

# **Final Report**

## **AIRBUS A320, REGISTRATION 9V-JSM TAKE-OFF INCIDENT AT CHANGI AIRPORT**

**27 July 2021**

TIB/AAI/CAS.199

Transport Safety Investigation Bureau  
Ministry of Transport  
Singapore

17 May 2022

## **The Transport Safety Investigation Bureau of Singapore**

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## **SYNOPSIS**

On 27 July 2021 at about 2011h, an Airbus A320 took off from Changi Airport, Singapore on Runway 20L with all runway lights OFF. After the aircraft was airborne, the flight crew informed the Runway Controller of the unlit runway who subsequently switched ON the runway lights.

The aircraft continued with the remainder of the flight uneventfully.

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

## **AIRCRAFT DETAILS**

Aircraft type	:	Airbus A320
Operator	:	JetStar Asia
Aircraft registration	:	9V-JSM
Date and time of incident	:	27 July 2021, 2011 hours
Location of occurrence	:	Runway 20L, Changi Airport
Type of flight	:	Scheduled passenger
Persons on board	:	15

## 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 27 July 2021, an Airbus A320 was scheduled to depart from Changi Airport, Singapore to Soekarno-Hatta International Airport, Jakarta, Indonesia at about 2000h. The Pilot-in-Command (PIC) was the Pilot Flying (PF) and the First Officer (FO) was the Pilot Monitoring (PM).

1.1.2 The aircraft was subsequently cleared to be pushed back. It taxied on Taxiways K, B, B1 and A1 (see **Figure 1**) towards Runway 20L<sup>1</sup> which was the departure runway for the aircraft.

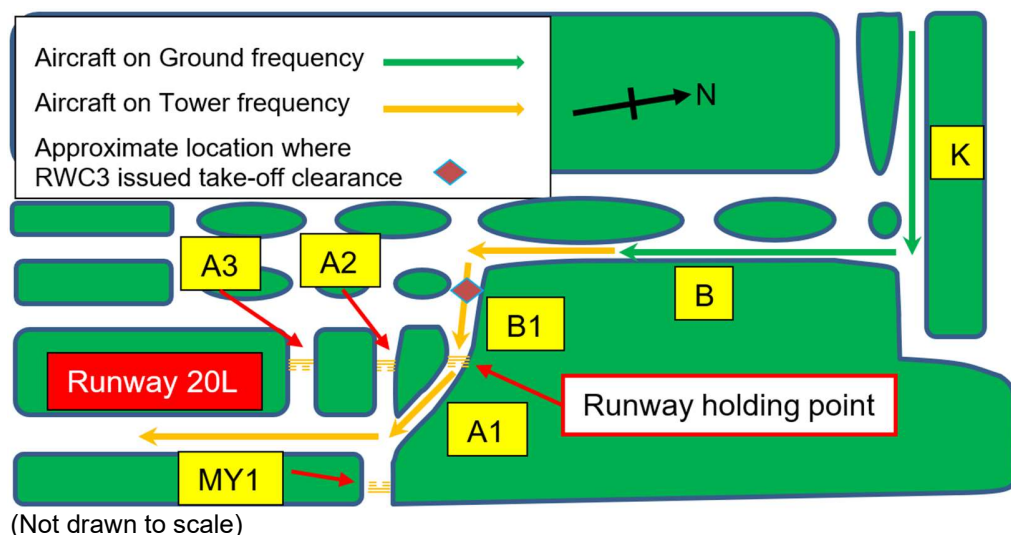


Figure 1: Aircraft taxi route

1.1.3 When the aircraft was taxiing along Taxiway B1, the runway controller (hereinafter referred to as RWC3) at the Changi East Tower (CET) issued take-off clearance to the aircraft. The aircraft performed a rolling take-off<sup>2</sup>.

<sup>1</sup> Changi Airport has three runways, viz. Runway 1 (02L/20R), Runway 2 (02C/20C) and Runway 3 (02R/20L).

<sup>2</sup> The aircraft did not stop on the runway prior to its take-off roll, as shown in the aerodrome operator's closed-circuit television (CCTV) footage of the runway.

