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AAIA

Air Accident Investigation Authority

Aborted Takeoff on an Engaged Runway

Investigation Report

Serious Incident to Hong Kong Airlines Airbus A330-343, B-LNU and Cathay Pacific Airways Boeing 747-867F, B-LJK at Hong Kong International Airport 23 December 2017

03-2022

AAIA Investigations

Pursuant to Annex 13 to the Convention on International Civil Aviation and the Hong Kong Civil Aviation (Investigation of Accidents) Regulations (Cap. 448B), the sole objective of the investigation and the Investigation Report is the prevention of accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

The then Chief Inspector of Accidents-cum-Director-General of Civil Aviation ordered an inspector's investigation into the serious incident in accordance with the provisions in Cap. 448B. As the powers of accident investigation were transferred to the Air Accident Investigation Authority (AAIA) with effect from 10 September 2018, the investigation of the serious incident was carried on by AAIA.

This serious incident investigation report contains information of an occurrence involving an Airbus A330-343 aircraft, registration B-LNU, operated by Hong Kong Airlines Limited and a Boeing 747-867F aircraft, registration B-LJK, operated by Cathay Pacific Airways Limited, which occurred at Hong Kong International Airport on 23 December 2017.

The Hong Kong Civil Aviation Department (CAD) and the aircraft operators provided assistance to the investigation.

Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the State or Administration having responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken.

This Investigation Report supersedes all previous Preliminary Report and Interim Statements concerning this serious incident investigation.

All times in this Investigation Report are in Hong Kong Local Times unless otherwise stated. Hong Kong Local Time is Coordinated Universal Time (UTC) + 8 hours.

Chief Accident and Safety Investigator

Air Accident Investigation Authority

Transport and Housing Bureau

Hong Kong

June 2022

Synopsis

At time 21:07 on 23 December 2017 a serious incident occurred at Hong Kong International Airport on Runway 07R (RWY07R) when a Hong Kong Airlines Limited Airbus A330-343 (A333) aircraft, given take-off clearance by Air Traffic Control (ATC), commenced the take-off roll while a Cathay Pacific Airways Limited Boeing 747-867F (B748F) aircraft was crossing at the far end of the same runway in accordance with ATC instruction.

The flight crew of the B748F aircraft immediately informed ATC that the aircraft was still crossing the runway. ATC immediately instructed the A333 aircraft to stop. The A333 aircraft aborted the take-off and came to a full stop on the runway after rolling for less than 200 metres.

The closest distance between the two aircraft was in excess of 3,000 metres. There was no damage to either aircraft and no injury was reported. The B748F aircraft continued to cross RWY07R and taxied to the cargo apron. The A333 aircraft vacated the runway, re-joined the departure queue and subsequently departed RWY07R at 21:14 without further incident.

The investigation team has made four safety recommendations.

Contents

1. FACTUAL INFORMATION

1.1. Sequence of Events

(1) At time 20:43 on 23 December 2017, the air traffic controller (hereafter "controller") involved in this occurrence took over the control position of Hong Kong Tower South, also referred as Air Movements South (AMS), and assumed control of all aircraft movements on the south runway i.e. RWY07R. AMS was in combined mode and was responsible also for operations at three other positions namely Zone Control, Flight Information Service and Tower Departure Planner. (Figure 1 illustrates the different areas of controller jurisdiction for Runway 07 operation) (Refer to Appendix 9.1 for Aerodrome Layout)

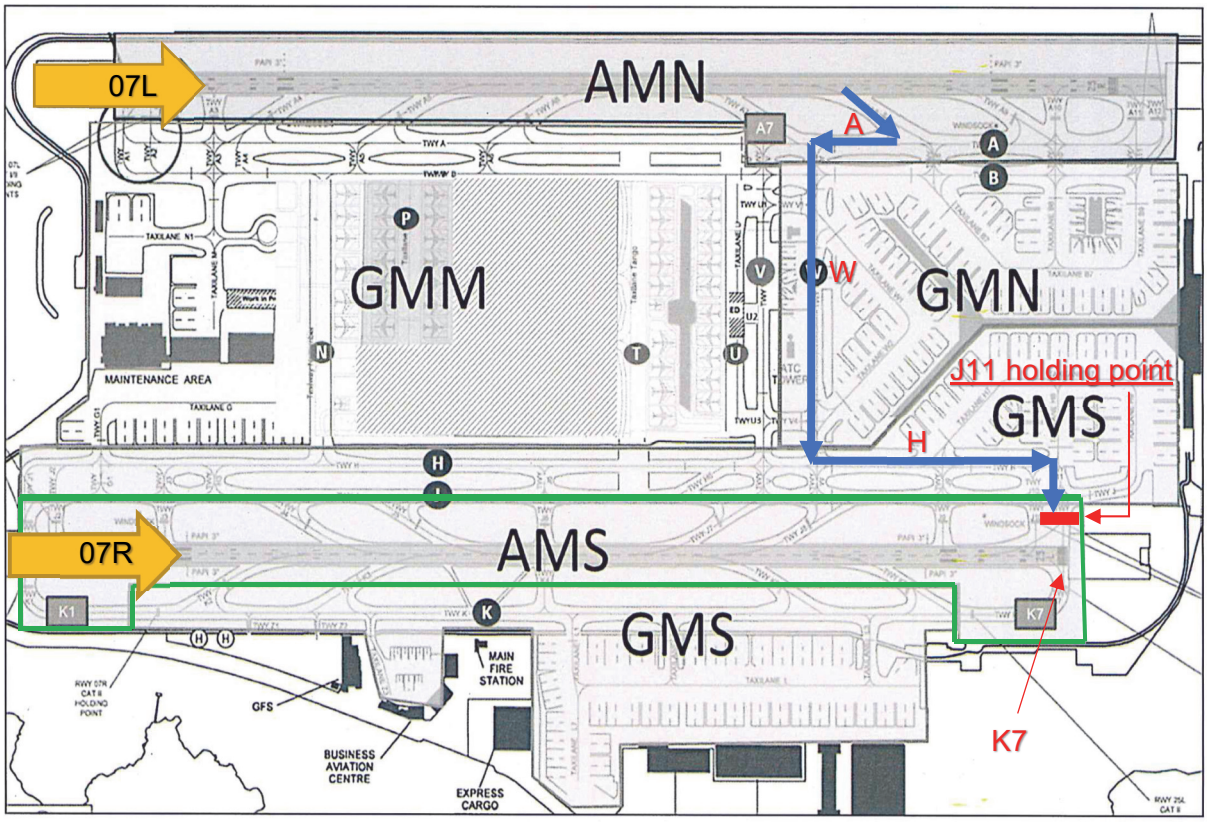

Figure 1 – Areas of controller jurisdiction for Runway 07 operation

(AMS area of jurisdiction delineated in green)

Acronyms for Aerodrome control positions:
AMN/AMS = Air Movements (North / South) Controller
GMN/GMS/GMM* = Ground Movements (North / South / Midfield) Controller
*GMM operating hours depend on traffic; when not manned, duties absorbed by GMN

(2) Both runways designated 07 were in operation at Hong Kong International Airport (VHHH). Whilst the south runway (RWY07R) was dedicated for departures and the north runway (RWY07L) for arrivals, Tactical Runway Allocation Mode (TRAM) was in use whereby individual arrivals could be coordinated to land on the south runway. (See also 1.10.2.1)

(3) At 20:45, a Hong Kong Airlines A333 aircraft, registration B-LNU with flight number CRK709 (hereafter "AC-DEP") operating a scheduled public transport to Bali, established contact with the controller on Tower South frequency 118.4 MHz and joined the departure queue on Taxiway (TWY) H for RWY07R. A total of fifteen departures were taxiing on various taxiways.

(4) Figure 2 illustrates the taxiways and the holding points with co-located red stop-bar[1] lights in the area around the threshold of RWY07R at the western end of the south runway. At 20:48 a departure aircraft at holding point J1, after receiving a line-up clearance from the controller, experienced a radio problem affecting communication between the aircraft and the controller. As this aircraft was occupying TWY J1, entering RWY07R via TWY J1 by other aircraft became unavailable.

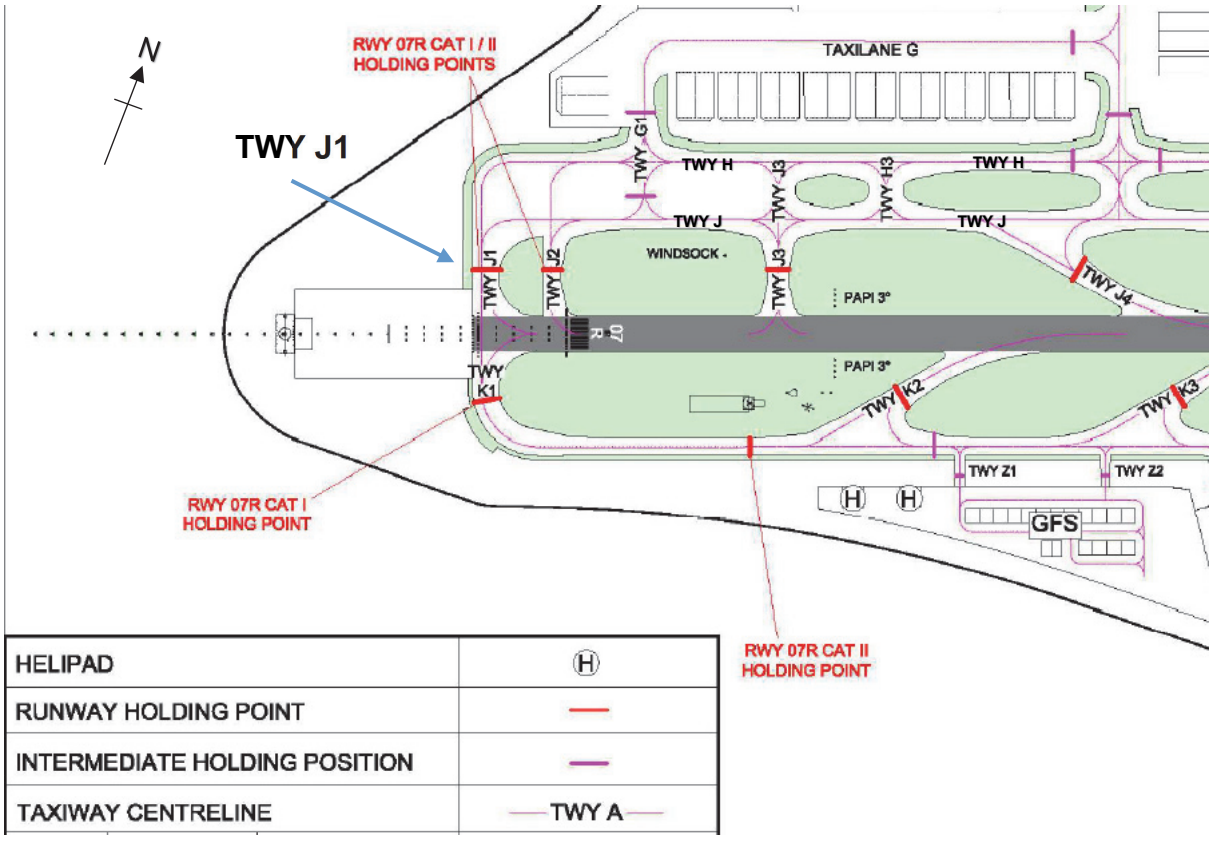

Figure 2 – Western end of Runway 07R

[1] Stop-bars are ground light installations at airports located across taxiways at the point where it is desired that traffic (including aircraft and vehicles) stop, and consist of red lights spaced across the taxiway. At VHHH stop-bars are located across all taxiways leading directly onto the runway.

(5) To resolve the situation, the controller instructed the aircraft with the radio problem to enter RWY07R from TWY J1 and then vacate the runway via TWY J3. As a result, for about 5 minutes RWY07R was occupied by the aircraft and not available for departure or arrival. This caused temporary disruption to RWY07R operation.

(6) After vacating the runway and turning onto TWY J, the aircraft with the radio problem selected code "7600" on the transponder[2]. This is an international emergency code dedicated for Radio Communication Failure (RCF). The selection of code "7600" triggered an alarm in the Control Tower, which was generated by the Advanced Surface Movement Guidance and Control System (A-SMGCS[3]).

(7) The controller eventually succeeded in changing this particular aircraft to another frequency (118.7 MHz) and clearing 118.4 MHz of the radio communication problem. The RCF alarm lasted for slightly over 3 minutes and stopped when the concerned aircraft deselected the "7600" code. The radio communication problem was fully resolved at 21:00.

(8) At 20:58, a Cathay Pacific Airways B748F aircraft, registration B-LJK with flight number CPA071 (hereafter "AC-CROSS") operating on scheduled cargo transport from Anchorage International Airport, landed on RWY07L. The aircraft was given instructions by Ground Movements Control to taxi via Taxiways A, W, H and to hold at the J11 holding point (see blue line in Figure 1).

