not remember if they had seen the directional signboard (indicating NC2) before they turned into NC2. Along NC2, there were seven location signboards, but the flight crew could not remember if they had cross-checked the aircraft's position with the signboards or charts during the taxiing. Their focus was on the green lights and they were comfortable with just being guided by the green lights to the runway.
 - (c) The FO said that, during daytime, he would cross-check with the other pilot to confirm the taxi route, but at night he would strictly follow the green lights as instructed by the ATC.
 - (d) When the GMC asked the flight crew at 02:22 hours what the latest time was that they had to depart to meet the AKMON time restriction,

⁶ A quick access recorder (QAR) is an airborne flight data recorder designed to provide quick and easy access to raw flight data.

the flight crew thought that the GMC was asking for the earliest time they would need to depart. Thus, when the RWC asked the flight crew to expedite taxiing and also gave the clearance for the flight crew to line up on Runway 20C and take off (see paragraph 1.1.6), the PIC found this rather puzzling. As he thought he had indicated to the ATC that the earliest time he would need to depart was 02:33 hours, he did not expect to be given an earlier departure time, because departing earlier would mean the aircraft would arrive at AKMON before the ATC time window restriction.

- (e) After crossing the intersection of A7 and making a turn onto EP, the PIC received confirmation from the controller that he was cleared to line up and take off from Runway 20C. Having presumed that they were on NC3, the flight crew thought that they were already on Runway 20C after making a right turn from NC2. The FO felt that something was not right as the “runway” lights appeared dimmer and the view was somewhat different. The FO said he called out to the PIC (but could not remember what he said) but there was no response from the PIC. The FO began the take-off procedure because he believed he should hurry up (as prompted by the PIC).
- (f) After the aircraft turned onto EP, the PIC saw the green lights were showing an “S” turn on his left, and there were red lights ahead of him. He said that he had sensed that something was not right during the line-up for take-off and when the FO started to power up. While he was still trying to sort this out, the aircraft was already moving forward. Since he could not obtain assurance that they were on the runway, he ordered the FO to stop. Immediately after that, he also heard “stop” from the tower controller.
- (g) During the turn onto EP, the FO did not see any lighted stop-bar lights ahead of him. However, he saw the lighted stop-bar lights when the aircraft started to roll down EP. He felt that something was not right and he took the decision to abort the take-off and slowly brought the aircraft to a stop. He also heard ATC say “stop” over the radio.

2 DISCUSSION

2.1 Mistaking taxiway as runway

2.1.1 The FO, who was the PF, expected the taxi route from the parking bay C22 to be U1-WA-NC3-EN-R20C. This was the shortest route. Following this route, an aircraft on NC3 would only need to continue straight onto EN and make one single and gradual right turn to enter R20C.

2.1.2 The FO appeared to have fixated on this mental picture of taxi route (i.e. one single and gradual right turn to enter R20C). He could have applied this mental picture when he was on NC2, believing that one single and gradual right turn after NC2 (which he mistook as NC3, despite a multitude of signs that would remind him he was on NC2) would bring him to R20C. He seemed to have been so fixated that he missed the red stop-bar lights on EP at the EP/E1 intersection and the fact that there were still green light ahead for him to follow that would have guided him to turn left onto EN. The flight crew apparently did not notice the lack of runway lightings and markings (e.g. threshold and runway edge lights; runway designator, runway taxi-holding position markings) which identified a runway.

2.1.3 When flight crews are instructed by the ATC to follow the greens, they should still monitor the progress of the taxiing and ensure they know where they are on the taxi route. In this occurrence, the flight crew apparently did not monitor the taxiing by, for example, cross-checking with the outside cues and aids, to ensure that they reach the correct runway entry point. One would have the impression that effective communication and coordination was lacking in the cockpit.

2.1.4 It cannot be over-emphasised that thorough planning for taxi operations is essential for a safe operation. Flight crew should plan for the taxi phase of the flight just as they plan for the other phases of flight.

2.2 Expediting taxiing and take-off

2.2.1 When the GMC asked the flight crew what the latest time would be that they had to depart to meet the AKMON time restriction, the PIC misunderstood the question. He thought the ATC was asking what the earliest time would be that they needed to depart to meet the AKMON time restriction. Therefore when the RWC asked the flight crew to expedite taxiing, the PIC was puzzled. However, he did not query the ATC.

2.2.2 The flight crew missed a chance to clear up the misunderstanding, but tower controllers might also have been able to detect that something is amiss with the flight crew's timing for departure since they could also have calculated the departure time for the flight in order to meet the restriction at AKMON. Such calculation would allow controllers to countercheck pilots' inputs.

