Final Report

RUNWAY INCURSION
AT CHANGI AIRPORT

28 AUGUST 2024

TIB/AAI/CAS.237

Transport Safety Investigation Bureau
Ministry of Transport
Singapore

1 August 2025

The Transport Safety Investigation Bureau of Singapore

The Transport Safety Investigation Bureau of Singapore (TSIB) is the air, marine and rail accidents and incidents investigation authority in Singapore. Its mission is to promote transport safety through the conduct of independent investigations into air, marine and rail accidents and incidents.

The TSIB conducts air safety investigations in accordance with the Singapore Transport Safety Investigations Act 2018, Transport Safety Investigations (Aviation Occurrences) Regulations 2023 and Annex 13 to the Convention on International Civil Aviation, which governs how member States of the International Civil Aviation Organization (ICAO) conduct aircraft accident investigations internationally.

The sole objective of TSIB's air safety investigations is the prevention of aviation accidents and incidents. The safety investigations do not seek to apportion blame or liability. Accordingly, TSIB reports should not be used to assign blame or determine liability.

Table of Contents

ABBREVIATIONS

AGL	Above Ground Level
ASMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence
ATS	Air Traffic Services
ATSM	Air Traffic Services Manual
ATSP	Air Traffic Services Provider
FO	First Officer
ft	Feet
ICAO	International Civil Aviation Organization
kt	Knot
m	Metre
NM	Nautical Mile
PANS-ATM	Procedures for Air Navigation Services – Air Traffic Management
PF	Pilot Flying
PIC	Pilot-in-Command
PM	Pilot Monitoring
PTT	Push-To-Talk
QAR	Quick Access Recorder
RET	Rapid Exit Taxiway
RWC	Runway Controller
TSIB	Transport Safety Investigation Bureau of Singapore
VHF	Very High Frequency

WM	Watch Manager

SYNOPSIS

At about 2013 hrs on 28 August 2024, while an Airbus A320-200neo (Aircraft A) was vacating Runway 20R at Changi Airport via Rapid Exit Taxiway W7 and was not yet clear of the runway strip, a Boeing 777-300ER (Aircraft B) was instructed by the Air Traffic Control to go around when it was 76ft above ground level, about 296m from the threshold of Runway 20R. However, the flight crew of Aircraft B did not respond to the go-around instruction and landed on Runway 20R. This resulted in a runway incursion situation.

The Transport Safety Investigation Bureau of Singapore classified this occurrence as an incident.

AIRCRAFT DETAILS

	Aircraft A	Aircraft B
Aircraft type	A320-200neo	B777-300ER
Operator	China Eastern Airlines	China Eastern Airlines
Aircraft registration	B30AV	B2021
Date and time of incident	28 August 2024, 2013 hrs (LT)	
Location of occurrence	Changi Airport Runway 20R	
Type of flight	Scheduled	Scheduled
Persons on board	100	220

1 FACTUAL INFORMATION

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

1.1 History of the flight

1.1.1 On 28 August 2024, an Airbus A320-200neo (Aircraft A) operating as flight CES6017 departed Shanghai Pudong International Airport for Singapore Changi Airport. Its flight crew comprised three members:

(a) Pilot-in-command (PIC), operating as pilot monitoring (PM)

(b) First officer (FO), operating as pilot flying (PF)

(c) Second officer, operating as Communicator, in charge of communications with air traffic control

1.1.2 During the approach preparation for the landing at Changi Airport, the flight crew of Aircraft A utilised the Airbus Flysmart+ application[1] to calculate the landing performance of the aircraft. Based on the aircraft configuration of full landing flaps, low automatic brake setting and approach speed of 130kt, the flight crew calculated that the landing distance required was 2,057m from the runway threshold. In view that Rapid Exit Taxiway (RET) W6 and W7 were 1,655m and 2,105m from the runway threshold respectively, the flight crew discussed in their approach briefing that they expected to vacate the runway via RET W7.

1.1.3 At 20:10:14 hrs, the Runway Controller (RWC) issued landing clearance for Aircraft A to land on Runway 20R when it was 1,158ft above ground level (AGL) and about 1.36NM before the runway threshold.

1.1.4 At 20:10:27 hrs, the subsequent aircraft, a Boeing 777-300ER (Aircraft B), in the landing sequence established contact with the RWC who instructed it to continue its approach in preparation for landing on Runway 20R.

[1] The Flysmart+ application is an electronic flight bag solution to optimise aircraft performance, for weight and balance calculations and for flight crew to access electronic documentation.