(9) At 21:04 AC-DEP was on TWY J1 approaching the J1 holding point. Coincidentally, another aircraft behind AC-DEP in the departure sequence informed the controller of an on-board medical issue. This aircraft (hereafter "AC-MED") requested and was approved by the controller to hold position on TWY H east of TWY G1 (see Figure 2). AC-CROSS, then on GMS frequency, was taxiing eastbound on TWY H for TWY J11 in accordance with ATC instructions.

(10) At 21:05:04 the controller instructed AC-DEP to line up RWY07R behind another aircraft that was on the runway waiting for departure. At 21:05:19 AC-CROSS contacted the controller and reported approaching holding point J11. The controller instructed AC-CROSS to hold at the J11 holding point.

(11) The controller then issued a take-off clearance to the aircraft that was waiting on RWY07R. After that, the controller coordinated with GMS in respect of AC-MED, in preparation for the aircraft's possible return to the

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[2] Transponder is an electronic device that produces a response when it receives a radio-frequency interrogation. Aircraft with transponders operating will be detected by air traffic control radar assisting controllers in aircraft identification.

[3] A-SMGCS is an airport traffic management tool using a combination of Surface Movement Radar data and a network of sensors installed at VHHH to establish the positions and identities of aircraft and vehicles on and around the airport surface including runways and manoeuvring areas. The positions and identities of aircraft and vehicles are continuously tracked and displayed at A-SMGCS workstations provided in the Control Tower for reference of air traffic controllers.

terminal apron. A taxi instruction was then issued to AC-MED to taxi onto TWY J, so that TWY H could be made available to other aircraft queuing behind AC-MED. AC-MED did not respond.

(12) At 21:06:30, the controller instructed AC-CROSS to cross RWY07R via TWY J11 and at the same time switched off the J11 stop-bar. AC-CROSS acknowledged. Following this, the controller again coordinated with GMS and then called AC-MED. Again there was no response from AC-MED. At this juncture AC-DEP had lined up on RWY07R.

(13) At 21:07:01 the controller issued a take-off clearance to AC-DEP. The clearance was duly acknowledged. Immediately AC-CROSS reacted saying they were crossing RWY07R and were not clear of the runway. The controller instructed AC-DEP to "stop immediately". AC-DEP reported stopping abeam TWY J2. The closest distance between AC-DEP and AC-CROSS was in excess of 3,000 metres.

(14) AC-CROSS continued to cross RWY07R and taxied to the cargo apron. AC-DEP followed the controller's instructions to vacate the runway and departed uneventfully seven minutes after the occurrence.

(Appendix 9.2 are Records of A-SMGCS display taken when AC-DEP respectively (a) acknowledged the take-off clearance and (b) stopped after the take-off was rejected.)

(Appendix 9.3 shows Communications Transcript between the controller and AC-DEP / AC-CROSS up to the time AC-DEP re-joined the departure sequence after the occurrence.)

1.2. Injuries to Persons

There was no injury to any person on board either aircraft or to any third party.

Injuries to Persons						
Persons on board:	Crew	12	Passengers	255	Others	0
Injuries	Crew	0	Passengers	0		

Table 1: Persons on board A333 (AC-DEP)

Injuries to Persons						
Persons on board:	Crew	3	Passengers	0	Others	0
Injuries	Crew	0	Passengers	0		

Table 2: Persons on board B748F (AC-CROSS)

1.3. Damage to Aircraft

There was no damage to either aircraft.

1.4. Other Damage

There was no other damage to property or the environment.

1.5. Personnel Information

1.5.1. Flight Crew

The flight crew of both aircraft held valid licences and medical certificates. Details are in Section 6.2.

1.5.1.1. Crew of A333 (AC-DEP)

The First Officer (FO) in the right hand seat was the Pilot Flying, responsible for the take-off and the Pilot-in-Command (PIC) was the Pilot Monitoring in the left hand seat. Both the PIC and the FO reported that they were well rested prior to the occurrence flight.

1.5.1.2. Crew of B748F (AC-CROSS)

The crew comprised a PIC, a FO and a Second Officer. The PIC in the left hand seat was the Pilot Flying, responsible for taxiing the aircraft to the cargo bay and the FO in the right hand seat was the Pilot Monitoring. Both the PIC and the FO reported that they were not being affected by fatigue at the time of the occurrence.

1.5.2. Air Traffic Controller

(1) The controller held a valid ATC licence with appropriate rating and a valid medical certificate. Details are in Section 6.2.

(2) The controller commenced duties on the day of the occurrence at 14:30 after a rest period of 54.5 hours on completion of the previous shift and started working at the Tower South position at 20:43 after a 75-minute break.

(3) The controller indicated that a sufficient rest period had been provided between shifts and he was not being affected by fatigue before the occurrence.

1.6. Aircraft Information

1.6.1. Airbus A333 (AC-DEP)

The Airbus A333 passenger aircraft had been operated by Hong Kong Airlines Limited since 2016. The aircraft had valid Certificate of Registration and Certificate of Airworthiness. Details are in Section 6.3.

1.6.2. Boeing B748F (AC-CROSS)

The Boeing 748F freighter aircraft had been operated by Cathay Pacific Airways Limited since 2013. The aircraft had valid Certificate of Registration and Certificate of Airworthiness. Details are in Section 6.3.

1.6.3. Maintenance History

Not related to this occurrence.

1.7. Meteorological Factors

The aerodrome weather report for RWY07R at 21:00 indicated the following: wind was from 180 degrees at 5 knots, visibility was 8 kilometres, cloud coverage of 1-2 oktas was at 4,000 feet, temperature was 20 ºC, dew point was 14 ºC and the runway surface was dry. Weather was not a factor in this occurrence.

1.8. Navigation Aids

There were no reports of abnormal operation of any ground-based navigation aids or aerodrome visual ground aids including ground markings, movement area guidance signs, taxiway lights, stop-bar lights and runway lights.

1.9. Communications

Both AC-DEP and AC-CROSS were equipped with Very High Frequency (VHF) radio communication systems. All VHF radios were serviceable. All communications between Hong Kong ATC and the aircraft were recorded by the Digital Recording System (DRS[4]) of Hong Kong ATC, in support of the provision of air navigation services. There was no interruption to communications between the controller and the respective crew of AC-DEP and AC-CROSS.

[4] Digital Recording System is an ATC system that provides recording, playback and real time monitoring functions for radio transmissions, intercom and audio reception at controller workstations from the headset microphone and the surrounding area.

1.10. Aerodrome Information

1.10.1. Hong Kong International Airport (VHHH)

Details are in Section 6.4.

1.10.2. Additional Information on VHHH

1.10.2.1. Parallel Runway Operations

(1) Aeronautical Information Publication Hong Kong (AIPHK[5]) states the following: *When both runways are available the operating mode is normally segregated operations, i.e. one runway for arrival and one runway for departure. The north runway, RWY 07L/25R, is the normal arrival runway and the south runway, RWY 07R/25L, is the normal departure runway.*

(2) During the occurrence, RWY07L (the north runway) was the landing runway under the control of the Air Movements North Controller (AMN), RWY07R (the south runway) was the departure runway under the control of the Air Movements South Controller (AMS), and ground traffic was handled by three controllers namely GMN, GMS and GMM as depicted in Figure 1.

(3) For an aircraft landing on RWY07L and assigned parking on the cargo apron which was located on the south side of RWY07R, crossing RWY07R from north to south would be required. The runway crossing would normally be accomplished via TWY J6 or TWY J11. (See Appendix 9.1 - Aerodrome Layout)

(4) At the time of the occurrence, Tactical Runway Allocation Mode (TRAM[6]) operation was in use and coordinated arrivals would land on RWY07R (the south runway).

1.10.2.2. Control of Runway Crossing Aircraft

(1) According to the Manual of Air Traffic Control (MATC[7]), GMS shall instruct aircraft requiring to cross the south runway to "*taxi to the runway holding*

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5 AIPHK is a publication issued and updated by the Hong Kong Civil Aviation Department containing details of regulations, procedures and other information pertinent to the operation of aircraft in Hong Kong. The structure and contents of AIPHK are standardised by international agreement through the International Civil Aviation Organization (ICAO). [ICAO is a specialized agency of the United Nations tasked to review the principles and techniques of international air navigation and to foster the planning and development of international air transport to ensure safe and orderly growth.]

6 Tactical Runway Allocation Mode (TRAM) would be implemented when arrival demand significantly exceeds arrival capacity leading to excessive delay for arrival flights. The objective of TRAM is to reduce average delay for arrival flights by utilizing both runways for arrivals.

7 MATC is a CAD internal controlled document containing standard operating procedures to be followed by controllers.

point and contact AMS for the runway crossing". And "*close co-ordination between GMS and AMS shall be effected to ensure a smooth operation*".

(2) The purpose of having all aircraft/vehicles/personnel requiring to use the south runway to be on the AMS control frequency is to facilitate south runway utilisation coming under one single control i.e. AMS. Situational awareness of all involved parties can thus be enhanced.

1.10.2.3. Enhanced Runway Crossing Operational Measures

Consequent to a runway incursion in September 2017 (about three months prior to this occurrence), the following additional operational measures to enhance safety in runway crossing operations were emphasized to operational staff by CAD:

(a) In the AMS electronic flight strip[8] (EFS) display board, an electronic 'Runway Blocked' strip must be placed together with the aircraft EFS when the aircraft is given permission to cross the runway. The 'Runway Blocked' strip will change colour from white to red and become double the normal strip size thus creating a visual prompt to attract the attention of AMS (see example in Figure 3).

(b) The take-off (or landing) button in the departure (or arrival) EFS of the aircraft planning to depart (or land) after the aircraft crossing the runway cannot be activated and an audio alert will be generated if the deactivated take-off (or landing) button is selected.

(c) In association with (b) above, the EFS of an aircraft planning to cross any active runway are to be indented (or un-indented) on the GMS EFS display board by GMS before (or after) the runway crossing as an additional reminder to GMS.

(d) Stop-bars at all runway entry points are illuminated at all times (H24).

(e) Aerodrome operational staff are reminded of the operating instruction "not to adjust the volume settings of the A-SMGCS that might adversely affect the effectiveness of audible conflict alert generated by the system".

[8] Electronic flight strips (EFS) are the electronic equivalents of paper flight progress strips which contain flight data of specific flights e.g. flight number, aircraft type, flight altitude, departure aerodrome or destination aerodrome, etc. Air traffic controllers make use of EFS in the provision of ATC service to aircraft under their control through monitoring, tracking and updating the EFS data.

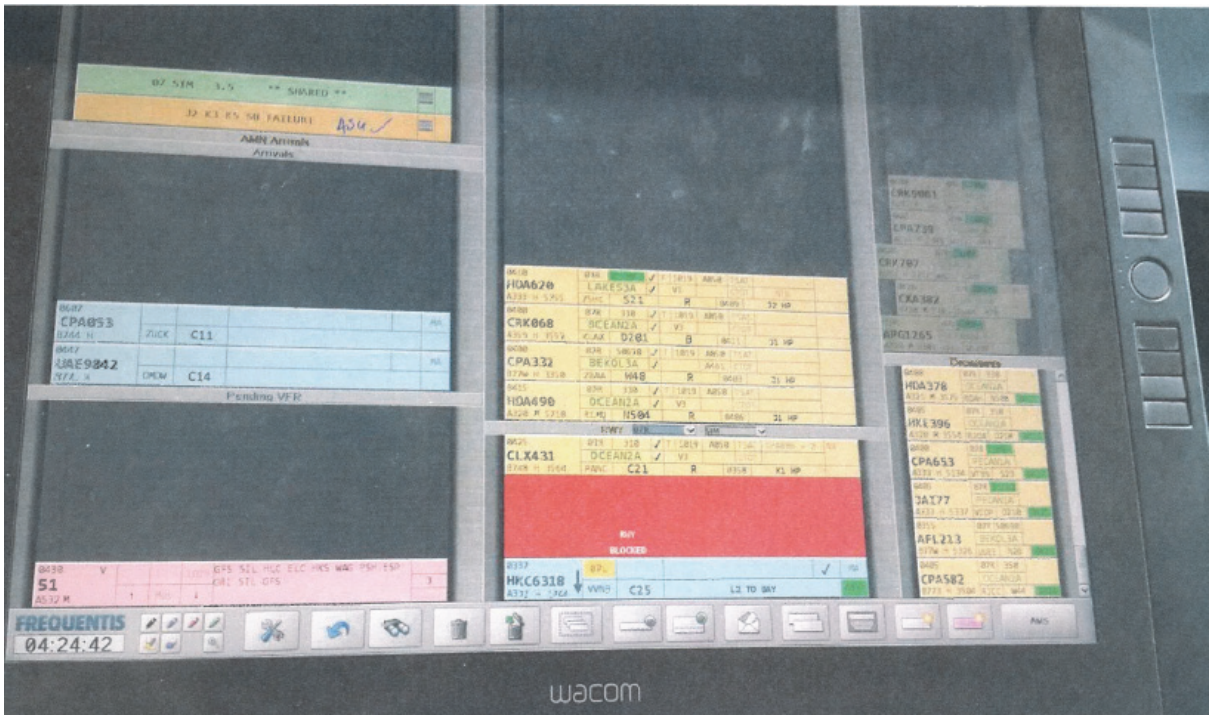

Figure 3 – Example of Electronic Flight Strip display board at AMS

The central column is the 'active bay area' displaying aircraft using or waiting to use RWY07R. Blue EFS represent arrival aircraft. Yellow EFS represent departure aircraft. The aircraft at the bottom of the active bay area has the highest priority and will be the first to use the runway. The position of the red 'Runway Blocked' strip indicates an arrival freighter aircraft (HKC6318 in blue) having landed on RWY07L would cross RWY07R ahead of a departure aircraft (CLX431 in yellow).