- 1.1.4 According to both the PIC and FO, when entering Runway 20L, they saw that the runway edge lights were ON and the runway centreline lights were OFF, although the FO did notice that the runway edge lights appeared dimmer than usual. The PIC and FO could not recall whether they looked in the direction of the runway end lights and hence could not be sure if the runway end lights were ON.
- 1.1.5 According to the FO, he had wanted to suggest to the PIC to query Air Traffic Control (ATC) why the runway centreline lights were OFF but decided to first see what the PIC was going to do<sup>3</sup>.
- 1.1.6 According to the PIC, he shared his assessment of the situation with the FO as follows:
- (a) The operator's SOP did not require runway centreline lights to be ON for take-off at night<sup>4</sup>.
  - (b) The runway edge lights were ON.
  - (c) The runway was visible for a safe take-off.
  - (d) There was no reason to delay the take-off as ATC had already issued the take-off clearance.
- 1.1.7 The FO concurred with the PIC's assessment of the situation and decision to go ahead with the take-off. He did not consider it necessary to suggest to the PIC to query ATC regarding the runway centreline lights.
- 1.1.8 The flight crew's considerations did not include the runway end lights, which the operator's standard operating procedures (SOP) required to be ON for take-off at night.
- 1.1.9 The aircraft took off at about 2011h. According to the flight crew, they noticed that, shortly after the aircraft had lifted off from the runway, the runway edge lights went OFF. They subsequently reported to RWC3 that both the runway

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<sup>3</sup> According to the FO, there was no communication barrier between him and the PIC. He held back his suggestion as he expected the PIC would take the necessary action.

<sup>4</sup> For take-off at night, the operator's SOP requires one of the following two airfield lighting conditions be satisfied:

- (a) runway end lights ON + runway edge lights ON
- (b) runway end lights ON + runway centreline lights ON

edge lights and runway centreline lights were OFF. RWC3 acknowledged and switched ON the runway lights.

1.1.10 At the time of the incident there was no aircraft waiting to depart from or on finals to land on Runway 20L.

1.1.11 The flight continued without further event.

1.2 Unlit lights on Runway 3

1.2.1 According to CET's procedure, the runway lights were to be ON during hours of darkness<sup>5</sup> and it was RWC3's duty to switch them ON<sup>6</sup>. According to RWC3, she did look out of the tower windows and checked her ground movement radar display of the Advanced Surface Movement Guidance and Control System (A-SMGCS. More on this in paragraph 1.11.2) to check the runway edge lights and runway centreline lights. To RWC3, the view was normal for night operations<sup>7</sup>.

1.2.2 On the day of the incident, there was a maintenance activity to address a fault (not relating to airfield lighting). The maintenance work triggered repeated aural alarms at a panel located at the RWC3 control position from 1926h to 2034h.

1.2.3 According to RWC3, she was being distracted by the aural alarm which sounded intermittently at intervals ranging from a few seconds to a few minutes. RWC3's attention was divided between having to repeatedly acknowledge and silence the aural alarm (by pressing a button on a system panel near her control position) and performing her other controller duties.

1.3 Injuries to persons

1.3.1 There was no injury.

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<sup>5</sup> Although the sunset time on the day of the incident was 1916h, controllers would use their judgment as regards the day/night transition to decide when to switch ON the airfield lights.

<sup>6</sup> RWC3 had forgotten to switch ON the runway lights. The aerodrome operator's record of the airfield lighting system and the CCTV footage of the runway also confirmed that the runway lights were all OFF during the time the aircraft was rolling for take-off.

<sup>7</sup> The taxiway lights had been switched ON since 1842h.

1.4 Damage to aircraft

1.4.1 The aircraft was not damaged.

1.5 Personnel information

1.5.1 PIC

Gender	Male
Age	42 years old
Licence	Airline Transport Pilot Licence
Issuing authority	Civil Aviation Authority of Singapore
Licence validity date	3 March 2022
Medical certificate	Class 1
Medical certificate validity	31 July 2022
Medical operational proviso	Wear corrective lenses that correct for distant vision, and have available a second pair of spectacles.
Total flying hours	12,193h
Total hours on type	11,964h
Total command hours	9,054h
Total command hours on type	8,361h
Flying in last 24 hours	Nil
Flying in last 7 days	13h 00min
Flying in last 28 days	42h 08min
Flying in last 90 days	105h 12min

1.5.2 FO

Gender	Male
Age	50 years old
Licence validity date	Airline Transport Pilot Licence
Issuing authority	Civil Aviation Authority of Singapore
Licence validity date	28 May 2022
Medical certificate	Class 1
Medical certificate validity	30 June 2022
Medical operational proviso	Wear corrective lenses that correct for near vision, and have available a second pair of spectacles.
Total flying hours	6,706h



Total hours on type	4,298h
Total command hours	Nil
Total command hours on type	Nil
Flying in last 24 hours	Nil
Flying in last 7 days	10h 35min
Flying in last 28 days	27h 19min
Flying in last 90 days	83h 20min

### 1.5.3 RWC3 at CET

Gender	Female
Age	34
Date rated to operate at Changi Aerodrome	28 October 2015

## 1.6 Meteorological information

1.6.1 According to the weather reports at 2000h and 2030h, visibility was more than 10km. There was no precipitation at the time of the incident.