1.1.5 Aircraft B was operating flight CES565, which also departed from Shanghai Pudong International Airport. The flight crew of Aircraft B comprised four members:

(a) PIC, operating as PF

(b) Second Officer, operating as PM

(c) FO, operating as Communicator, in charge of communications with air traffic control

(d) A Captain as observer, who would be the PIC for the return sector from Singapore to Shanghai

1.1.6 Aircraft A landed on Runway 20R at 20:12:04 hrs and the aircraft's autobrake system decelerated the aircraft. At 20:12:24 hrs, the RWC instructed Aircraft A to vacate the runway via RET W6. At that point, the ground speed of Aircraft A was 57kt. According to the flight crew, they judged that it was not possible to slow the aircraft below 40kt, as required by the operator's procedures, to vacate the runway via RET W6. In order to vacate via RET W7, as decided during the approach briefing, the PF disengaged the autobrake system and applied manual braking to continue decelerating the aircraft.

1.1.7 Aircraft A did not respond to the RWC's instruction to vacate the runway via RET W6. Judging that it was unlikely that Aircraft A would vacate via RET W6, the RWC instructed Aircraft A at 20:12:32 hrs to vacate the runway via RET W7 and to turn left onto taxiway W thereafter. This instruction was read back correctly by the Aircraft A Communicator.

1.1.8 The RWC was cognizant that the separation between Aircraft A and Aircraft B would be tight by the time Aircraft A had fully vacated the runway strip (see runway strip as described in Section 1.8.2) via RET W7. As such, the RWC instructed Aircraft A to expedite vacating the runway on RET W7. Aircraft A acknowledged this instruction and initiated a left turn towards RET W7 at 20:12:47 hrs to vacate the runway when its ground speed was about 34kt.

1.1.9 At 20:12:54 hrs, the Advanced Surface Movement Guidance and Control System (ASMGCS) displayed on the RWC's control screen a runway incursion warning in the form of a yellow runway incursion visual alert message[2] (as

[2] The ASMGCS yellow warning identifies a condition that is not serious but can cause an incident if it is not addressed.

designed, such yellow warnings do not trigger aural alarms). The RWC noted this alert which highlighted a possibility that Aircraft A might not be clear of the runway strip in time for the landing of Aircraft B[3]. The RWC re-assessed the traffic situation and proceeded to issue the landing clearance for Aircraft B at 20:12:55 hrs, based on the following considerations:

(a) The RWC judged that the tail of Aircraft A was already clear of the runway edge line and there was no immediate obstruction that would interfere with Aircraft B's landing.

(b) The RWC judged that, given that Aircraft A was still in motion, it would be clear of the runway strip by the time Aircraft B was over the runway threshold.

1.1.10 The yellow runway incursion visual alert message on the ASMGCS control screens ceased five seconds later at 20:12:59 hrs. At this moment, Aircraft A was still not clear of the runway strip and Aircraft B was about 1.2NM before the runway threshold.

1.1.11 As Aircraft A taxied onto RET W7, the PF continued to apply manual braking to further slow the aircraft down to below 10kt[4]. According to the flight crew, they were not certain if the RWC had cleared them to turn onto Taxiway W after taxiing on RET W7, even though the Communicator had earlier correctly read back the RWC's instruction on turning onto Taxiway W (see paragraph 1.1.7). The PF planned to stop Aircraft A after crossing the holding line on RET W7 to let the Communicator seek clarification from the RWC regarding the subsequent taxi route.

1.1.12 At 20:13:19 hrs when Aircraft A was still taxiing on RET W7, the RWC instructed again Aircraft A to turn left for Taxiway W. Immediately after Aircraft A had read back the taxi instruction, the RWC instructed Aircraft B to go around. This was because the RWC had re-assessed the situation and decided that Aircraft A would unlikely be able to vacate the runway strip in time. The record of communication during this period is as follows:

[3] This alert is meant to prompt the air traffic controller to reassess the situation. The ATSP's procedures does not require a go-around instruction to be issued at this point.

[4] After vacating RET W7, Aircraft A needed to make a left turn onto Taxiway W. This was a turn of more than 90˚. The operator's procedures, in line with the aircraft manufacturer's procedures, require their pilot taxiing an aircraft not to exceed 10kt when making turns which are larger than 90°.

Time (hrs)	Party Speaking	Content
20:13:19	RWC	China Eastern Six Zero One Seven turn left now onto whiskey
20:13:22	Aircraft A CES6017	Turn left now join whiskey China Eastern Six Zero One Seven
20:13:25	RWC	China Eastern Five Six Five* go around I say again go around climb to three thousand feet continue runway heading

*Aircraft B

1.1.13 While the RWC was instructing Aircraft A and Aircraft B, an ASMGCS runway incursion alarm[5] in the form of a red visual alert was displayed on the ASMGCS control screens at 20:13:22 hrs, accompanied by an aural alarm.