1.10.2.4. Tower Electronic Flight Strip System (TEFS)

(1) The TEFS is a network of electronic display boards installed in the Control Tower at designated controller working positions showing up-to-date data of individual flights in the form of EFS. It provides controllers with a touchscreen interface to input real time ATC instructions and operational annotations onto active and pending EFS.

(2) It is also an efficient means of distributing flight data from one control position to other control positions and for exchange of flight data with other ATC systems of CAD.

(3) Together with functions to manipulate the EFS, the TEFS assists controllers to build up and maintain a mental picture of aircraft currently and going to be under the jurisdiction of individual controllers thereby enhancing their situational awareness.

(4) In the TEFS an accurate record of displayed EFS and controller inputs is kept and can be retrieved for review or investigation purposes.

1.10.2.5. Ground Surveillance

(1) A-SMGCS is a ground traffic management tool used at VHHH for surveillance purposes. Explanation is given in footnote 3 on page 6.

(2) Surface Movement Radar (SMR) – The SMR is a short range radar for the monitoring of all movements on the manoeuvring areas of VHHH. The SMR system provides a number of functions, including runway incursion and conflict alert warnings. The SMR signal is normally integrated into the A-SMGCS and displayed on A-SMGCS workstations.

1.10.2.6. Use of A-SMGCS and SMR

The MATC states that prior to providing guidance or instruction to an aircraft based on A-SMGCS or SMR-derived information, air traffic controllers are required to establish positive aircraft identification by one of the following methods:

(a) Correlate the position of an aircraft as visually observed to that indicated on the A-SMGCS or SMR display;

(b) Ensure the automatic association by A-SMGCS or SMR of a label to an arriving aircraft;

(c) Correlate the exact position of an aircraft as reported by pilot's radio transmission to that indicated on the A-SMGCS or SMR display.

1.10.2.7. Safety Logic Functions of A-SMGCS

(1) There are many Safety Logic functions in A-SMGCS to help prevent potential aircraft collisions on the runways and manoeuvring areas. Based on target surveillance and prediction data, A-SMGCS continually monitors single tracks on or approaching closed runways, tracks that are too close together, and tracks predicted to be too close together. When the system detects tracks that are too close under any of these conditions, it generates visual and audible alerts to notify air traffic controllers of the situation.

(2) One of these Safety Logic functions is to provide 'Runway Incursion Monitoring and Conflict Alert' for departure aircraft. When a departure aircraft is tracked at a speed of 50 knots or greater, the A-SMGCS monitors the runway ahead of the departing aircraft and if another target is detected on the runway, the colour of the relevant aircraft or vehicle labels on A-SMGCS display will turn red and an audio alert will also be triggered.

1.11. Flight Recorders and ATC Records

Cockpit Voice Recorders (CVR) and Digital Flight Data Recorders (DFDR) were installed on both aircraft. The DFDR data of AC-DEP and records from ATC systems including DRS, A-SMGCS and TEFS were retrieved and analysed.

1.12. Wreckage and Impact

Neither aircraft were damaged.

1.13. Medical and Pathological Information

No medical or physiological investigations were conducted as a result of the occurrence nor were they required.

1.14. Smoke, Fire, and Fumes

Not applicable in this investigation.

1.15. Survival Aspects

Not applicable in this investigation.

1.16. Tests and Research

On-site assessments were conducted to ascertain visual observation of the south runway from the Control Tower. Details are in 2.3.2.3.1(2).

1.17. Organizational and Management Information

1.17.1. Hong Kong Airlines Limited

Hong Kong Airlines held an Air Operator's Certificate (AOC) issued by the CAD. The operator uses VHHH as the base for passenger operations. The existing fleet consists of Airbus A320 and A330 aircraft types.

1.17.2. Cathay Pacific Airways Limited

Cathay Pacific Airways held an AOC issued by the CAD. The operator uses VHHH as the base for passenger and cargo operations. The existing fleet consists of Boeing 744F, 748F, and 777 aircraft types as well as Airbus A320, A330 and A350 aircraft types.

1.17.3. ATC at Hong Kong International Airport

ATC service is one of the air navigation services[9] provided by the Air Traffic Management Division of CAD to all flights operating within the Hong Kong Flight Information Region as assigned by the International Civil Aviation Organization (ICAO).

1.18. Additional Information

1.18.1. Flight Crew Actions during the Occurrence

1.18.1.1. Flight Crew of A333 (AC-DEP)

(1) Upon cleared for take-off, the FO started to apply take-off thrust. At the same time, the PIC observed AC-CROSS, with strobe lights, beacons and landing lights turned on, entering the runway at the far end. A transmission was also heard on Tower South frequency indicating that a runway cross was in progress.

(2) The PIC immediately called “stop” and simultaneously the FO closed the thrust levers. Take-off thrust had not been established. By the time ATC instructed AC-DEP to stop, the aircraft had already come to a halt.

1.18.1.2. Flight Crew of B748F (AC-CROSS)

(1) At the J11 holding point, the crew heard ATC giving an aircraft a clearance to line up RWY07R. They were therefore aware of an aircraft lining up at the other end of the runway[10].

(2) When given the clearance to cross RWY07R, the crew turned on strobe lights, beacons, and landing lights in accordance with company standard operating procedures (SOP) and commenced taxiing. As they were crossing the stop-bar on J11, which had been switched off for their crossing, the crew observed an aircraft (AC-DEP) at the other end of RWY07R.

(3) Before the aircraft nose reached the centreline of the runway, the crew heard ATC giving take-off clearance to AC-DEP and realised that it could create a conflict traffic situation.

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[9] Air navigation services comprise air traffic services, communication/navigation/surveillance services, meteorological services for navigation, aeronautical information services, etc. Air traffic services comprise air traffic control service, flight information service & alerting service.

[10] It is not uncommon to have one aircraft lined up on the runway and another aircraft crossing the same runway at the same time. It is a safe ATC operating technique as long as the lined up aircraft is holding position on the runway and a take-off clearance is withheld by ATC until **after** the other aircraft has crossed and is completely clear of the runway. Such ATC operating technique facilitates aircraft movements and improves aircraft handling efficiency.

(4) Considering the separation between the two aircraft and that the other aircraft had only started rolling, the PIC judged that it would be safer to continue crossing the runway as soon as possible, thus carried on with the crossing. At the same time, the PIC instructed the FO to advise ATC that they were still crossing the runway.

(5) The FO informed ATC that AC-CROSS was “clearing the runway”. The PIC then transmitted advising ATC that AC-CROSS was not clear of the runway and that they were “on the runway crossing”. After The transmission of AC-CROSS, which lasted for 14 seconds, ATC was then heard instructing AC-DEP to stop immediately.

1.18.2. Manning of Air Traffic Control Positions

(1) As stipulated in MATC Part 3, the duty Aerodrome Supervisor (ASU) would consider actual traffic needs and determine the opening and/or closing of individual control positions in the Control Tower and the associated deployment of controllers to man the operating positions.

(2) At the time the controller took over the AMS position, AMS was operating in combined mode and was also responsible for operations at three other control positions, namely Zone Control, Flight Information Service and Tower Departure Planner.

(3) The duty of Zone Control was to handle local flight operations within designated areas around the airport. Since only authorised flights would carry out night operations, traffic under Zone Control in night time would be very limited. AMS normally would take up Zone Control duties after sunset.

(4) The duty of Flight Information Service was to handle visual flight operations within designated airspace away from the airport between 09:00 local and sunset. After sunset there would not be any visual flight operations. Consequently only monitoring of the assigned frequency for the purpose of search and rescue would be required.

(5) The duty of Tower Departure Planner was to plan the sequence of departure aircraft when they were ready to start engines. By that time such duty had been absorbed by GMS. Any other coordination duties Tower Departure Planner might have been assigned would be handled by individual controllers in the Control Tower.

(6) Notwithstanding that AMS was in combined mode, the controller was in effect only responsible for south runway operations as well as the limited number of aircraft operating in Zone Control airspace. Deployment of staff by the ASU was in line with stipulation of the MATC.

1.18.3. Operational Use of the 'Runway Blocked' strip

(1) The 'Runway Blocked' strip (1.10.2.3(a) refers) was introduced for operational use by CAD in May 2017. When a 'Runway Blocked' strip is placed in the active column of the AMS EFS display board (indicating an imminent use of the runway for crossing or other purposes), the respective EFS take-off or landing buttons of any departure or arrival aircraft planned to take place after the runway crossing / occupying activity, will be deactivated (1.10.2.3(b) refers).

(2) Such temporary deactivation is a design mechanism of TEFS that aims to safeguard against inadvertent use of an occupied runway. Any attempt to select the relevant buttons, for instance, when issuing a take-off or landing clearance prior to the occupied runway becoming available, will generate an audible alarm to alert AMS.

1.18.4. Situational Awareness

(1) Situational awareness refers to the ability to perceive and comprehend all of the relevant information available and anticipate what could happen that may affect the operation. In aviation, situational awareness is the ability to keep track of the prioritised significant events and conditions in the environment of an air traffic controller or pilot[11].

(2) European Action Plan for the Prevention of Runway Incursions (EAPPRI[12]) states: *For air traffic controllers, situational awareness means mainly acquiring and maintaining a mental picture of the traffic situation considering all the potential unexpected progressions or changes in the scenario. It also involves projecting that mental picture into the immediate future and can create an expectation about what is going to happen next*.

1.18.5. Aerodrome Controller Visual Scanning Techniques

Visual scanning is the ability to efficiently, quickly, and actively look for information relevant to one's environment. In the context of aviation, according to EAPPRI:

(a) *scanning is the skill of seeing by looking in a methodical way;*

[11] ICAO Document 9756 Part IV – Manual of Aircraft Accident and Incident Investigation

[12] European Action Plan for the Prevention of Runway Incursions (EAPPRI) is a publication of EUROCONTROL which is a pan-European civil–military organization dedicated to supporting European aviation.

(b) *glancing out without stopping to focus on anything is of limited value;*

(c) *scanning is not limited to the external (outside of Control Tower) view but must also incorporate a structured search (inside the Control Tower) at supporting systems such as weather and surveillance systems, EFS, etc.; and*

(d) *a structured, methodical scanning technique will help controllers integrate 'heads down' tasks (visual search inside the Control Tower) with the need to maintain a 'heads up' posture (direct out-of-the-window observation) to achieve a 'continuous watch' of aerodrome operations.*

1.19. Useful or Effective Investigation Techniques

Not applicable in this investigation.

2. SAFETY ANALYSIS

The Safety Analysis provides a detailed discussion of the safety factors identified during the investigation, providing the evidence required to support the findings, contributing factors and the safety recommendations.

2.1. Introduction

The serious incident involved two aircraft that operated according to ATC instructions issued by the same air traffic controller. There was no evidence suggesting aircraft maintenance, prevailing weather, ground-based navigation aids, and aerodrome visual ground aids (including ground markings, movement area guidance signs, taxiway lights, stop-bar lights and runway lights), or communication systems utilised by the involved pilots or the air traffic controller had any bearing on the occurrence. The investigation therefore focused on analysing flight operations, ATC operations, and any probable human factors involved.

2.2. Flight Operations

2.2.1. AC-DEP Flight Crew

(1) Referring to 1.18.1.1, the PIC made the decision to immediately reject the take-off, before getting the 'stop' instruction from ATC. The rejected take-off did not result in hot-brakes or any other exigency. AC-DEP was able to re-join the departure sequence and depart uneventfully seven minutes after the occurrence.

(2) The DFDR data indicated that the maximum speed recorded, when take-off was rejected, was 20 knots[13]. Consequently no visual or audio alerts were triggered on the A-SMGCS (1.10.2.7(2) refers).

(3) The flight crew of AC-DEP demonstrated appropriate situational awareness during the occurrence and their response to the unexpected situation was appropriate and prompt.