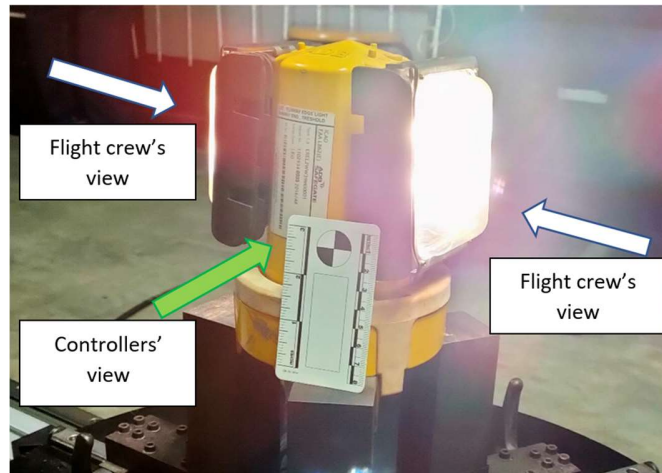
1.6.2 At the time of the incident, the sun had set and the moon had not yet risen<sup>8</sup>.

## 1.7 Aerodrome information

### 1.7.1 Runway 3's edge lights

1.7.1.1 Runway 3 is installed with runway edge lights that are bi-directional (see **Figure 2**) with the main beams shining towards flight crew when aircraft are at either ends of the runway.

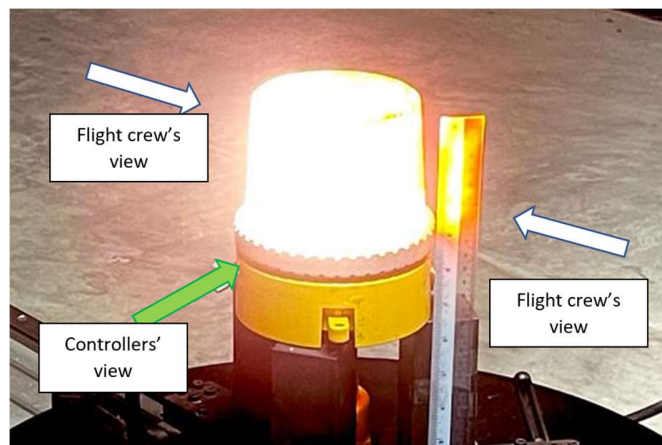
<sup>8</sup> According to data from the Meteorological Service Singapore, the moon rise time on the day of the incident was 2214h.



(Source: TSIB)

Figure 2: Bi-directional runway edge light

1.7.1.2 In contrast, the light emitting from the runway edge lights installed along Runway 1 and Runway 2 can be seen by controllers in the control tower (see **Figure 3**).

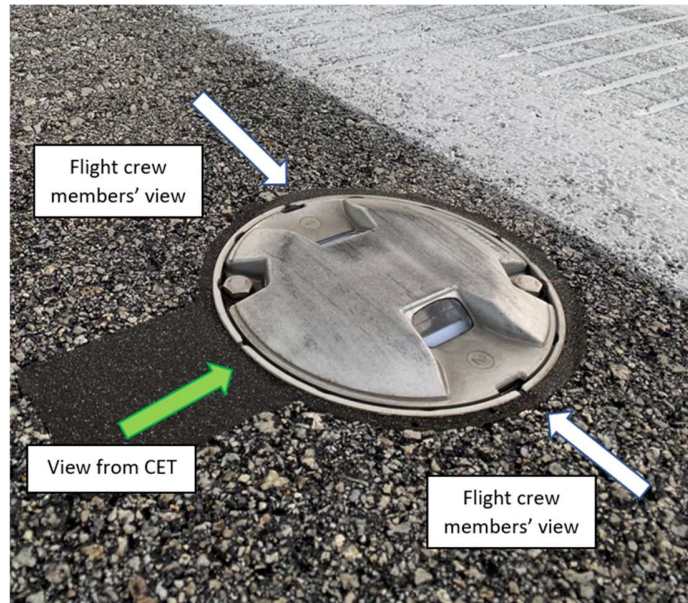


(Source: Changi Airport Group)

Figure 3: Runway edge light installed along Runway 1 and Runway 2

1.7.2 Runway 3's centreline lights

1.7.2.1 Runway 3 is installed with inset runway centreline lights that are also bi-directional (see **Figure 4**), shining towards either ends of the runway. The runway centreline lights installed on Runway 1 and Runway 2 are also inset bi-directional lights.



(Source: Changi Airport Group)

Figure 4: Inset runway centreline light

1.7.3 Viewing the bi-directional runway edge lights and runway centreline lights

1.7.3.1 Given the directional nature of the runway edge lights and runway centreline lights, as well as the location of CET relative to Runway 3, it is quite impossible for air traffic controllers (hereinafter referred to as 'controllers') at CET to see the runway edge lights and runway centreline lights within about 500m along the runway on either side of CET. However, controllers may see those lights that are further away from this section (see sketch in **Figure 5**).