1.1.14 When the RWC issued the go-around instruction, Aircraft B was at 76ft AGL and about 296m before the runway threshold. Aircraft B did not acknowledge the go-around instruction. The PF of Aircraft B continued with the landing, commanding both engines to idle power at 20:13:31 hrs when the aircraft was 15ft AGL. Aircraft B touched down on Runway 20R at 20:13:38 hrs. As Aircraft B had already landed, the RWC assessed that it was no longer necessary to instruct Aircraft B to go around, taking into consideration that the tail of Aircraft A was clear of the runway edge line and there was no obstruction that would interfere with Aircraft B's landing roll. Subsequently, both Aircraft A and B taxied to their assigned parking bays uneventfully.

[5] The red ASMGCS alarm identifies a condition that can cause a serious, potentially dangerous incident that needs immediate attention.

(Source: Google Earth) (Annotation: TSIB)

Figure 1: Relative positions of Aircraft A and B when Aircraft B touched down

1.1.15 The flight crews of both Aircraft A and B were instructed to contact the watch manager (WM), who was the supervisor of the RWC, after the completion of their flights.

(a) For the flight crew of Aircraft A, when queried by the WM why the aircraft slowed significantly when vacating RET W7 for Taxiway W, they explained that they needed to slow the aircraft to below 10kt before making the larger-than-90° turn onto Taxiway W, in accordance with the operator's requirements.

(b) For the flight crew of Aircraft B, they were surprised when informed by the WM that the RWC had instructed them to go around. The PIC of Aircraft B informed the WM that all four flight crew members, who were in the flight deck during the landing, heard the RWC's instruction to Aircraft A to expedite the vacating of RET W7 (see paragraph 1.1.8) and that they were certain they did not hear the go-around instruction (see paragraph 1.1.12).

1.2 Injuries to persons

1.2.1 There was no injury to any person.

1.3 Damage to aircraft

1.3.1 There was no damage to Aircraft A or Aircraft B.

1.4 Personnel information

1.4.1 PIC of Aircraft A

Age	37
Licence type	Commercial Pilot Licence
Issuing authority	Civil Aviation Administration of China
Licence validity date	Valid till 3 July 2030
Medical certificate	Class 1
Medical certificate validity	Valid till 19 December 2024
Medical operational proviso	NA
Last Base Check date	5 August 2024
Last Line Check date	31 March 2024
Total flying hours	11,049 hrs
Aircraft types flown	A320, A330
Total hours on type	8,476 hrs
Flying in last 90 days	215:19 hrs
Flying in last 7 days	24:33 hrs
Flying in last 24 hours	5:19 hrs
Duty time in last 48 hours	19:10 hrs
Rest period in last 48 hours	28:50 hrs

1.4.2 FO of Aircraft A

Age	30
Licence type	Commercial Pilot Licence
Issuing authority	Civil Aviation Administration of China
Licence validity date	Valid till 6 September 2030
Medical certificate	Class 1
Medical certificate validity	Valid till 10 June 2025
Medical operational proviso	Must wear corrective lenses for distant vision
Last Base Check date	19 April 2024
Last Line Check date	NA
Total flying hours	6,439 hrs

Aircraft types flown	A320, A330
Total hours on type	1,628 hrs
Flying in last 90 days	246:07 hrs
Flying in last 7 days	24:17 hrs
Flying in last 24 hours	05:19 hrs
Duty time in last 48 hours	18:20 hrs
Rest period in last 48 hours	29:40 hrs

1.4.3 Second Officer of Aircraft A

Age	30
Licence type	Commercial Pilot Licence
Issuing authority	Civil Aviation Administration of China
Licence validity date	Valid till 27 June 2030
Medical certificate	Class 1
Medical certificate validity	Valid till 12 April 2025
Medical operational proviso	None
Last Base Check date	31 July 2024
Last Line Check date	NA
Total flying hours	1,092 hrs
Aircraft types flown	A320
Total hours on type	859 hrs
Flying in last 90 days	265:19 hrs
Flying in last 7 days	18:10 hrs
Flying in last 24 hours	5:19 hrs
Duty time in last 48 hours	11:02 hrs
Rest period in last 48 hours	36:58 hrs

1.4.4 PIC of Aircraft B

Age	49
Licence type	Commercial Pilot Licence
Issuing authority	Civil Aviation Administration of China
Licence validity date	Valid till 15 October 2027
Medical certificate	Class 1