2.2.2. AC-CROSS Flight Crew

(1) Referring to 1.18.1.2, the crew actively monitored the Tower South frequency and the developing situation. When ATC gave take-off clearance to AC-DEP, the PIC instructed the FO to advise ATC while continuing to cross the runway. The FO informed ATC that AC-CROSS

[13] AC-DEP ground speed increased from 0 knot at 21:07:13 to 20 knots at 21:07:24 then decreased to 0 knot at 21:07:31

was clearing the runway. The PIC then transmitted and clarified that AC-CROSS was still crossing the runway.

(2) The transmission and clarification of AC-CROSS occupied the frequency for 14 seconds. The controller issued the “stop” instruction to AC-DEP as soon as AC-CROSS finished the transmission.

(3) Despite the transmission of AC-CROSS occupying the frequency for some time, it had no bearing on the outcome of the occurrence because the rejected take-off was initiated by the flight crew of AC-DEP as soon as they observed and heard AC-CROSS.

(4) The flight crew of AC-CROSS maintained appropriate situational awareness throughout the occurrence, promptly detected the potential conflict traffic situation and proactively reacted using the radio frequency to alert others.

2.3. ATC Operations

(1) The occurrence took place 24 minutes after the controller took over the AMS control position. The significant events at AMS during this 24-minute period are summarised as follows in chronological order:

(a) the controller took over AMS position handling departure and arrival aircraft on RWY07R as well as helicopter traffic around the airport;

(b) a departure aircraft experienced a radio problem;

(c) a radio communication failure (RCF) alarm was generated by the A-SMGCS;

(d) ASU took over control of the RCF aircraft;

(e) AC-MED reported having a medical issue;

(f) AC-DEP was cleared to line up RWY07R;

(g) the controller coordinated with GMS regarding the re-positioning of AC-MED;

(h) AC-CROSS was cleared to cross RWY07R;

(i) the controller coordinated with GMS again in connection with AC-MED;

(j) AC-DEP was cleared for take-off on RWY07R; and

(k) AC-DEP aborted the take-off.

(2) The 24-minute period is split into two stages for analysis of the events together with the concurrent traffic situation and the corresponding actions taken by the controller. Stage 1 covered the period from the time the controller took over AMS until AC-DEP was cleared to line up and the J1 stop-bar was switched off, i.e. (a)-(f) in (1) above. Stage 2 commenced from end of Stage 1 until AC-DEP aborted the take-off, i.e. (g)-(k) in (1) above.

2.3.1. Stage 1 at AMS (from taking over AMS until J1 stop-bar off)

2.3.1.1. Workload

(1) The controller took over the AMS position which was operating in combined mode. The controller stated the following: (a) 2000-2100 was the normal rush-hour and traffic was “busy as usual” with aircraft given departure restrictions and/or clearance expiry times; and (b) there were several helicopter flights operating.

(2) ASU stated that at the time of the occurrence the manning level was normal and it was a routine practice to combine controller working positions in the Control Tower. ASU considered the workload of the controller normal working the four positions combined (1.18.2 refers).

(3) Records showed two helicopters operated during that period which were operating in different areas not constituting traffic to each other.

(4) In summary, based on reviewing and analysing all available ATC surveillance and communication records during the concerned period, it was not apparent that working AMS together with three other control positions in combined mode result in a significant increase of workload exceeding the handling capacity of a single Aerodrome controller.

2.3.1.2. Handling the aircraft with a radio problem

(1) When the aircraft at the J1 holding point experienced a radio problem, the controller stated that he was feeling under increasing pressure to resolve the situation because TWY J1 being the main line-up taxiway for RWY07R became unavailable. The controller thus coordinated with GMS and instructed the aircraft to enter RWY07R then taxi down to vacate the runway via TWY J3. This would allow TWY J1 becoming available to other aircraft.

(2) As communication with the aircraft was difficult, the runway might be occupied by the aircraft for a prolonged period. The controller therefore

coordinated with Approach Control[14] to have all arriving aircraft that had been offered RWY07R under TRAM, re-directed to RWY07L.

(3) To summarise, the controller was able to discharge the responsibilities of AMS under pressure when faced with an unexpected aircraft radio communication event by making all the necessary planning and coordination with other relevant control units and issuing appropriate instructions to the aircraft concerned.

2.3.1.3. RCF (radio communication failure) alarm

(1) After vacating the runway, the aircraft with radio problem selected the RCF emergency code on the transponder which triggered an alarm generated by the A-SMGCS. The controller stated that he was "startled" and felt significantly affected by the alarm.

(2) To the operational staff on duty in the Control Tower during the occurrence, it was possibly the first time the RCF alarm was heard. The alarm was loud and took everyone there by surprise[15]. The controller did not realise the alarm was generated by the A-SMGCS and no assistance was available from other colleagues.

(3) The alarm lasted for about 3 minutes and stopped when the RCF aircraft deselected the RCF code and reset the transponder. Although the procedure to silence the alarm was documented in Part 12 of the MATC (see Appendix 9.4), it would appear operational staff were not familiar with the procedure.

(4) As managing the ever increasing air traffic would invariably involve introduction of new facilities or functions in the operating environment, over time there would likely be an increase of associated audible alarms from various operating systems that operational personnel need to know.

(5) In view of the above, it is considered that CAD should review the function and/or status of all operational audible alarms at a time interval CAD consider suitable, and to draw the attention of operational personnel to the results of such periodic reviews for purposes of refreshing memory or otherwise, if appropriate. Should there be a proliferation of alerts or warnings, CAD may consider if an additional dedicated display for alerts or warnings could assist operational staff in instantly recognising and understanding the alert or warning as well as taking the appropriate action(s) in response.

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[14] Approach Control is the ATC unit responsible for directing arrivals towards the airport with the aid of radar.

[15] In psychology, surprise is a cognitive-emotional response to mismatches between mental expectations and perceptual representations of the actual environment. Cognitive responses to surprise include confusion and loss of situational awareness. It may involve the inability to remember the current operating procedures (*Rivera et al. (2014) Startle and surprise on the flight deck: Similarities, differences and prevalence*)

(6) In aviation, startle effect (mentioned in (1) above) can be defined as an uncontrollable, automatic reflex that is elicited by exposure to a sudden, intense event that violates a pilot's (or controller's) expectations [16]. SKYbrary[17] offers elaboration[18] on the subject of startle effect.

(7) During the three minutes of the RCF alarm activation, the controller made 5 radio transmissions to 5 aircraft; 1 coordination with the ASU; and 1 input command of switching off the J1 stop-bar in the Airfield Ground Lighting system. All these were correctly and timely executed. Considering all the actions and coordination carried out by the controller, which were in line with standard operating procedures, it was not apparent that the loud RCF alarm had observable negative impact on the performance of the controller.

2.3.1.4. ASU took over control of the RCF aircraft

Shortly after vacating the runway, the RCF aircraft was taken up by ASU who assisted in communicating with the aircraft on frequency 121.5 MHz (frequency for emergency communications) and eventually on 118.7 MHz thereby isolating the radio issue on a separate frequency.

2.3.1.5. Traffic handling after the RCF alarm

(1) After the RCF alarm had stopped, one helicopter reported departing from Hong Kong Island for Macao, another helicopter reported leaving western Lantau for Hong Kong Island, and the controller proactively coordinated with Approach Control offering RWY07R to a cargo flight that was 20 minutes away from landing.

(2) AC-MED, while taxiing on TWY H and approaching TWY G1, reported having a medical issue. The controller approved AC-MED to hold position. The controller then cleared AC-DEP to line up RWY07R behind another aircraft waiting for departure on the runway. AC-CROSS also made their first radio contact with the controller and was instructed to hold at the J11 holding point. Then the controller cleared the aircraft waiting on RWY07R for take-off. At the same time the controller switched off the J1 stop-bar for AC-DEP to enter RWY07R.

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[16] FAA Advisory Circular 120-111 - Upset Prevention and Recovery Training (Despite this document only describes training for pilots, the study and understanding of the startle effect offers useful reference for ATC from the human factor perspective.)

[17] SKYbrary is an electronic repository of safety knowledge related to flight operations, air traffic management and aviation safety in general. SKYbrary was initiated by EUROCONTROL in partnership with various organizations including the International Civil Aviation Organization.

[18] The startle effect includes both the physical and mental responses to a sudden unexpected stimulus. While the physical responses are automatic and virtually instantaneous, the mental responses - the conscious processing and evaluation of the sensory information - can be much slower. Studies have determined that, following a startling stimulus such as a loud noise, basic motor response performance can be disrupted for as much as 3 seconds and performance of more complex motor tasks may be impacted for up to 10 seconds. Startle has been found to impair information processing performance on mundane tasks for 30 to 60 seconds after the event occurrence. The duration of the performance degradation increases as the task becomes more complex. Thus, the startle effect disrupts cognitive processing and can negatively influence an individual's decision making and problem solving abilities.

(3) The events described in (1) & (2) above took place within a span of about five minutes. Altogether the controller made 18 radio transmissions to 11 aircraft, 2 transmissions to ground vehicles, 2 coordination with other controllers, and 4 input commands on the Airfield Ground Lighting system. All these were correctly and timely executed with the exception of one. In connection with the helicopter bound for Macao mentioned in (1) above, the controller was responsible to notify Macao Tower without delay in accordance with SOP. Such notification was not immediately carried out. The controller realised the notification was still outstanding when the helicopter made a position report near the airspace boundary. The controller then notified Macao Tower.

(4) Apart from the procedural lapse mentioned in (3) above, the controller had a clear mental picture of the airport traffic, gave instructions without hesitation, initiated coordination with Approach Control, maintained a smooth traffic flow on RWY07R, and operated the stop-bar in accordance with SOP.

(5) The procedural lapse could be an indication that the controller was affected by the RCF alarm which had stopped approximately 1 minute prior to the helicopter reporting departure from Hong Kong Island. It could also be possible that the controller's situational awareness then was focused on the airport traffic rather than the two helicopters.

(6) In summary, considering all the actions taken by the controller in Stage 1 as a whole, the unexpected aircraft communication problem and the ensuing triggering of the RCF alarm does not appear to have had significant impact on the controller's performance. It is possible that the controller was affected to a certain extent by the events.

2.3.2. Stage 2 at AMS (from end of Stage 1 until AC-DEP aborted)

2.3.2.1. Actions of the controller in respect of AC-MED and AC-CROSS

(1) After switching off the J1 stop-bar, the controller coordinated with GMS to re-position AC-MED onto TWY J in order to release TWY H for other aircraft in the queue. The controller then passed the coordinated taxi instruction to AC-MED. There was no response from the aircraft.

(2) When the aircraft preceding AC-DEP was airborne passing the departure end of the runway, the controller gave AC-CROSS which was holding at the J11 holding point a clearance to cross RWY07R. At the same time the J11 stop-bar was switched off. The controller then made another coordination with GMS in respect of AC-MED and called the aircraft again. There was no response from AC-MED.

(3) To summarise, it can be seen from the controller's actions in (1) & (2) above that a practical taxi plan was coordinated with GMS for AC-MED and the other aircraft in the departure sequence; a runway crossing clearance was issued to AC-CROSS at an appropriate time; and the stop-bar was operated in accordance with SOP. It can be said that situational awareness was well maintained by the controller.

2.3.2.2. Actions of the controller in respect of AC-DEP

(1) In preparation for the release of AC-DEP, the controller first scanned the middle to western portion of RWY07R, followed by scanning of the A-SMGCS. The purpose of scanning the runway and the A-SMGCS was to determine whether or not the runway was clear of traffic/obstacles and was safe to be used by the next aircraft. The controller then scanned the surveillance radar which indicated that the preceding departure aircraft was 1 NM beyond the departure end of the runway. Based on this information, the controller assessed that the required separation between two successive departure aircraft would be achieved if the second aircraft was to be released at this point.

(2) The visual scan mentioned in (1) above was completed in approximately 5 seconds and was carried out by the controller after trying to contact AC-MED the second time without success.

(3) The controller then gave AC-DEP a take-off clearance. When AC-DEP was reading back the clearance, the controller scanned the eastern portion of RWY07R and saw AC-CROSS taxiing across the runway. As soon as AC-DEP finished the read-back, the crew of AC-CROSS reported that they were crossing RWY07R and not clear of the runway. Immediately after AC-CROSS completed the transmission, the controller instructed AC-DEP to stop. AC-DEP reported stopping abeam TWY J2.

2.3.2.3. Analysis of the controller's scanning actions in 2.3.2.2

2.3.2.3.1. Scanning the runway

(1) According to ICAO Document 4444 (Procedures for Air Navigation Services – Air Traffic Management), *Aerodrome controllers shall maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome; and visual observations shall be achieved through direct out-of-the-window observation, or through indirect observation utilizing a visual surveillance system e.g. A-SMGCS*.