- 2.2.3 This occurrence serves again as a reminder of the need to check or to ask for clarification when in doubt.
- 2.3 ATC's "Taxi on the greens" taxi guidance
- 2.3.1 This occurrence shows that the benefits of the "taxi on the green" system as mentioned in paragraph 1.2.1 were not realised because the PF of the incident aircraft had a mistaken mental picture of the taxi route. For unknown reasons, the PF apparently never confirm his mental picture of taxi route with the cues and aids outside the aircraft and did not follow the green lights fully. The PIC, as the PM, apparently also did not assist to monitor the taxiing of the aircraft.
- 2.3.2 Therefore, there may be merit in ATC verbalising the specific taxi route. Any inconsistency between the verbalised taxi route and the taxi-on-the-greens route may also be spotted by flight crews, thus affording opportunities for clarification and correction.
- 2.4 "Line up"/"Take-off" clearances
- 2.4.1 Take-off clearance is usually given to an aircraft when the aircraft is approaching the departure runway. The rationale is that aircraft should be closely watched as they approach this position to ensure that the aircraft is taxiing to the correct runway before a take-off clearance is issued.
- 2.4.2 While the aircraft was taxiing on NC2, the flight crew contacted the RWC and reported that they were ready for departure. The RWC asked the flight crew to expedite taxiing and also gave the clearance for the flight crew to line up on Runway 20C and take off as she expected the flight crew to follow the green lights fully to the runway.
- 2.4.3 This occurrence highlights the need to expect the unexpected as the flight crew did not follow the green lights fully. It would be advisable not to issue line up and take-off clearances in one transmission. Issuing a line up clearance first and then a take-off clearance later will give the ATC a chance to monitor the aircraft's movement to ensure that it is on the right route to the departure runway. In this occurrence, there were red stop-bar lights on EP before the EP/E1 intersection to prevent an aircraft on EP from taxiing beyond the EP/E1 intersection. However, this line of defence was breached by the flight crew. Withholding take-off clearance till the last moment constitutes another line of defence.
- 2.4.4 The taxi route U1-WA-NC2-EP-EN to Runway 20C involves turning right from NC2 onto EP and turning left from EP onto EN. It would be prudent for the ATC to issue the take-off clearance only after seeing that the aircraft has turned left from EP onto EN.

3 SAFETY ACTIONS

During the course of the investigation and through discussions with the investigation team, the following safety actions were initiated by the operator and the ATC.

3.1 Safety actions taken by the operator

3.1.1 The operator highlighted the following, among others, to its flight crew members in a circular on 24 July 2015:

- The importance of reporting unsafe events to the operator.
- When in doubt, always check before proceeding.
- The need for cross verification of the aircraft's position while taxiing.
- The area of responsibility of each flight crew member.
- The importance of adhering to aircraft manuals and Standard Operating Procedures in assuring flight safety.

3.1.2 Between 29 July 2015 and 31 August 2015, the Chief Pilots of the operator's various aircraft fleets conducted face-to-face briefing to all the flight crew members on how the incident occurred.

3.1.3 The operator introduced a new taxi procedure in September 2015 with a view to preventing its flight crews from losing situation awareness during taxiing. The new procedure established the following rules, among others, for both PF and PM:

- PF shall understand the ATC's instructions and always control the aircraft with correct awareness of its position, using outside visual information (e.g. sign boards) primarily.
- PM shall monitor the aircraft's navigation, its present position and taxi route, and the ground speed with reference to charts or Airport Moving Map.
- PM shall call out the name of next taxiway to turn, its turning direction, and its present ground speed before aircraft reaches the turn.
- When instructed by the ATC to hold short of runway holding point, hold line, or a taxiway, PM shall call out the position to hold and the present ground speed whenever PM has the hold position in sight.
- PF shall stop the aircraft immediately whenever situational awareness of both PF and PM does not agree, or if any doubt is felt (e.g. when there is no callout from PM, even though approaching the taxiway to turn or the hold line to hold).

3.1.4 The operator reviewed the data collected from the Line Operations Safety Audit (LOSA) in 2014 and developed training material to be used for

discussion on safety issues in flight crews' group meetings, e.g. concerning procedures that could be wrongly performed or neglected. The material was disseminated to the fleet managers on 2 September 2015.

- 3.1.5 The operator introduced a mandatory requirement on 1 October 2015, in the form of a web test, for flight crew members to review their knowledge on non-technical skills, especially on multi-crew cooperation.

- 3.2 Safety actions taken by ATC
 - 3.2.1 The ATC shared the lessons learnt from this occurrence with its staff in an email on 9 September 2015. In this email, the ATC also instructed the ATC Watch Managers to brief the controllers on the following:
 - (a) To be aware of the possibility of pilots mistaking a parallel taxiway as a runway, especially in situations when pilots need to taxi through a number of turns to reach the runway entry point.
 - (b) To consider separating line up clearance from take-off clearance.
 - (c) To exercise caution when doubt exists as to whether pilots have understood the ATC instructions when, for example, pilots have asked many questions regarding the taxi. In such a situation, separating line up clearance from take-off clearance could be an added safeguard.
 - 3.2.2 The ATC has classified the area where the incident took place as a hot spot and made this known in the Singapore AIP Changi Aerodrome Advisory Chart on 15 October 2015. The ATC has also reminded its controllers to pay particular attention to aircraft manoeuvring at hot-spot areas.

4 **SAFETY RECOMMENDATIONS**

A safety recommendation is for the purpose of preventive action and shall in no case create a presumption of blame or liability.

In view of the safety actions taken by the operator, no safety recommendation is proposed for the operator.

- 4.1 It is recommended that the ATC consider verbalising the main taxi route in addition to the instruction to “taxi on the greens” in the taxi clearance.
[AAIB Recommendation R-2016-005]