Medical certificate validity	Valid till 17 January 2025
Medical operational proviso	NA
Last Base Check date	11 June 2024
Last Line Check date	5 March 2024
Total flying hours	20,459 hrs
Aircraft types flown	A320, A330, B777
Total hours on type	7,749 hrs
Flying in last 90 days	235:04 hrs
Flying in last 7 days	10:29 hrs
Flying in last 24 hours	4:56 hrs
Duty time in last 48 hours	7:47 hrs
Rest period in last 48 hours	40:13 hrs

1.4.5 Second Officer of Aircraft B

Age	27
Licence type	Commercial Pilot Licence
Issuing authority	Civil Aviation Administration of China
Licence validity date	Valid till 9 April 2030
Medical certificate	Class 1
Medical certificate validity	Valid till 27 July 2025
Medical operational proviso	none
Last Base Check date	7 August 2024
Last Line Check date	NA
Total flying hours	919 hrs
Aircraft types flown	B737, B777
Total hours on type	118 hrs
Flying in last 90 days	118 hrs
Flying in last 7 days	19:18 hrs
Flying in last 24 hours	4:56 hrs
Duty time in last 48 hours	7:47 hrs
Rest period in last 48 hours	40:13 hrs

1.4.6 FO of Aircraft B

Age	28
Licence type	Commercial Pilot Licence
Issuing authority	Civil Aviation Administration of China
Licence validity date	Valid till 29 June 2030
Medical certificate	Class 1
Medical certificate validity	Valid till 13 October 2024
Medical operational proviso	Must wear corrective lenses for distant vision
Last Base Check date	8 June 2024
Last Line Check date	NA
Total flying hours	5,783 hrs
Aircraft types flown	B767, B777
Total hours on type	5,497 hrs
Flying in last 90 days	262:46 hrs
Flying in last 7 days	24:49 hrs
Flying in last 24 hours	4:56 hrs
Duty time in last 48 hours	7:47 hrs
Rest period in last 48 hours	40:13 hrs

1.4.7 Observer Captain of Aircraft B

Age	37
Licence type	Commercial Pilot Licence
Issuing authority	Civil Aviation Administration of China
Licence validity date	Valid till 20 July 2029
Medical certificate	Class 1
Medical certificate validity	Valid till 10 August 2025
Medical operational proviso	Must wear corrective lenses for distant vision
Last Base Check date	18 May 2024
Last Line Check date	7 May 2024
Total flying hours	9,777 hrs
Aircraft types flown	A320, B777
Total hours on type	1,216 hrs

Flying in last 90 days	242 hrs
Flying in last 7 days	33 hrs
Flying in last 24 hours	4:56 hrs
Duty time in last 48 hours	7:47 hrs
Rest period in last 48 hours	40:13 hrs

1.4.8 Runway Controller

Age	32
ATCO licence validity	Valid till 28 February 2026
Ratings	Changi Tower, Seletar Tower
Total experience	8 years 10 months
Experience in position manned	8 years 10 months
Duty time in last 48 hours	17 hrs
Rest period in last 48 hours	31 hrs

1.5 Aircraft information

1.5.1 VHF (Very High Frequency) Communication System in Aircraft B

1.5.1.1 Aircraft B is equipped with a VHF communication system that permits voice and data communication between two aircraft or between aircraft and ground stations (e.g. control towers).

1.5.1.2 When a transmission is received by the VHF system, either from other aircraft or from air traffic control, the audio information will be played on any headset that is plugged into the system or, if enabled on the audio control panel, the flight deck speakers.

1.5.1.3 To transmit a message, the flight crew may depress any of the push-to-talk (PTT) switches and start speaking. When a PTT switch is depressed, the audio information from other aircraft and ground stations will not be received.

1.5.1.4 Prior to departure from Shanghai, the flight crew of Aircraft B had reviewed the aircraft logbooks and found no recorded defect pertaining to the communication systems of Aircraft B. The flight crew recalled that the VHF communication system functioned normally during the occurrence flight. The flight crew of Aircraft B could not recall having depressed the PTT switch around the time

Aircraft B was about to touch down[6]. The Quick Access Recorder (QAR) data from Aircraft B also showed that there was no radio transmission from Aircraft B through Aircraft B's three VHF systems around the time when the go-around instruction was issued.

1.5.2 Enhanced Ground Proximity Warning System (EGPWS)

1.5.2.1 Aircraft B is equipped with an EGPWS. When an EGPWS-equipped aircraft is near terrain, the EGPWS alerts the flight crew of the unsafe condition. As the aircraft descends to land, the EGPWS will also provide aural callouts when descending through predefined radio altitudes. For example, when the aircraft radio height is 200ft, the EGPWS will generate a "Two Hundred" aural callout, which will be annunciated on the flight deck speakers. When the aircraft is close to landing, aural callouts for 100ft radio altitude, followed by aural callouts every 10ft radio altitude from 50ft to 10 ft, will be annunciated in quick succession.