(2) Day and night on-site assessments were conducted in the Control Tower to ascertain that the J11 holding point, the J1 holding point and the respective associated area of Runway 07R could be seen from the AMS workstation. There was no evidence to indicate that observing aircraft from the AMS workstation might be impaired.

(3) The controller made a visual scan of the western half of the runway and not the eastern half prior to clearing AC-DEP for take-off. Without scanning the full length of the runway, it would not be possible to determine whether the runway was safe for use by AC-DEP.

(4) Figure 4 is a screen capture illustrating the AMS EFS display board at 20:46, four minutes after the controller took over the AMS position. The freighter aircraft (indented blue EFS) had landed on RWY07L and been assigned parking on the cargo apron. The aircraft was cleared by the controller to cross RWY07R at TWY J6 (midpoint of the south runway) between two successive departure aircraft. Relevant SOP, with the exception of using the red 'Runway Blocked' strip, were followed and the runway crossing was accomplished.

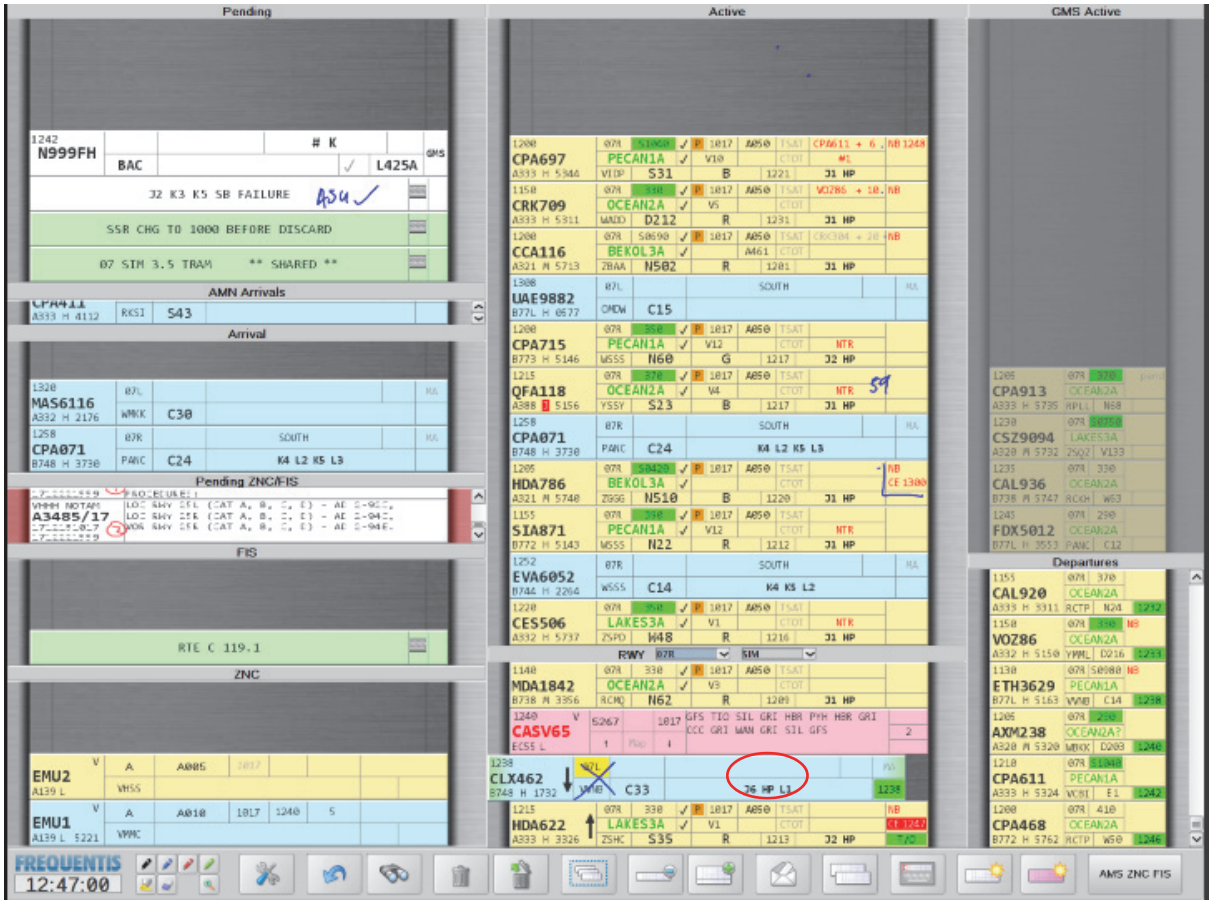

Figure 4 : AMS Electronic Flight Strip display board at 20:47 Local Time

HDA622 (bottom yellow EFS) was given take-off clearance.

CLX462 (blue EFS indented) was planned by the controller to cross RWY07R via J6 (red circle) after HDA622 and before the next departure aircraft MDA1842 (second yellow EFS from bottom).

CASV65 (pink EFS) was the helicopter waiting to depart from the airport and the plan of the controller was to give CASV65 the approval after the departure of HDA622.

There was no red 'Runway Blocked' strip.

(5) One of the differences between the runway crossing in (4) above and that of AC-CROSS was the crossing point on RWY07R. The former crossed at TWY J6 (midpoint of RWY07R) and the latter (AC-CROSS) crossed at TWY J11 i.e. the eastern end of RWY07R.

(6) Referring to Appendix 9.1 – Aerodrome Layout, it can be seen that TWY J6 and TWY J11 are both suitable for cargo flights to cross the south runway because of their proximity to the cargo terminal which is on the south side of the south runway. TWY J6 was more commonly used for runway crossing during both RWY07R and RWY25L operations because crossing at the runway midpoint would not hinder taxiing departure aircraft that would congregate at either end of the runway.

(7) From a human factor perspective, the relatively more frequent usage of TWY J6 for runway crossing, if developed subconsciously as a habit through practice, might explain why the controller only scanned the western half of the runway. The investigation found no evidence to support such a theory.

(8) Considering all aspects, it remained the responsibility of the controller to scan the full length of the runway under all circumstances. If the controller had also scanned the eastern half of the runway, there was a high probability that the controller would have noticed AC-CROSS entering RWY07R via TWY J11. (See also 2.3.2.2(3) & 2.3.3(2))

2.3.2.3.2. Scanning the A-SMGCS

(1) The controller scanned the A-SMGCS display but did not notice AC-CROSS entering RWY07R from TWY J11. The controller stated that the A-SMGCS display background colour and the blue labels of arrival aircraft were similar, implying that the label of AC-CROSS was not conspicuous.

(2) Playback of A-SMGCS record of the period when the controller was working as AMS indicated that all aircraft and vehicles on the runway and manoeuvring area were clearly and unambiguously detected and displayed. On-site visits to the Control Tower noticed that there was no apparent difficulty in observing arriving aircraft labels on the A-SMGCS displays.

(3) Referring to 1.18.5, visual scanning needs to be an active search for information and glancing out without stopping to focus on anything is of limited value. It is probable that the controller did not notice AC-CROSS on the A-SMGCS because of the scanning technique at the time rather than the colour of the A-SMGCS background or label.

2.3.2.3.3. No scanning of the EFS display board

(1) Referring to 1.10.2.4(3), the TEFS assists controllers to build up and maintain a mental picture of aircraft currently and going to be under the jurisdiction of individual controllers thereby enhancing their situational awareness. A constantly up-to-date EFS display board therefore is a source of essential and reliable traffic information.

(2) The controller stated that he was not looking at the AMS EFS display board before issuing the take-off clearance to AC-DEP. Figure 5 is a screen capture illustrating the AMS EFS display board at 21:06:40, shortly after the controller gave runway crossing clearance to AC-CROSS. The EFS arrangement indicated that the plan of the controller was to cross AC-CROSS (CPA071) in between the first departure aircraft (CCA116) and the second departure aircraft (CRK709). By omitting to scan the EFS display board at a critical time, the controller lost the opportunity to acquire an up-to-date situational awareness.

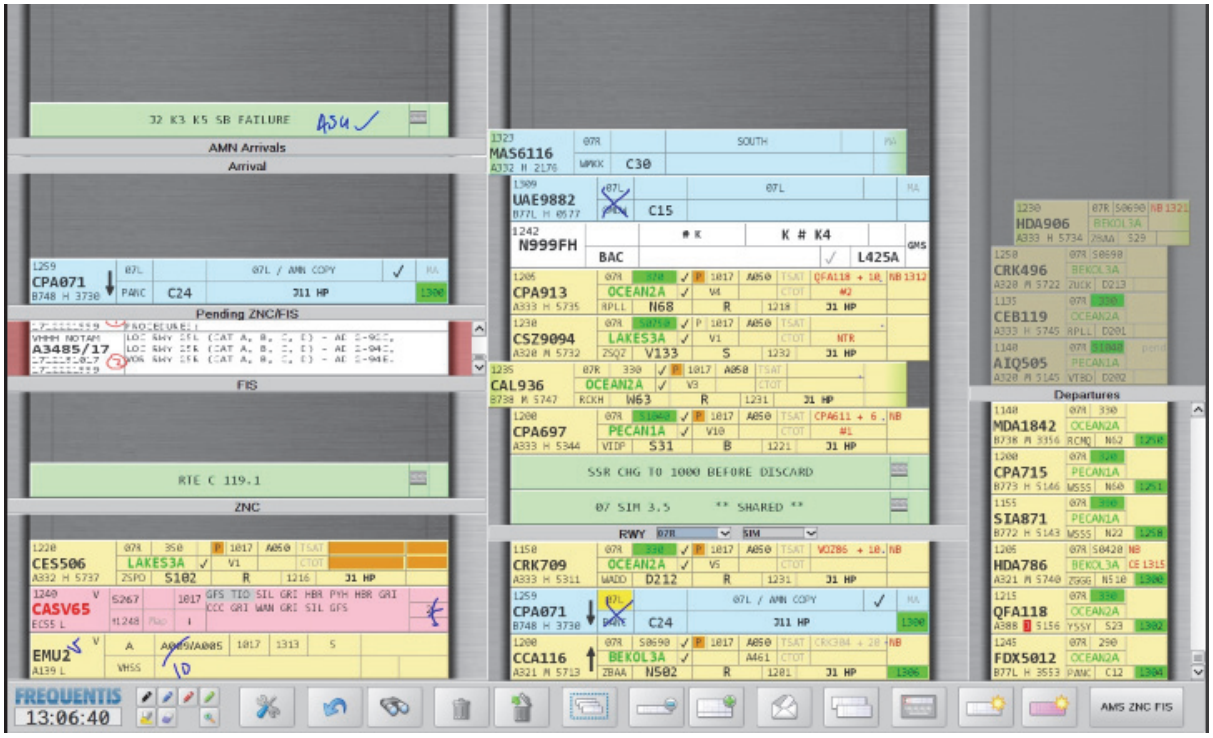

Figure 5 : AMS Electronic Flight Strip display board at 21:06:40 Local Time

CCA116 (bottom yellow EFS) had been cleared for take-off at 21:05. CPA071 (AC-CROSS) (blue EFS) was cleared to cross runway at 21:06:30. CRK709 (AC-DEP) (yellow EFS) would depart in sequence after CPA071 completed crossing the runway. CAL936 (AC-MED) (yellow EFS) was indented indicating 'sequence not confirmed'. (There was no red 'Runway Blocked' strip.)

(3) It is considered that a large red 'Runway Blocked' strip (as illustrated in Figure 3) placed together with the AC-CROSS EFS would readily catch the attention of the controller, had the EFS display board been scanned. Even

without the red 'Runway Blocked' strip, the controller would have the opportunity to "see and be refreshed" of the planned traffic sequence as shown by the position of the EFS, had scanning of the EFS display board been included as a routine action prior to giving a take-off clearance.

2.3.3. Development of events following the aborted take-off

(1) After AC-CROSS had completely crossed the runway, the controller transferred the aircraft to GMS for further taxi instructions. The controller, then taking into consideration the possibility of AC-DEP having hot brakes, asked AC-DEP if they were still able to depart. AC-DEP requested to re-join the departure queue and departed uneventfully at 21:14.

(2) The controller's action of scanning the eastern portion of RWY07R (2.3.2.2(3) refers) indicated that the controller maintained a continuous watch on aircraft operations on the runway. The fact that the controller saw AC-CROSS crossing the runway indicates that had the controller scanned the eastern half of the runway before issuing the take-off clearance to AC-DEP, there was a high probability that the controller would have seen AC-CROSS entering RWY07R via TWY J11 (2.3.2.3.1(8) refers) and would therefore withhold the take-off clearance until AC-CROSS completely vacated the runway.

(3) To summarise, (a) based on analysis in 2.2 the responding actions of the respective flight crew of AC-DEP and AC-CROSS were appropriate; (b) despite the occurrence, the controller responded to the developing situation in an appropriate manner and immediate recovery actions taken were appropriate.