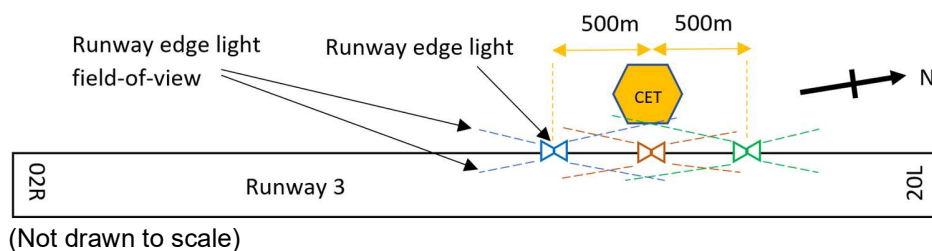


Figure 5: Viewing of runway edge lights from CET

1.7.4 Furthermore, Runway 3's edge lights, owing to their directional nature, may not be easily discernible even when they are switched ON. **Figure 6** and **Figure 7**

below illustrate the views from CET of a section of Runway 3 when the edge lights were switched OFF and ON respectively.



(Source: TSIB)

Figure 6: View from CET with Runway 3's edge lights OFF



(Source: TSIB)

Figure 7: View from CET with Runway 3's edges light ON

## 1.8 Flight recorders

1.8.1 The Cockpit Voice Recorder recording pertaining to the occurrence was not available as the recording had been overwritten.

1.8.2 As there were no aircraft performance issues, the Flight Data Recorder information was not acquired.

## 1.9 Medical and pathological information

1.9.1 TSIB was notified of the occurrence more than 24 hours after it had occurred. TSIB did not request the controllers and flight crew members to undergo toxicological examination as the results would not be representative of their conditions at the time of the incident.

1.10 Tests and research

1.10.1 A night taxi trial<sup>9</sup> on Runway 3 was conducted by the investigation team on 24 August 2021 using the incident aircraft to test the hypothesis that Runway 3's edge lights could appear to be ON when in fact they were not.

1.10.2 The taxi trial was conducted under similar conditions as on the day of the incident:

- (a) At about 2000h, around the time of the incident on 27 July 2021.
- (b) Similar meteorological conditions, i.e. visibility more than 10km, no moon.
- (c) Taxiing along the same taxi route as the incident aircraft.
- (d) Taxiway centreline lights and taxiway edge lights were ON.

1.10.3 During the trial, the investigation team aimed to determine whether Runway 3's edge lights, runway centreline lights and runway end lights were visible from the cockpit when the aircraft is at Runway 20L's threshold. A summary of the observations is tabulated below:

Scenario	Runway centreline lights	Runway edge lights	Observations/Remarks
1	OFF	OFF	<ul style="list-style-type: none"><li>- See <b>Figure 8</b>.</li><li>- Actual runway lights configuration at the time of the incident.</li><li>- Lights from the airport vicinity can be seen at the background of the runway.</li><li>- The runway edge lights, runway centreline lights and runway end lights were clearly OFF.</li></ul>
2	OFF	ON	<ul style="list-style-type: none"><li>- See <b>Figure 9</b>.</li><li>- The runway edge lights and runway end lights were visible.</li><li>- The runway centreline lights were clearly OFF.</li></ul>

<sup>9</sup> As mentioned in paragraph 1.1.3, the incident aircraft performed a rolling take-off, i.e. it did not stop at the runway threshold. However, for better viewing of the runway lighting conditions, the taxi trial was carried out with the aircraft stationary at the runway threshold.

Scenario	Runway centreline lights	Runway edge lights	Observations/Remarks
3	ON	ON	<ul style="list-style-type: none"> <li>- See <b>Figure 10</b>.</li> <li>- This is the normal runway lights configuration for night operations.</li> <li>- The runway centreline, runway edge lights and runway end lights were visible.</li> </ul>



(Source: TSIB)

Figure 8: Runway edge lights and runway centreline lights both OFF



(Source: TSIB)

Figure 9: Runway edge lights ON and runway centreline lights OFF



(Source: TSIB)

Figure 10: Runway edge lights and runway centreline lights both ON



1.10.4 The trial also aimed to determine whether the blue taxiway edge lights at Taxiway A2 and Taxiway A3 (which are near the threshold of Runway 3 – see **Figure 1**) could be mistaken as the white runway edge lights. A summary of the observations is tabulated below:

Scenario	Runway edge lights	Taxiway A2/A3 edge lights	Observations/remarks
4	ON	ON	<ul style="list-style-type: none"> <li>- See <b>Figure 11</b>.</li> <li>- Runway edge lights visible.</li> <li>- White runway edge lights were distinct from the blue taxiway edge lights at Taxiway A3.</li> </ul>
5	OFF	ON	<ul style="list-style-type: none"> <li>- See <b>Figure 12</b>.</li> <li>- Actual lights configuration at the time of the incident.</li> <li>- Taxiway edge lights at Taxiway A2 and A3 were blue and not white.</li> <li>- White runway edge lights were clearly OFF.</li> </ul>



(Source: TSIB)

Figure 11: Taxiway edge lights, near the runway threshold, ON with runway edge lights ON





(Source: TSIB)

Figure 12: Taxiway edge lights, near the runway threshold, ON with runway edge lights OFF

- 1.10.5 In summary, the night taxi trial showed that while the aircraft was on Runway 3's threshold preparing for the take-off, it is:
- (a) unlikely that Runway 3's edge lights could appear ON when they were OFF;
  - (b) unlikely that the blue taxiway edge lights near the threshold of Runway 3 could be misidentified as white runway edge lights; and
  - (c) unlikely that the lights from the airport vicinity could have been mistaken as runway edge lights.

## 1.11 Organisational factors

### 1.11.1 Introduction of new type of edge lights at Runway 3

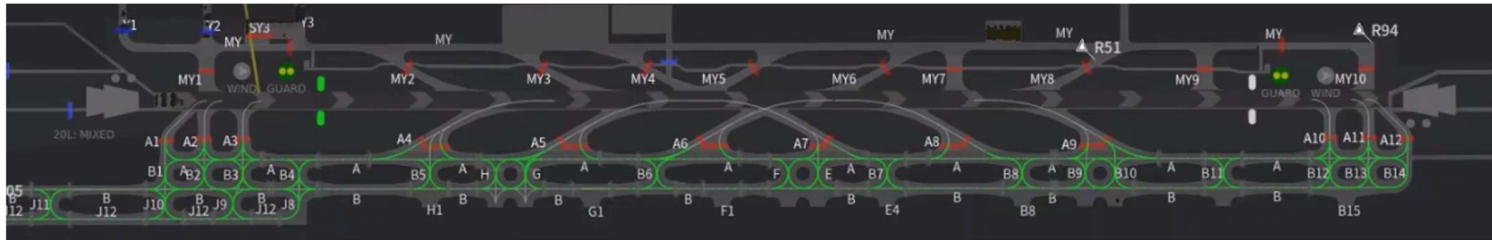
- 1.11.1.1 Runway 3 was commissioned in November 2020 after the aerodrome regulator had assessed that the runway lighting system complied with the local regulations, which are based on the Standards and Recommended Practices set by the International Civil Aviation Organization (ICAO). The assessment included a review of the runway lighting design and hardware used. Flight checks were also carried out to confirm the suitability of the runway lights for flight operations.

- 1.11.1.2 There was no evidence that the assessment<sup>10</sup> had considered whether the Runway 3's edge lights could be seen, or could be easily seen, by controllers at CET.
- 1.11.2 Introduction of new aerodrome lighting control and display system (A-SMGCS)
- 1.11.2.1 The aerodrome lights at Changi Airport are controlled via the A-SMGCS, which was commissioned by the Air Navigation Service Provider (ANSP) in November 2020. The primary functions of the A-SMGCS are to indicate the positions of aircraft and ground vehicles, and to control the runway and taxiway lights<sup>11</sup>.
- 1.11.2.2 The A-SMGCS displays the ON/OFF status of runway lights to the controllers. **Figure 13** and **Figure 14** below illustrate a section of the A-SMGCS display indicating Runway 3's lights switched OFF and ON respectively. It seems that controllers would not be able to discern just by a quick glance at the display whether the runway lights are ON or OFF and would need to look closely at the display.
- 1.11.2.3 There had been no feedback to the ANSP from any controllers concerning whether it was difficult to discern the ON/OFF indication of the Runway 3's lighting on the A-SMGCS display.
- 1.11.3 ANSP's in-house hazard reporting system
- 1.11.3.1 The ANSP shared that the following channels were available for controllers to report hazards:
- (a) In-house confidential voluntary hazard reporting system
  - (b) Operational Safety and Standard Feedback System
  - (c) Reporting to their safety officers, Watcher Managers or ANSP management (e.g. Unit Heads)
  - (d) *Tell Sarah*, Singapore's confidential aviation safety reporting system