1.5.2.2 The EGPWS callouts are independent of the VHF system. If an EGPWS callout is triggered when there is a transmission received by the VHF system, the audio information from the EGPWS callout will be played simultaneously on the flight deck speakers with the VHF transmission.

1.6 Meteorological information

1.6.1 The occurrence took place at night. There was no precipitation and visibility was 10km.

1.7 Communication

1.7.1 There was no recorded defect or reported issue with the VHF equipment utilised by the Air Traffic Control (ATC) to communicate with the two aircraft and other traffic on the day of occurrence.

[6] This would suggest that the flight crew of Aircraft B should be able to hear any transmissions received by the VHF system around the time Aircraft B was about to touch down.

1.8 Aerodrome information

1.8.1 Advanced Surface Movement Guidance and Control System (ASMGCS)

1.8.1.1 The ASMGCS augments the air traffic controllers' visual observation of the traffic. The core functions of the ASMGCS are to provide identification and surveillance of suitably equipped aircraft and vehicles in the aerodrome manoeuvring area, control of airfield ground lighting and safety alerting.

1.8.1.2 The RWC control position has an ASMGCS terminal. The ASMGCS terminal comprises a control screen, a speaker, a keyboard and a mouse. The ASMGCS presents traffic information on the control screen and can generate aural alarms and visual alerts.

1.8.1.3 The automatic alerting functions provide information to the air traffic controller of potentially dangerous situations and violation of traffic rules. They are classified as

(a) Warnings – To identify conditions that are not serious but can cause an incident if they are not addressed.

(b) Alarms – To identify conditions that can cause a serious, potentially dangerous incident that need immediate attention.

1.8.1.4 Warnings are displayed as yellow visual alerts on the control screen that stay on for five seconds and are not accompanied by an aural alert. Alarms are displayed as red visual alerts on the control screen, accompanied by an audio message that will be played on the ASMGCS speakers. The audio alert is programmed to sound repeatedly or until it has been acknowledged by the controller. An alarm visual alert stays displayed for five minutes, or until it has been acknowledged by the controller within these five minutes.

1.8.1.5 Air traffic controllers are trained to look out of the control tower windows when an alert is triggered and respond in accordance with air traffic service provider's procedures.

1.8.2 Runway strip

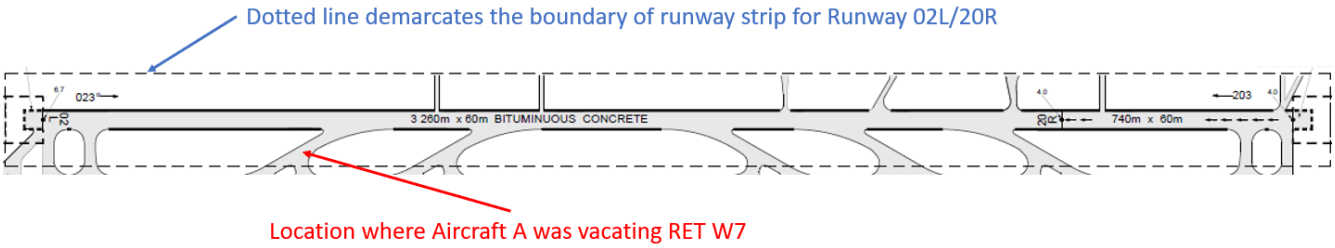
1.8.2.1 The runway strip is a defined area including the runway and stopways, if provided, intended to reduce the risk of damage to aircraft running off a runway,

and to protect aircraft flying over it during take-off or landing operations.

1.8.2.2 For Runway 02L/20R, the runway strip (see **Figure 2**) comprises[7]:

(a) An area that extends 140m laterally from the centreline of the runway

(b) An area that extends 60m from the ends of the two stopways



(Source: Singapore Aeronautical Information Publication) (Annotation: TSIB)

Figure 2: Runway strip area of Runway 02L/20R

1.9 Flight recorders

1.9.1 The flight recorders of both Aircraft A and B were not obtained by the Transport Safety Investigation Bureau of Singapore (TSIB) as both aircraft had departed Singapore when the occurrence was reported to the TSIB. However, information from the QARs of both aircraft were provided to the investigation team. The information during the time of occurrence from both aircraft were available, which allowed the investigation team to establish the flight crews' actions and sequence of events.