2.3.4. Non-adherence to SOP

(1) As illustrated in Figure 4 and Figure 5, there was no 'Runway Blocked' strip on the AMS EFS display board. The controller was aware of the SOP to use a 'Runway Blocked' strip during runway crossing operation. The controller stated that the 'Runway Blocked' strip was unavailable on the strip board and there was no time to create one.

(2) ASU stated that creating a new 'Runway Blocked' strip could be done quickly and if necessary other colleagues in the Control Tower could help create and send a 'Runway Blocked' strip to the controller electronically.

(3) ASU also stated that on several occasions prior to the occurrence the 'Runway Blocked' strip was found not available on the AMS EFS display board. The Team Supervisor of the involved controller was also invited for an interview and stated an observation that controllers were not always following the 'Runway Blocked' strip procedure. Both supervisors stated

they would remind and ensure controllers to follow the new procedure whenever non-compliance was noticed.

(4) Whilst usage of a 'Runway Blocked' strip was introduced by CAD in May 2017 and the procedure was reiterated to aerodrome operational staff after a runway incursion in September 2017, it was evident that individual controllers still did not follow the SOP.

(5) It is considered important for CAD to review the implementation of the 'Runway Blocked' strip procedure and put in place necessary measures to ensure compliance with the procedure. The same principle should be applicable to implementation of any operating procedures.

2.3.5. Deactivation of the EFS take-off or landing button (1.18.3)

(1) The controller was aware of the deactivation function associated with the use of the 'Runway Blocked' strip. However the controller had adopted a practice of issuing take-off / landing clearance and then marking the strips during pilot read-back.

(2) The TEFS and the voice communication system operate independently and the TEFS was not designed to monitor communications between aircraft and controllers. It is therefore necessary for individual controllers to consciously monitor the traffic situation and to give take-off or landing clearance on the radio frequency when the runway becomes available.

(3) In the case of the controller's practice of "issuing take-off / landing clearance and then carrying out strip marking", an aircraft would have already received the ATC clearance before the controller would be alerted by the TEFS in situations of premature clearances being issued.

(4) It is therefore important for controllers to follow the correct handling sequence, i.e. mark strip first then transmit on radio frequency, in runway crossing situations to avoid occasions of premature take-off / landing clearances being issued. The potential risk otherwise involved must be clearly and specifically emphasized to all operational staff.

(5) If operated in a proper manner, the temporary deactivation of the take-off / landing button of the TEFS would serve as an additional layer of defence in the safety net. It is considered that CAD should review the deactivation function and in particular the associated handling sequence mentioned in 2.3.5(4) above and explore enhancement measures to support the function.

2.3.6. Collective analysis of controller actions in Stages 1 and 2

(1) From the moment the controller took over AMS until AC-CROSS was given clearance to cross RWY07R and the J11 stop-bar was switched off, it would

appear the controller maintained a clear mental picture of the airport traffic, made internal co-ordinations and issued instructions to aircraft in an appropriate manner. The controller also carried out SOP accordingly, with the exception of using the 'Runway Blocked' strip.

(2) However, the scan processes carried out by the controller prior to clearing AC-DEP for take-off were considered inadequate. Only the western half and not the full length of the runway was scanned. Scanning of the A-SMGCS did not result in the detection of AC-CROSS entering the runway. Scanning of the AMS strip board was omitted thus situational awareness was further reduced. Also, the 'Runway Blocked' strip SOP was not adhered to regarding AC-CROSS.

(3) The controller stated that taxi-route options for AC-MED were being considered when AC-DEP was cleared for take-off. The controller further stated that attention was diverted by having to come up with an alternative taxi plan as the taxiway in the original plan[19] was occupied by an aircraft under tow.

(4) The controller made a second coordination with GMS regarding AC-MED immediately after giving AC-CROSS a runway crossing clearance. At that point, traffic being handled by the controller included:

(a) AC-DEP lined up on RWY07R waiting for a departure clearance;

(b) AC-CROSS starting to cross RWY07R at the eastern end;

(c) another departure aircraft waiting in sequence at the J1 holding point;

(d) AC-MED with a medical issue but intention of the aircraft was unknown;

(e) other aircraft on TWY H behind AC-MED waiting; and

(f) two helicopters operating outside of the airport vicinity.

(5) The traffic scenario would call for a high level of situational awareness and prioritisation of tasks.

(6) Under the circumstances, a higher priority should be given to runway movements rather than the determination of a taxi-route in a location outside AMS's area of jurisdiction because the former task carries safety implications as opposed to the latter.

(7) It was not inappropriate for the controller to contemplate moving AC-MED clear of TWY H and making the taxiway available to other aircraft. However, such contemplation, irrespective of the taxi-route option, should

[19] TWY N was the taxiway the controller referred to in the original plan. TWY N was under the jurisdiction of GMM/GMN and not AMS (see Figure 1)

not impede the delivery of other operational tasks, especially when safety could be at stake, lest it should become a distraction.

(8) Thirty-two seconds after instructing AC-CROSS to cross RWY07R, the controller gave AC-DEP the take-off clearance while AC-CROSS was still crossing the runway. The instruction was not appropriate because AC-CROSS had not completed the runway crossing and RWY07R was not yet available to AC-DEP for take-off.

(9) It can be concluded that the controller had a momentary lapse of situational awareness as a result of distraction when take-off clearance was given to AC-DEP. The distraction was attributable to actions physically and mentally taken by the controller within the thirty-two-second period in relation to AC-MED, namely the second coordination with GMS in respect of repositioning AC-MED, the unsuccessful communication with AC-MED and the facilitation of another taxi-route.

(10) The controller's inadequate scanning and not utilising the 'Runway Blocked' strip were contributing factors in the occurrence.

2.4. Comparison with Previous Runway Incursion Occurrence

(1) A runway incursion occurrence took place at VHHH in September 2017 (mentioned in 1.10.2.3 and 2.3.4). The runway incursion was compared with this occurrence of aborted take-off on an engaged runway. Some similarities were found between the two occurrences.

(a) Both occurrences took place on RWY07R involving a departure aircraft and a freighter aircraft crossing the runway.

(b) In both cases the flight crew of the departure aircraft saw the crossing aircraft and aborted the take-off.

(c) On both occasions ATC in response to the situation instructed the departure aircraft to 'stop immediately'.

(d) Both departure aircraft involved were able to depart uneventfully a short period after the occurrences.

(e) On the part of ATC, same issues identified in both occurrences included the following: (1) distraction or lapse of concentration, (2) degradation of situational awareness, (3) scanning technique related issues, and (4) certain SOP being not followed.

(2) To address the same human factor issues identified in (1)(e) above, it is recommended that CAD, apart from continuing to review runway crossing procedures and associated operational requirements, should

(a) evaluate the adequacy and effectiveness of initial training for air traffic controllers on scan and/or scanning techniques;

(b) consider the necessity for controllers to undergo recurrent scan training; and

(c) put in place measures to ensure compliance with implemented procedures.

2.5. Risk Assessment and Severity Classification

(1) In the occurrence AC-DEP rolled a short distance and stopped while AC-CROSS was crossing at the other end of the runway. When the take-off was rejected, take-off thrust had not been established. The closest distance between the two aircraft was more than 3,000 metres. There was no risk of collision.

(2) Using the Severity Classification scheme in ICAO Document 9870 (Manual on the Prevention of Runway Incursions) as a tool, the severity classification of this occurrence is C, i.e. there was ample time and distance to avoid a collision.

3. CONCLUSIONS

3.1. Findings

From the evidence available, the following findings are made with respect to this occurrence. These findings should not be read as apportioning blame or liability to any organization or individual.

(1) The flight crew of both AC-DEP and AC-CROSS held valid licences and medical certificates. [1.5.1]

(2) The involved air traffic controller held a valid ATC licence and a valid medical certificate. [1.5.2(1)]

(3) Both AC-DEP and AC-CROSS had valid Certificate of Registration and Certificate of Airworthiness. [1.6]

(4) The aerodrome surface marking, lighting, signage and visual aids did not contribute to the incident. [1.8]

(5) All communication equipment in the Control Tower were serviceable and there was no report of defective radio communication system in AC-DEP or AC-CROSS. There was no interruption to communication between the controller and the respective crew of AC-DEP and AC-CROSS. [1.9]

(6) The controller took over the AMS control position which was operating in combined mode assuming control over operations on the south runway and at three other control positions namely Zone Control, Flight Information Service and Tower Departure Planner. [1.1(1)] [1.18.2(2)-(5)]

(7) Deployment of staff by the ASU was in line with the MATC stipulation. Working AMS together with three other control positions in combined mode did not result in a significant increase of workload. [1.18.2(6)] [2.3.1.1]

(8) Prior to the occurrence there was an aircraft with radio communication problem which caused disruption to RWY07R operation. [1.1(4)-(5)]

(9) The radio communication event led to the activation of the RCF alarm which was generated by the A-SMGCS. Although the procedure to silence the alarm was documented in the MATC, operational staff were not familiar with the procedure. [2.3.1.3(1)-(3)]

(10) The unexpected aircraft communication problem and the ensuing triggering of the RCF alarm does not appear to have had significant impact on the

controller's performance. It is possible that the controller was affected to a certain extent by the events [2.3.1.5]

(11) The controller coordinated twice with GMS regarding the possible return of AC-MED to the terminal apron. After each coordination, the controller attempted to pass a taxi instruction to AC-MED. On both occasions AC-MED did not respond. In between the two coordination, the controller cleared AC-CROSS to cross RWY07R at the eastern end of the runway, with AC-DEP lined-up on RWY07R at the western end of the runway. [1.1(11)-(12)] [2.3.2.1(1)-(2)]

(12) While AC-CROSS was starting to cross the runway, the controller made a series of visual scans before issuing a take-off clearance to AC-DEP. [2.3.2.2(1)]

(13) In this series of visual scans, the controller did not scan the eastern half of the runway and did not see AC-CROSS crossing the runway via TWY J11. If the controller had also scanned the eastern half of the runway, there was a high probability that the controller would have noticed AC-CROSS entering RWY07R via TWY J11. [2.3.2.3.1(3)&(8)] [2.3.3(2)]

(14) The controller scanned the A-SMGCS display but did not notice AC-CROSS entering RWY07R from TWY J11. It is probable that the controller did not notice AC-CROSS on the A-SMGCS because of the scanning technique at the time. [2.3.2.3.2]

(15) The controller did not scan the EFS display board before issuing a departure clearance to AC-DEP. The controller would have noticed the planned crossing of AC-CROSS from the EFS arrangement had scanning of the EFS display board been included as a routine action prior to giving a take-off clearance. [2.3.2.3.3]

(16) The controller did not follow the SOP on usage of a 'Runway Blocked' strip during the runway crossing of AC-CROSS. It was evident that the SOP was still not followed by individual controllers. [2.3.4]

(17) The controller had a momentary lapse of situational awareness as a result of distraction. The distraction was attributable to actions taken by the controller in relation to AC-MED. [2.3.6(9)]

(18) The controller's inadequate scanning and no usage of a 'Runway Blocked' strip were contributing factors in the occurrence. [2.3.6(10)]

(19) While AC-CROSS was still crossing RWY07R, the controller gave take-off clearance to AC-DEP and AC-DEP commenced the take-off roll as instructed by ATC resulting in a serious incident. [1.1(13)] [2.3.6(8)]

(20) Upon hearing ATC giving take-off clearance to AC-DEP, AC-CROSS reported on Tower South frequency that the aircraft was still crossing the runway. The flight crew of AC-DEP saw and heard AC-CROSS. AC-DEP immediately aborted the take-off. The controller also instructed AC-DEP to stop immediately. [1.1(13)] [1.18.1] [2.3.2.2(3)]

(21) The responding actions of the respective flight crew of AC-DEP and AC-CROSS were appropriate. [2.3.3(3)]

(22) Despite the occurrence, the controller responded to the developing situation in an appropriate manner and immediate recovery actions taken were appropriate. [2.3.3(3)]

(23) AC-DEP stopped abeam TWY J2. The closest distance between AC-DEP and AC-CROSS was more than 3,000 metres. There was no risk of collision. [1.1(13)] [2.5]

3.2. Causes

(1) A take-off clearance was issued to the A333 (AC-DEP) when the B748F (AC-CROSS) was still crossing the runway. The A333 commenced the take-off roll as instructed resulting in a serious incident. [3.1.19]

(2) The inappropriate instruction was the result of a momentary lapse of situational awareness caused by distraction. [3.1.17]

3.3. Contributing Factors

(1) An inadequate scanning prior to issuing a take-off clearance to the A333. [3.1.18]

(2) No usage of a ‘Runway Blocked’ strip during the runway crossing of the B748F. [3.1.18]

4. SAFETY ACTIONS ALREADY IMPLEMENTED

Whether or not the AAIA identifies safety issues in the course of an investigation, relevant organizations may proactively initiate safety action in order to reduce their safety risk.