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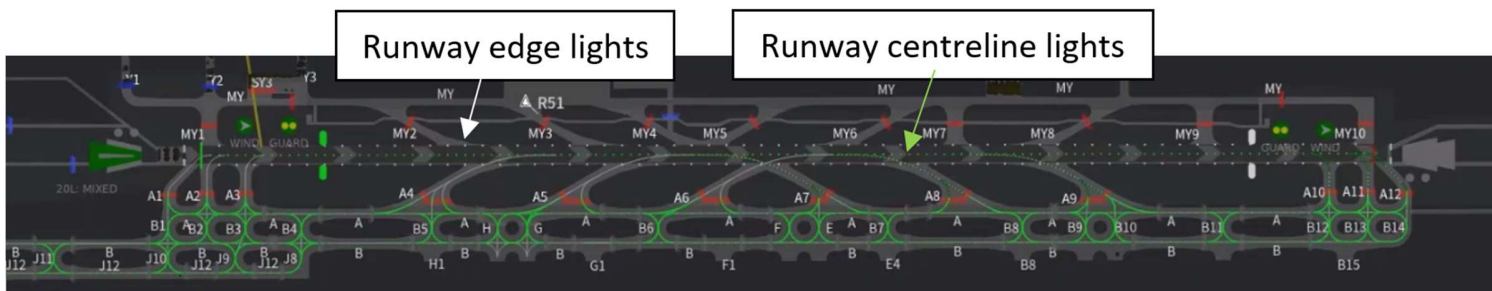
<sup>10</sup> There are no requirements or guidance either in ICAO Annexes or ICAO Documents, or in local regulations to consider whether runway edge lights could be seen by controllers in tower.

<sup>11</sup> The A-SMGCS replaced the Airfield Ground Lighting Control and Monitoring System which provided the control/indications of the airfield lights to controllers. The A-SMGCS integrates both the control/indications of the airfield lights and the positions of aircraft and vehicles into a single system and display.



(Source: Air Navigation Service Provider)

Figure 13: Section of A-SMGCS display indicating Runway 3's lights OFF



(Source: Air Navigation Service Provider)

Figure 14: Section of A-SMGCS display indicating Runway3 lights ON

1.11.3.2 The investigation team understood the following in the course of its investigation:

- (a) Not all controllers were aware of the in-house hazard reporting system and the Operational Safety and Standard Feedback System.
- (b) Prior to the incident, controllers did not recognise the safety hazard posed by their inability to see or any difficulty that they had in seeing from CET the bi-directional edge lights and centreline lights around the centre portion of Runway 3.
- (c) Controllers whom the investigation team spoke to would, if they become aware of a safety hazard or a potential safety hazard, report it verbally or via email to their safety officers, Watch Managers or the ANSP management.
- (d) The reporting of hazards to safety officers, Watch Managers or the ANSP management verbally or via email is informal and may not be closely tracked or followed up. Especially in the case of verbal reporting, the hazard can be easily overlooked and can end up not processed through the organisation's safety risk assessment and mitigation process as required by its safety management system.

1.11.3.3 According to the ANSP, it had been promoting systematically its hazard reporting system to controllers. For example:

- (a) Sending regular emails containing safety messages.
- (b) Conducting safety briefings and presentations during controllers' recurrent training sessions.
- (c) Encouraging controllers to report hazards and sharing hazard reports received from controllers.

## 2 ANALYSIS

The investigation looked into the following:

- (a) Flight crew's decision making
- (b) Expectation bias on the part of the flight crew and RWC3
- (c) Runway lighting control
- (d) Organisational factors

### 2.1 Flight crew's decision making

#### 2.1.1 Querying ATC about abnormal runway lighting configuration

2.1.1.1 According to the flight crew, Runway 3's edge lights were ON when they were entering the runway and remained ON until shortly after the aircraft had lifted off from the runway. They could not recall whether they looked in the direction of the runway end lights and hence were not sure of the status of the runway end lights. The CCTV footage and record of the airfield lighting system obtained by the investigation team clearly showed that they were mistaken, as Runway 3's edge lights, centreline lights and end lights had not yet been switched ON by RWC3 at CET at the time of the incident.

2.1.1.2 The operator's SOP allows take-off without runway centreline lights, provided that both the runway end lights and runway edge lights are ON. The flight crew did not ensure this condition was satisfied before initiating the take-off roll.

2.1.1.3 The flight crew are based in Singapore and familiar with Changi Airport. Such flight crew are expected to regard it as unusual to see Changi Airport operate with the runway centreline lights OFF at night. Even if the runway light configuration meets the operator's take-off requirement (i.e. runway edge lights ON and runway end lights ON), it would be prudent for such flight crew to query ATC about the absence of the runway centreline lights.

#### 2.1.2 Crew resource management

2.1.2.1 The flight crew had noticed that Runway 3's centreline lights were OFF. According to the FO, he did have the thought to suggest to the PIC to query

ATC about the absence of the runway centreline lights, but he put off the idea and waited instead to see what the PIC was going to do. This suggests that the flight crew's crew resource management performance was not optimum.

2.1.2.2 The FO indicated to the investigation team that, in hindsight, he should have been more proactive to share his thoughts with and make suggestions to the PIC instead of waiting to see what the PIC was going to do.