1.10 Medical and pathological information

1.10.1 Medical and toxicological examinations of the flight crews were not conducted.

[7] The runway strip dimensions for Runway 20R are in accordance with the requirements of the International Civil Aviation Organization.

1.11 Organisational and management information

1.11.1 Issuance of landing clearance

1.11.1.1 According to the Air Traffic Services Manual (ATSM) of the Air Traffic Services Provider (ATSP), the requirements for the issuance of landing clearance[8] are as follows:

(a) A landing aircraft will not normally be permitted to cross the runway threshold until all preceding landing aircraft are clear of the runway-in-use.

(b) An aircraft may be cleared to land when there is reasonable assurance that the necessary separation will exist when the aircraft crosses the runway threshold.

1.11.1.2 The ATSP indicated that, to meet the above requirements, when an air traffic controller has reasonable assurance that the preceding aircraft is in a continuous motion vacating the runway and will clear the runway (the term runway refers to the runway strip as described in para 1.9.2) by the time the succeeding aircraft arrives over the runway threshold, the landing clearance for the succeeding arrival aircraft can be issued.

1.11.1.3 In the ATSM, a runway incursion is defined as an occurrence involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface (the term “protected runway” refers to the runway strip as described in Section 1.8.2) designated for the landing and take-off of aircraft.

1.11.1.4 The ATSM provides that:

In the event the air traffic controller, after a take-off clearance or landing clearance has been issued, becomes aware of runway incursion or the imminent occurrence thereof, or the existence of any obstruction on or in close proximity to the runway likely to impair the safety of an aircraft taking off or landing, appropriate action shall be taken as follows:

(a) cancel the take-off clearance for a departing aircraft;

[8] These requirements are in accordance with the International Civil Aviation Organization’s Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM).

(b) instruct a landing aircraft to execute a go-around or missed approach;

(c) in all cases inform the aircraft of the runway incursion or obstruction and its location in relation to the runway.

1.11.1.5 There is also a note in the ATSM, for the air traffic controllers' awareness, indicating that:

An aborted take-off or a go-around executed after touchdown may expose the aeroplane to the risk of overrunning the runway. Moreover, a low altitude missed approach may expose the aeroplane to the risk of a tail strike. Pilots may, therefore, have to exercise their judgement in accordance with Annex 2, 2.4[9], concerning the authority of the pilot-in-command of an aircraft.

1.11.1.6 The ATSP allows its air traffic controllers to issue landing clearance to a landing aircraft before the preceding aircraft is fully clear of the runway strip. According to the ATSP:

(a) if there is reasonable assurance that the preceding aircraft is able to vacate the runway strip before the landing aircraft arrives over the runway threshold, then issuing the landing clearance would benefit both ATC and pilots as the landing traffics are expedited; and

(b) if an air traffic controller judges that the preceding aircraft is unable to vacate the runway strip by the time the landing aircraft arrives over the runway threshold, then he or she is required by the ATSM procedures to instruct the landing aircraft to go around in order to ensure safe separation between the landing aircraft and the preceding aircraft.

1.11.1.7 Furthermore, the ATSP also shared with the investigation team the following considerations:

(a) Pilots and ATC personnel experience increased workload during a go-around. The psychological impact of a go-around can lead to increased stress for pilots and ATC personnel, potentially affecting their judgment and performance that may result in a higher chance of errors in communication or decision-making.

[9] ICAO Annex 2, 2.4 states that the pilot-in-command of an aircraft shall have final authority as to the disposition of the aircraft while in command.

(b) A go-around would necessitate further coordination and could add to the complexity in air traffic management.

(c) A go-around could have a down-stream effect on subsequent arrival aircraft queueing to land. These aircraft may also need to execute a go-around, thus complicating the traffic flow.

(d) Extended flight times due to go-arounds may lead to fuel management difficulties for the go-around aircraft, especially if the aircraft is already low on fuel.

(e) While standard phraseologies are in place, communication breakdown may still happen as the circumstances that led to a go-around may differ. Quick, clear communication is critical during a go-around. Any misunderstandings can quickly escalate into safety hazards.

(f) The complexity increases for ATC personnel when an unnecessary go-around takes place as it will result in an increase in the number of aircraft in the terminal area, in additional aircraft vectoring and re-sequencing for other planned arrivals. Additional safety hazards may result, which could be exacerbated when the weather is bad.

1.11.2 International Civil Aviation Organization (ICAO) requirements

1.11.2.1 The ICAO Document 4444, Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM) contains procedures to be applied by air traffic services units in providing the various air traffic services to air traffic. The PANS-ATM is complementary to the Standards and Recommended Practices contained in ICAO Annex 2 – Rules of the Air and in Annex 11 – Air Traffic Services.