The AAIA has been advised by CAD of the following proactive safety actions that had been immediately taken after the occurrence with the aim of enhancing runway operational safety:

(1) A new radiotelephony requirement was mandated for Air Movements South Controller to pass traffic information to a departure aircraft that had been given permission to line-up and awaiting a take-off clearance when another aircraft would be taxiing across the same runway. The purpose was to raise the situational awareness of flight crew involved.

(2) An internal instruction addressed to all operational staff of the Aerodrome discipline was issued. The instruction consolidated and updated operational procedure changes related to runway crossing operations in the eight months prior to this occurrence.

5. SAFETY RECOMMENDATIONS

5.1. Safety Recommendation 05-2022

It is recommended that the Air Navigation Service Provider should evaluate the adequacy and effectiveness of initial training for air traffic controllers on scan and/or scanning techniques, and consider the necessity for controllers to undergo recurrent scan training. [2.4(2)(a)&(b)]

Safety Recommendation Owner: Hong Kong Civil Aviation Department

5.2. Safety Recommendation 06-2022

It is recommended that the Air Navigation Service Provider should review the implementation of the 'Runway Blocked' strip procedure and put in place necessary measures to ensure compliance with the procedure. In this connection it is also recommended that the Air Navigation Service Provider should consider adopting similar measures to ensure compliance with any newly introduced standard operating procedures. [2.3.4(5)] [2.4(2)(c)]

Safety Recommendation Owner: Hong Kong Civil Aviation Department

5.3. Safety Recommendation 07-2022

It is recommended that the Air Navigation Service Provider should review the temporary deactivation of the take-off / landing button function of the Tower Electronic Flight Strip System, and explore other enhancement measures to support the function. [2.3.5(5)]

Safety Recommendation Owner: Hong Kong Civil Aviation Department

5.4. Safety Recommendation 08-2022

It is recommended that the Air Navigation Service Provider should regularly review the function and/or status of all operational audible alarms, and draw the attention of operational personnel to the results of such periodic reviews. [2.3.1.3(5)]

Safety Recommendation Owner: Hong Kong Civil Aviation Department

6. GENERAL DETAILS

6.1. Occurrence Details

Date and time:	23 December 2017, 2107 hours (local time)	
Occurrence category:	Serious Incident	
Primary occurrence type:	Aborted take-off on an engaged runway	
Location:	Runway 07R, Hong Kong International Airport, Hong Kong	
	Latitude: 22°17’47”N	Longitude: 113°53’56”E

6.2. Pilot and ATC Personnel Information

6.2.1. CRK709 (AC-DEP)

6.2.1.1. Pilot in Command

Licence:	Hong Kong ATPL(A)
Aircraft ratings:	Airbus A330
Medical certificate:	Class 1 issued on 29 August 2017
Flying Experience:	
Total all types:	14 178 hours
Total on type (A330) :	3 567 hours

:

6.2.1.2. First Officer

Licence:	Hong Kong ATPL(A)
Aircraft ratings:	Airbus A330
Medical certificate:	Class 1 issued on 21 January 2017
Flying Experience:	
Total all types:	6 577 hours
Total on type (A330) :	3 760 hours

6.2.2. CPA071 (AC-CROSS)

6.2.2.1. Pilot in Command

Licence:	Hong Kong ATPL(A)
Aircraft ratings:	B747-400
Medical certificate:	Class 1 issued on 17 March 2017
Flying Experience:	
Total all types:	13 059 hours
Total on type (B747-400) :	7 998 hours

6.2.2.2. First Officer

Licence:	Hong Kong ATPL(A)
Aircraft ratings:	B747-400
Medical certificate:	Class 1 issued on 24 May 2017
Flying Experience:	
Total all types:	10 269 hours
Total on type (B747-400) :	6 326 hours

6.2.3. ATC Personnel (the controller)

Licence:	Hong Kong Air Traffic Controller Licence
Ratings:	Aerodrome Control
Date of first issue of rating:	22 June 2015
Medical certificate:	Class 3 issued on 11 March 2016
Instructor certificate:	Aerodrome Control issued on 4 October 2017

6.3. Aircraft Details

6.3.1. CRK709 (AC-DEP)

Manufacturer and model:	Airbus A330-343
Registration:	Hong Kong, China, B-LNU
Aircraft Serial number:	1124
Flight Number	CRK709
Year of Manufacture	2010
Engine	Two Rolls-Royce Trent 772B-60 turbo-fan engines
Operator:	Hong Kong Airlines
Type of Operation:	Commercial Air Transport (Passenger and Cargo)
Certificate of Airworthiness	Issued on 24 August 2017 and valid till 4 September 2018, Transport Category (Passenger)
Departure:	Hong Kong International Airport, Hong Kong
Destination:	Denpasar International Airport, Bali

6.3.2. CPA071 (AC-CROSS)

Manufacturer and model:	Boeing 747-867F
Registration:	Hong Kong, China, B-LJK
Aircraft Serial number:	43394
Flight Number	CPA071
Year of Manufacture	2013
Engine	Four General Electric Genx 2B67/P turbo-fan engines
Operator:	Cathay Pacific Airways
Type of Operation:	Commercial Air Transport (Cargo)
Certificate of Airworthiness	Issued on 6 December 2017, Transport Category (Cargo), valid until 17 December 2018.
Departure:	Ted Stevens Anchorage International Airport, Alaska
Destination:	Hong Kong International Airport, Hong Kong

6.4. Destination Aerodrome Information

Aerodrome Code	VHHH
Airport Name	Hong Kong International Airport
Airport Address	Chek Lap Kok, Lantau Island
Airport Authority	Airport Authority Hong Kong
Air Navigation Services	Approach Control, Aerodrome Control, Ground Movement Control, Zone Control, Flight Information Service, Clearance Delivery Control, Automatic Terminal Information Service
Type of Traffic Permitted	IFR (Instrument Flight Rules) / VFR (Visual Flight Rules)
Coordinates	22° 18’ 32” N, 113° 54’ 53” E
Elevation	28 feet
Runway Length	3,800 metres
Runway Width	60 metres
Stopway	Nil
Runway End Safety Area	240 metres x 150 metres
Azimuth	07L / 25R, 07R / 25L
Category for Rescue and Fire Fighting Services	CAT 10

7. ABBREVIATIONS

A333	Airbus A330-343
AAIA	Air Accident Investigation Authority
AIPHK	Aeronautical Information Publication Hong Kong
AMN	Air Movements North Controller
AMS	Air Movements South Controller
AOC	Air Operator's Certificate
A-SMGCS	Advanced Surface Movement Guidance and Control System
ASU	Aerodrome Supervisor
ATC	Air Traffic Control
B748F	Boeing 747-867F
ºC	Degree Celsius
Cap. 448B	Hong Kong Civil Aviation (Investigation of Accidents) Regulations
CAD	Hong Kong Civil Aviation Department
CPA	Cathay Pacific Airways
CRK	Hong Kong Airlines
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
DRS	Digital Recording System
EAPPRI	European Action Plan for the Prevention of Runway Incursions
EFS	Electronic Flight Strip
FO	First Officer
GMM	Ground Movements Midfield Controller
GMN	Ground Movements North Controller
GMS	Ground Movements South Controller
H24	24 hours
ICAO	International Civil Aviation Organization
MATC	Manual of Air Traffic Control
MHz	Mega Hertz
NM	Nautical Miles
PIC	Pilot-in-command

RCF	Radio Communication Failure
RWY	Runway
SMR	Surface Movement Radar
SOP	Standard Operating Procedures
TEFS	Tower Electronic Flight Strip System
TRAM	Tactical Runway Allocation Mode
TWY	Taxiway
UTC	Coordinated Universal Time
VHF	Very High Frequency
VHHH	Hong Kong International Airport

8. TABLE OF FIGURES AND TABLES

9. APPENDICES

9.1. Aerodrome Layout

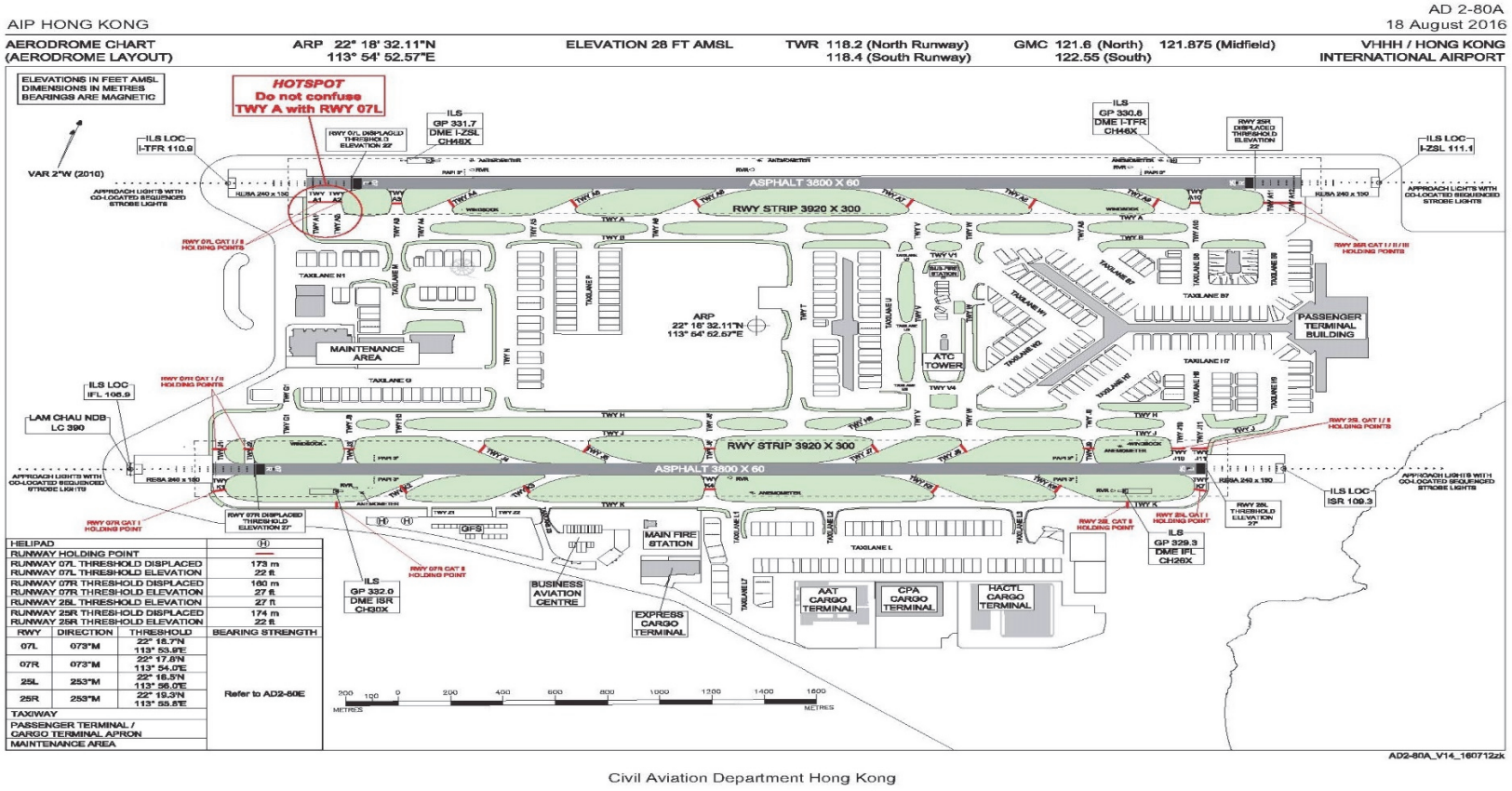

Figure 6 : Hong Kong International Airport Aerodrome Layout (current at the time of occurrence)