2.2 Expectation bias on the part of the flight crew and RWC3

2.2.1 The investigation team detected several instances of expectation bias<sup>12</sup> in this incident, as follow:

- (a) Runway 3's end lights were OFF, but the flight crew could not recall whether they looked in the direction of the runway end lights and hence could not be sure whether the runway end lights were ON. During the night trial mentioned in paragraph 1.10, the runway end lights could be clearly seen from Runway 20L's threshold when they were switched ON. Had the flight crew consciously checked for the status of the runway end lights, they would have noticed that the runway end lights were OFF and this could have prompted them to query ATC regarding the status of the runway lights. The flight crew probably had expected the runway end lights to be ON and thus did not positively look out for it.
- (b) Runway 3's edge lights were OFF, but the flight crew somehow noted that they were ON. As mentioned in paragraph 1.10.5, it was unlikely that Runway 3's edge lights could appear ON when they were in fact OFF, and also unlikely that other lights could be misidentified or mistaken as the runway edge lights. However, given the numerous taxiway edge lights around the threshold of Runway 20L, the flight crew may have experienced confirmation bias in perceiving the taxiway edge lights as runway edge lights while turning onto the runway, even though they are of different colours. The flight crew did not positively check for the status of the runway edge lights.
- (c) Runway 3's edge lights and centreline lights are bi-directional. When switched ON, it is doubtful if controllers can see the runway edge lights

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<sup>12</sup> Expectation bias occurs when an individual's expectation of an outcome influences his or her perception and/or decision making.

and runway centreline lights within about 500m along the runway on either side of CET (see **Figure 5**). While the edge lights beyond this section of the runway might be seen by controllers at CET, they are not easily discernible. When switched OFF, none of these lights could of course be seen. However, RWC3 did not detect anything unusual when she looked out of the tower windows to check the runway edge lights and runway centreline lights<sup>13</sup>. RWC3 probably had expected the runway lights to be ON and the quick glance at the A-SMGCS could not clearly indicate the status of these lights. Given the bi-directional nature of Runway 3's edge lights and runway centreline lights, the view of the centre portion of Runway 3 is similar at night whether the runway lights are ON or not. As CET had just been in operation for a few months, controllers might not have realised this similarity. It is desirable that the ANSP highlights such similarity to controllers and develops methods to enable controllers to positively identify the status of the runway lights.

2.2.2 Because of expectation bias, opportunities for the flight crew and RWC3 to notice the unusual configuration of the runway lights were missed. To mitigate the effect of expectation bias, it cannot be overemphasised that operational personnel should be vigilant and make conscious efforts to positively check things out when performing their tasks.

## 2.3 Runway lighting control

### 2.3.1 SOP for switching ON runway lights for night operations

2.3.1.1 Runway lights are required to be ON during hours of darkness. At the time of the incident, controllers had to make a judgment as to when to switch ON the runway lights.

2.3.1.2 The investigation team finds that controllers' judgment of the hours of darkness could be very subjective for deciding when to switch ON the airfield lighting for night operations. This can result in the airfield lighting in different areas of responsibility being switched ON at different times of the day.

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<sup>13</sup> According to RWC3, she was being distracted by an intermittent and loud aural alarm from a system panel from 1926h to 2034h, which prevented her from realising that the runway lights were still OFF.

- 2.3.1.3 A more objective approach to controlling the airfield lighting for night operations should be considered. For example, an alert (aural and/or visual) could be set to remind controllers to switch ON the airfield lighting at a pre-determined time at or near sunset time.
- 2.3.2 A-SMGCS display of ON/OFF status of runway lights
  - 2.3.2.1 According to the ANSP, the A-SMGCS provides controllers with an accurate representation of the ON/OFF status of runway lights. However, the investigation team found that the graphical presentation of the A-SMGCS appeared quite cluttered and that it was not easy to discern whether the runway lights are ON or OFF just by a quick glance at the A-SMGCS display. It seems desirable for the graphical presentation of the ON/OFF status of the runway lights to be enhanced.
- 2.4 Organisational factors
  - 2.4.1 Risk assessment on the use of Runway's 3 edge lights
    - 2.4.1.1 Although Runway 3's lighting system complied with international standards, the risk assessment of the runway lighting system apparently did not consider the differences in the views of Runway 3's edge lights and of the edge lights installed along Runway 1 and Runway 2. As a result, the risk assessment did not consider whether the Runway 3's edge lights could be seen, or could be easily seen, by controllers at CET, and nor establishing a method for controllers to visually verify the status of the runway lights.
  - 2.4.2 In-house hazard reporting system of the ANSP
    - 2.4.2.1 The ANSP has a hazard reporting system for controllers to report hazards. However, apparently not all its controllers were aware of this system.
    - 2.4.2.2 While the ANSP promotes systematically its hazard reporting system to controllers, it appeared that the promotional effort had not been effective in making all its controllers aware of the hazard reporting system.