1.11.2.2 As part of safety-enhancing measures requirements, PANS-ATM requires any actual or potential hazard related to the provision of ATS within an airspace or at an aerodrome, whether identified through an ATS safety management activity or by any other means, to be assessed and classified by the appropriate ATS authority for its risk acceptability[10].

1.11.2.3 When the investigation team requested for the documented safety assessment

[10] Refer to PANS-ATM Chapter 2.7 Safety-Enhancing Measures.

in respect to pilots not hearing or replying to go-around instructions, the ATSP indicated that this safety assessment was performed a long time ago and it was unable to locate the relevant document. As such, the investigation team could not review this safety assessment and determine if the risk of pilots not performing a go-around instruction was considered.

2 ANALYSIS

The investigation team looked into the following:

(a) Perceptibility of go-around instruction

(b) ATC's risk management for low-level go-around

2.1 Perceptibility of go-around instruction

2.1.1 The investigation team did not have the opportunity to review the recording of Aircraft B's CVR and is not able to establish whether the go-around instruction from the RWC was annunciated in the cockpit of Aircraft B, let alone whether the go-around instruction was heard by the flight crew of Aircraft B.

2.1.2 However, the investigation team is inclined to believe that the go-around instruction from the RWC was annunciated in the cockpit of Aircraft B and that the flight crew of Aircraft missed the instruction. This is in view of the following:

(a) There is no evidence of any VHF system or EGPWS malfunction.

(b) There is no evidence that the flight crew of Aircraft B was depressing the PTT switch around the time Aircraft B was about to touch down, which would have prevented any transmission from the RWC to be heard.

(c) When the RWC instructed Aircraft B to go around, the aircraft was at 76ft AGL. The EGPWS of Aircraft B would have been generating aural callouts, in quick succession, for the corresponding radio altitudes which the aircraft was descending past. This go-around instruction was likely annunciated simultaneously with the EGPWS aural callouts and might have affected the audibility of the RWCs transmission.

(d) Aircraft B was landing after Aircraft A (which was operated by the same operator as Aircraft B). There were two transmissions between the RWC and Aircraft A (see paragraph 1.1.12). These two transmissions and the RWC's go-around instruction to Aircraft B took place within a 10-second period. The first two transmissions included the phrase "China Eastern Six Zero One Seven" whereas the go-around instruction included the phrase "China Eastern Five Six Five". Given that the callsigns of both the aircraft began with "China Eastern", the flight crew of Aircraft B might

have believed the transmission was for “China Eastern Six Zero One Seven” and disregarded the go-around instruction.

(e) The go-around instruction came at a time when Aircraft B was close to touchdown. The flight crew of Aircraft B was in a phase of operation that demanded heightened attention to the external visual references to ensure the approach was stabilised and the touchdown could be executed safely. Studies have shown that the higher workload on flight crews during critical phases of a flight may result in failure on the part of the flight crews to hear or respond to a communication[11]. According to a neuroscience study, the senses of hearing and vision share a limited neural resource and the response of a person’s brain to sound could be significantly reduced when the person was engaging in a demanding visual task[12].

2.2 ATCs’ risk management for low-level go-around

2.2.1 The ASMGCS had generated a yellow runway incursion visual alert message, the RWC assessed the traffic situation and proceeded to issue the landing clearance for Aircraft B, having considered that the tail of Aircraft A was clear of the runway edge line and there was no immediate obstruction that would interfere with Aircraft B's landing, and that Aircraft A was in motion and would be clear of the runway strip by the time Aircraft B was over the runway threshold. The RWC still had the option of instructing Aircraft B to go around if it was judged later that Aircraft A would not be able to vacate the runway strip by the time Aircraft B was over the runway threshold.

2.2.2 The RWC’s approach and actions were consistent with the ATSP’s procedures and considerations mentioned in paragraphs 1.11.1.4 to 1.11.1.7.

2.2.3 It appears that when Aircraft A started to slow down when it was on RET W7, the RWC’s first instinct was to expedite the movement of Aircraft A to vacate the runway strip likely in the hope of preventing Aircraft B from performing what the RWC perceived was an unnecessary go-around.

[11] Refer to Flight Safety Foundation Approach-and-landing Accident Reduction Tool Kit 2.1 – Human Factors.
[12] University College London. (2015, December 8). Why focusing on a visual task will make us deaf to our surroundings. ScienceDaily. www.sciencedaily.com/releases/2015/12/151208184335.htm (accessed November 1, 2024).