9.2. Records of A-SMGCS display

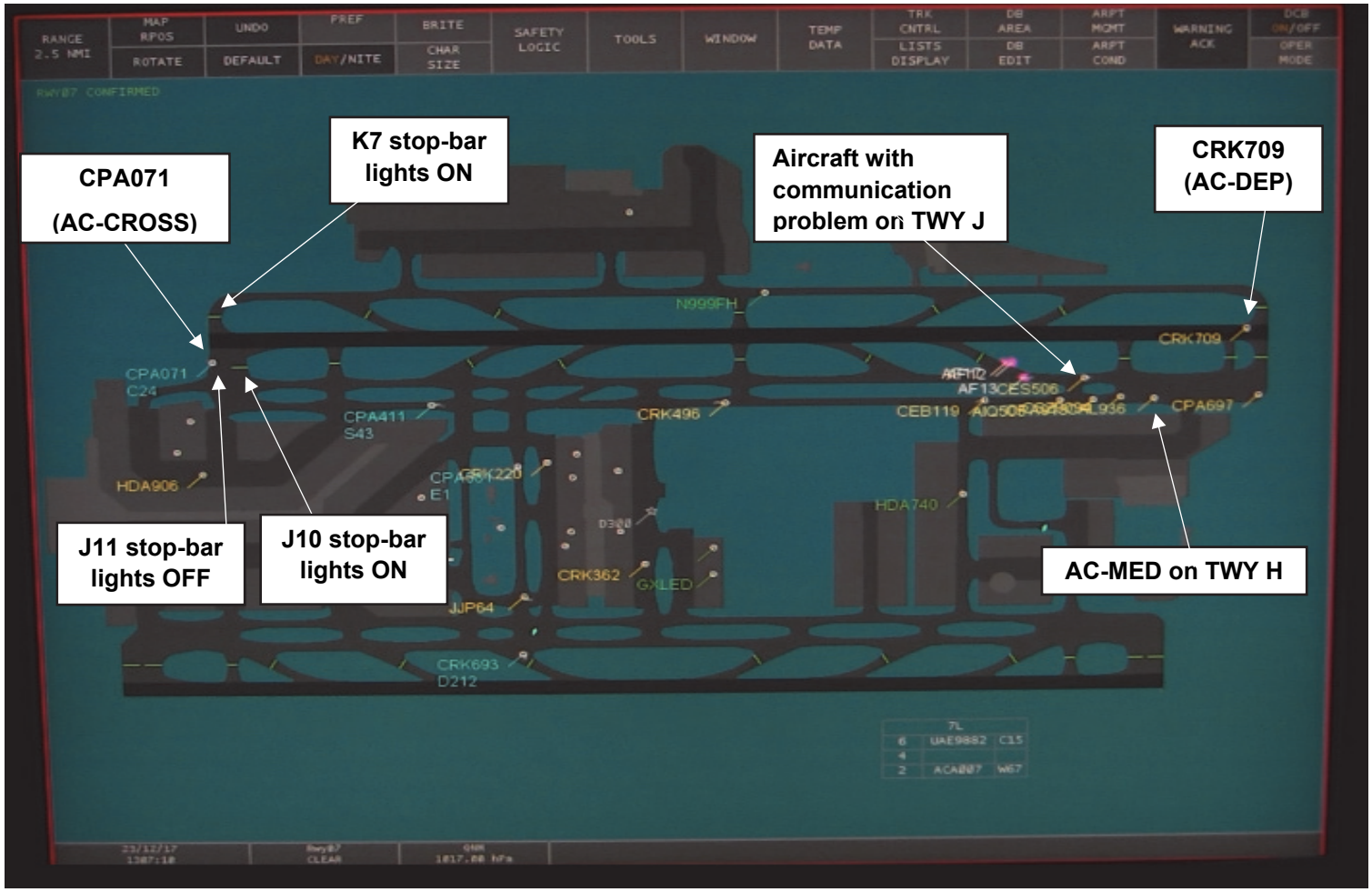

Figure 7 : AC-DEP (CRK709) on Runway 07R acknowledged take-off clearance at 21:07:10 Local Time. AC-CROSS (CPA071) had taxied past J11 holding point and J11 stop-bar lights had been switched off.

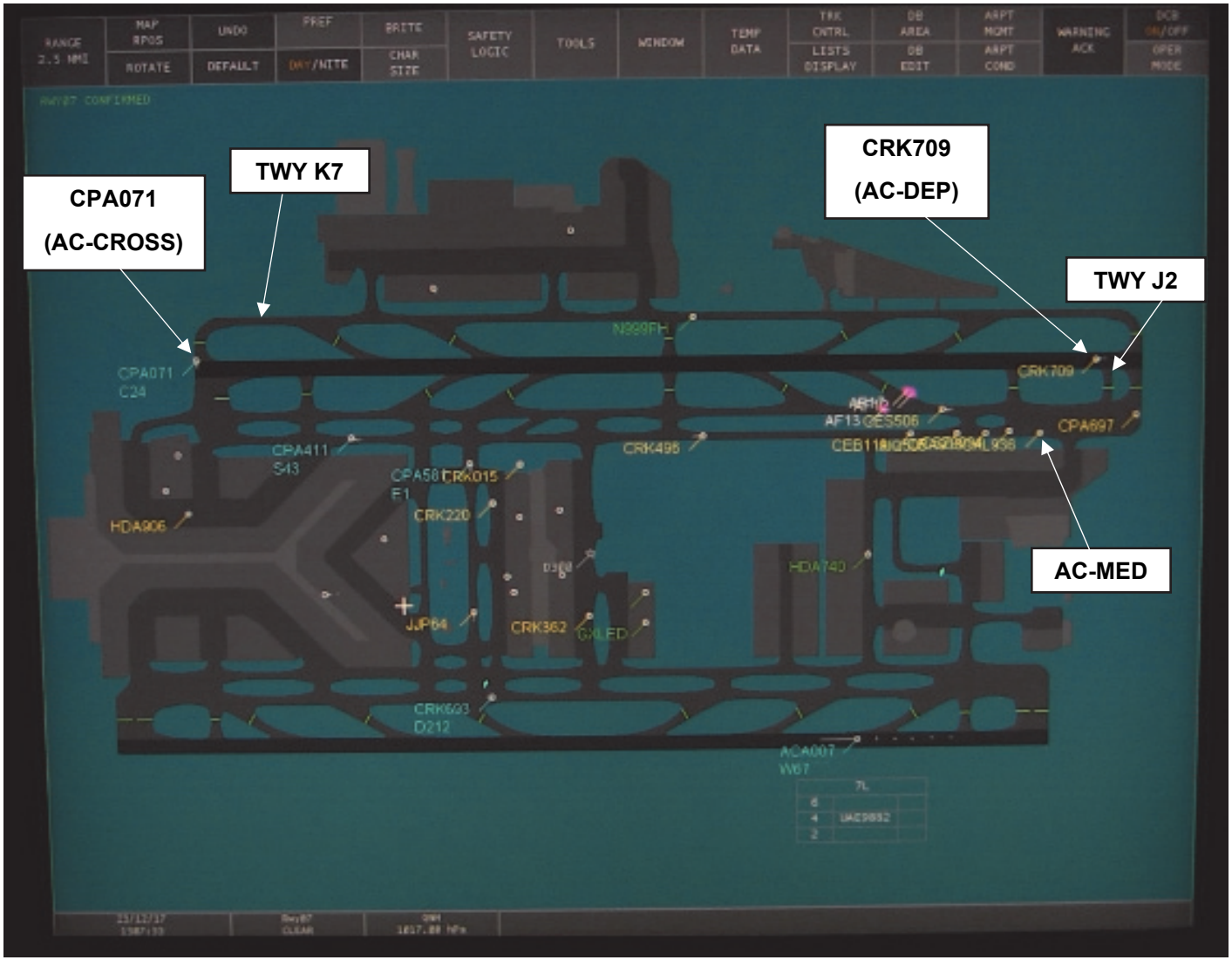

Figure 8 : AC-DEP (CRK709) reported stopping abeam TWY J2 at 21:07:33 Local Time. AC-CROSS (CPA071) was about to enter TWY K7.

9.3. Communications Transcript of CRK709 / CPA071 and HK Tower South

(Note: UTC+8 = Local Time e.g. 13:05:04 UTC = 21:05:04 Local Time)

(HK TOWER SOUTH = the controller, CRK709 = AC-DEP, CPA071 = AC-CROSS)

TIME (UTC)	STATION	R/T COMMUNICATION
13:05:04	HK TOWER SOUTH	BAUHINIA SEVEN ZERO NINE BEHIND DEPARTING CHINA CORRECTION AIR CHINA LINE UP AND WAIT RUNWAY ZERO SEVEN RIGHT BEHIND
13:05:10	CRK709	BEHIND DEPARTING AIR CHINA RUNWAY ZERO SEVEN RIGHT LINE UP BEHIND BAUHINIA NINE ZERO BAUHINIA SEVEN ZERO NINE
13:05:19	CPA071	CATHAY ZERO SEVEN ONE APPROACHING HOLDING POINT AT JULIETT ELEVEN
13:05:24	HK TOWER SOUTH	CATHAY ZERO SEVEN ONE HOLD AT JULIETT ONE ONE HOLDING POINT
13:05:28	CPA071	HOLD AT JULIETT ONE ONE CATHAY ZERO SEVEN ONE
13:06:30	HK TOWER SOUTH	CATHAY ZERO SEVEN ONE JULIETT ONE ONE CROSS RUNWAY ZERO SEVEN RIGHT
13:06:34	CPA071	CLEARED TO CROSS SEVEN RIGHT AT JULIETT ONE ONE CATHAY ZERO SEVEN ONE
13:07:01	HK TOWER SOUTH	BAUHINIA SEVEN ZERO NINE WIND VARIABLE FIVE KNOTS RUNWAY ZERO SEVEN RIGHT CLEARED FOR TAKE OFF
13:07:06	CRK709	RUNWAY ZERO SEVEN RIGHT CLEARED FOR TAKE OFF BAUHINIA SEVEN ZERO NINE
13:07:10	CPA071	CATHAY ZERO SEVEN ONE IS CLEARED RUNWAY IS CLEARED CROSSING RUNWAY I SAY AGAIN CATHAY ZERO SEVEN ONE IS CLEARED THE RUNWAY
		WE ARE NOT CLEARED OF THE RUNWAY WE ARE ON THE RUNWAY CATHAY ZERO SEVEN ONE IS ON THE RUNWAY CROSSING

TIME (UTC)	STATION	R/T COMMUNICATION
13:07:25	HK TOWER SOUTH	BAUHINIA SEVEN ZERO NINE STOP IMMEDIATELY
13:07:27	CRK709	WE ARE STOPPING ABEAM JULIETT TWO STOPPING BAUHINIA NINE ZERO SEVEN ZERO NINE
13:07:51	HK TOWER SOUTH	CATHAY ZERO SEVEN ONE CONTACT GROUND ONE TWO TWO DECIMAL FIVE FIVE
13:07:53	CPA071	ONE TWO TWO FIVE FIVE CATHAY ZERO SEVEN ONE
13:08:04	HK TOWER SOUTH	BAUHINIA SEVEN ZERO NINE ARE YOU STILL ABLE TO DEPART
13:08:07	CRK709	BAUHINIA SEVEN ZERO NINE WE ACTUALLY PASSED JULIETT TWO NOW WE DO HAVE WE CAN CALCULATE SPEED FOR JULIETT TWO ANY CHANCE OF GOING JULIETT THREE FOR JULIETT TWO AGAIN FOR DEPART
13:08:16	HK TOWER SOUTH	BAUHINIA SEVEN ZERO NINE APPROVED AND VACATE JULIETT THREE AND TURN LEFT ON JULIETT
13:08:20	CRK709	VACATE JULIETT THREE BAUHINIA SEVEN ZERO NINE WILCO THANK YOU
13:10:01	HK TOWER SOUTH	BAUHINIA SEVEN ZERO NINE TAXI TO JULIETT TWO HOLDING POINT
13:10:04	CRK709	JULIETT TWO HOLDING POINT BAUHINIA SEVEN ZERO NINE THANK YOU

END

9.4. A-SMGCS Special Beacon Codes

3.5.5 Detailed Label Window

You can open a Detailed Label window to get a listing of information on a target. The Detailed Label window displays all of the data block fields in a list format. When you select a target for detailed label information, a blue circle appears around the target. You can use the following method to get detailed label information on a track.

- On the DCB, left-click on TRK CNTRL
- On the Track Control menu, left-click on DETAILED VIEW ON
- Slew the cursor and left-click on the selected track
- To turn off the Detailed Label window, left-click on DETAILED VIEW OFF

3.5.6 Special Beacon Codes

Special beacon codes are set in the system adaptation and examples are as follow:

- 7500 - Hijack
- 7600 - Communications Failure
- 7700 - Emergency

When a target exhibits any of the adapted warning code, the following events occur:

- Line 1 of the target data block flashes on and off with text related to the special beacon code,
- An alarm sounds, repeating with each blink of line 1 on the data block

You can silence the audible alarm by the following procedure:

- On the DCB main menu, left-click on the TRACK CNTRL button
- On the Track Control menu, left-click on the WARNING CODE ACK button
- Slew to the track displaying the special beacon and left-click.

The alarm stops sounding. Line 1 on the target data block continues to flash on and off.

3.5.7 Arrival, Departure, and Local Lists

The system provides an Arrival List, Departure List, and Local List. Each of these lists can be toggled on or off. Listings in the Arrival List and Departure List come from flight plan data or are entered by an operator. Listings in the Local List are all operator entered.

3.6 Performing Safety Logic Functions

Safety Logic helps prevent potential collisions and problems on the airport surface. Based on target surveillance and prediction data, the system continually monitors single tracks on or approaching closed runways, tracks that are too close together, and tracks predicted to be too close together. When the system detects tracks that are too close into any of these conditions, it generates visual and audible alerts to notify controllers of the situation.