### 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 Controllers had to judge the hours of darkness to decide when to switch ON the airfield lighting for night operations. This method is subjective.
- 3.2 When RWC3 looked out of the tower windows to check if the runway edge lights and runway centreline lights were ON, it is likely that due to expectation bias, she did not notice that the runway lights were OFF.
- 3.3 RWC3 also looked at the A-SMGCS display to check if the runway lights were ON. However, the graphical presentation of the A-SMGCS display appeared quite cluttered and she did not discern that the runway lights were OFF.
- 3.4 It is likely that due to expectation bias, the flight crew presumed that the runway edge lights and runway end lights were ON and thus they proceeded with the take-off, on the grounds that such a runway light configuration met the operator's SOP requirement for a night take-off.
- 3.5 The FO did not share with the PIC his thoughts about querying ATC on the absence of the runway centreline lights. This suggests that the crew resource management performance was not optimum.
- 3.6 During the introduction of a new type of edge lights for Runway 3, the ANSP did not consider whether such runway edge lights could be seen, or could be easily seen, by controllers at CET.
- 3.7 Not all controllers were aware that the ANSP has an in-house hazard reporting system.

## 4 SAFETY ACTIONS

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

4.1 The aircraft operator has taken the following actions:

- (a) Conducted recurrent training pertaining to assertiveness and active pilot monitoring for their pilots in 2021 Q4.
- (b) Issued a Flight Standing Order (FSO) to its pilots on 1 August 2021 to remind them of the points below and planned to incorporate these points in its next Operations Manual update around June 2022.
  - (i) To ensure that runway lighting configuration is correct and complies with the operator's minimum requirements for that particular runway for night operations and/or low visibility conditions,
  - (ii) To seek clarification from ATC before take-off is commenced if the runway lighting configuration is not what is expected.

4.2 The ANSP has taken the following actions:

- (a) Highlighted to all its controllers the directional nature of Runway 3's edge lights and centreline lights, and how to discern whether these lights are ON.
- (b) Reminded all its controllers to monitor and ensure all required equipment are serviceable and switched ON (when necessary).
- (c) Required the lead controller at CET to inform the Changi Tower (CT) Watch Manager when the aerodrome lights within CET's area of responsibility have been switched ON/OFF at sunset/sunrise. A table of sunrise/sunset timings, extracted from the Singapore AIP, has been provided to controllers.
- (d) Installed an alert system both at CET and CT whereby an alarm will go off near sunset, thereby reminding controllers to switch ON the aerodrome lights.

- 4.3 The ANSP has enhanced the graphical representation, as shown in **Figure 15** below, on the A-SMGCS display to ensure that controllers can discern at a glance the ON/OFF status of the runway lights.

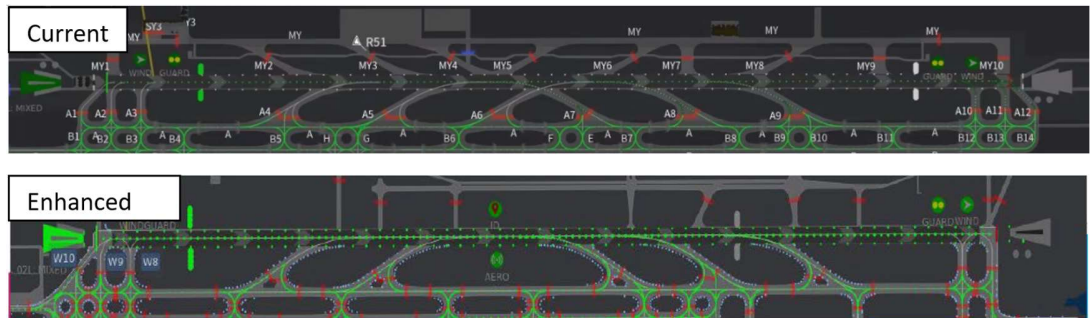


Figure 15: Enhanced A-SMGCS graphical representation

## 5 SAFETY RECOMMENDATIONS

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

- 5.1 It is recommended that the aircraft operator remind its pilots of the dangers of cognitive biases, and of the ways to mitigate the effects of such cognitive biases, when checking the status of runway lights. [TSIB Recommendation RA-2022-001]
- 5.2 It is recommended that the Air Navigation Service Provider:
- (a) Remind controllers of the dangers of cognitive biases, and of the ways to mitigate the effects of such cognitive biases, when checking the status of runway lights. [TSIB Recommendation RA-2022-002]
  - (b) Enhance the promotional activities of its hazard reporting system to increase its controllers' awareness of the system. [TSIB Recommendation RA-2022-003]