2.2.4 When the RWC assessed that it was unlikely that Aircraft A would be clear of the runway strip in time for Aircraft B's arrival over the runway threshold, thus becoming a runway incursion hazard, the go-around instruction was issued at 20:13:25 hrs. The RWC's management of the traffic situation was in compliance with the ATSP's procedures as the issuance of a go-around instruction is dependent on an air traffic controller's assessment when a situation constitutes to a runway incursion.

2.2.5 Had the RWC issued the go-around instruction to Aircraft B earlier instead of communicating with Aircraft A at 20:13:19 hrs (see paragraph 1.1.12), in the hope of expediting its vacating from the runway strip, this might have increased the chances of the flight crew of Aircraft B realising that a go-around instruction had been issued to them.

2.2.6 The ATSP had many considerations in its go-around management (see paragraph 1.11.1.7). It had an unenviable task to balance these considerations (air traffic control efficiency, avoidance of creation of stress for ATC personnel and pilots). In the opinion of the investigation team, the ATSP's procedures created the opportunity where situations could be marginal and there was no room for unexpected situations. In this case, the unexpected situation (where Aircraft B had landed while Aircraft A had yet to vacate the runway strip) occurred when the following happened:

(a) The flight crew of Aircraft A was adhering to the operator's taxi speed limit, but the RWC appeared to have expected Aircraft A to vacate the runway strip more expeditiously.

(b) The flight crew of Aircraft B did not execute the go-around instruction issued by the RWC as the flight crew could have missed the instruction in view of their high workload (as discussed in paragraph 2.1.2) at the time of its issuance.

2.2.7 Once the flight crew of Aircraft B missed the go-around instruction, there appeared to be insufficient time for the RWC to attempt to transmit the instruction again as the aircraft was just about to touch down.

2.2.8 In the absence of documented safety assessment by the ATSP in respect of the hazard of go-around instructions not being received or heard by pilots (see paragraph 1.11.2), the investigation team was unable to establish whether the

ATSP had considered the following aspects in the development of its existing go-around management procedures:

(a) Evaluation of the potential risks associated with this hazard

(b) Definition of an acceptable risk level

(c) Implementation of measures to control and mitigate potential consequences

2.2.9 Aviation is a complex environment where there are interdependencies among various operations (including flight operations and air traffic control) and the complete elimination of all risk in aviation is not possible. This occurrence serves as a timely reminder for stakeholders of the importance of implementing a robust safety management system, including refreshing the hazards identification and risk assessments and implementing mitigation measures for existing procedures. This allows stakeholders to systematically identify potential hazards, especially those that are not immediately apparent as they may belong to other domains of operations. Stakeholders are then able to objectively analyse and assess these hazards and, if needed, implement control measures or make adjustments to existing procedures to ensure that potential risks are as low as reasonably practicable.

3 CONCLUSIONS

From the information gathered, the following findings are made. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

3.1 The runway incursion occurred as Aircraft B landed on the runway while Aircraft A had yet to vacate the runway strip.

3.2 Aircraft A was adhering to the operator's taxi speed limit (not exceeding 10 kts) when taxiing on RET T7 while trying to vacate the runway strip. The RWC had expected Aircraft A to vacate the runway strip at a higher speed.

3.3 When the RWC realised that Aircraft A would unlikely be clear of the runway strip by the time Aircraft B arrived over the runway threshold, the RWC issued the go-around instruction to Aircraft B, in line with the ATSP's procedures.

3.4 The investigation team opined that flight crew of Aircraft B likely missed the RWC's go-around instruction as they were in a phase of operation where it could be difficult to perceive the instruction.

3.5 The investigation team was unable to establish if the ATSP considered the hazard of go-around instructions not being received or heard by pilots in the establishment of their go-around management procedures.

4 SAFETY ACTIONS

Arising from discussions with the investigation team, the organisations have taken the following safety action.

4.1 On 30 August 2024, the ATSP disseminated an email to all its air traffic controllers reminding them to be vigilant when in position and not to hesitate to instruct a landing aircraft to go around when a potential loss of separation might occur.

4.2 The ATSP has included this occurrence as a case study and incorporated the hazard of pilots not responding to a go-around instruction into the recurrent training syllabus for its air traffic controllers. The aim is to ensure the air traffic controllers are aware of this hazard and they consider this factor when managing traffic.

4.3 The working level departments within the ATSP have embarked on a comprehensive safety review of all its operations to re-assess potential hazards, analyse and re-evaluate if existing procedures need to be revised.

4.4 The operator has reminded all its pilots to be vigilant during all phases of flight and be mindful that air traffic controllers may issue a low-level go-around instruction in the event of an unexpected runway incursion.

5 SAFETY RECOMMENDATIONS

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