INCIDENT

Aircraft Type and Registration:	i) DHC-6 Twin Otter Series 310, G-BVVK ii) Embraer EMB-145EU, G-EMBV
No & Type of Engines:	i) 2 Pratt & Whitney PT6A-27 turboprop engines ii) 2 Allison AE 3007/A1/1 turbofan engines
Year of Manufacture:	i) 1980 ii) 2001
Date & Time (UTC):	29 August 2006 at 0932 hrs
Location:	Glasgow Airport
Type of Flight:	i) Commercial Air Transport (Passenger) ii) Commercial Air Transport (Passenger)
Persons on Board:	i) Crew - 2 Passengers - 16 ii) Crew - 4 Passengers - 25
Injuries:	i) Crew - None Passengers - None ii) Crew - None Passengers - None
Nature of Damage:	i) None ii) None
Commander's Licence:	i) Air Transport Pilot's Licence ii) Air Transport Pilot's Licence
Commander's Age:	i) 45 years ii) 36 years
Commander's Flying Experience:	i) 5,796 hours (of which 2,130 were on type) Last 90 days - 146 hours Last 28 days - 55 hours ii) 4,200 hours (of which 3,300 were on type) Last 90 days - 210 hours Last 28 days - 70 hours
Information Source:	AAIB Field Investigation

Synopsis

A DHC6 Twin Otter aircraft was stationary at the Y1 holding point (see Figure 1), at Glasgow Airport. Its flight crew had correctly acknowledged a clearance from ATC to cross Runway 23, which was the active runway, after the landing Embraer 145. The DHC-6 crew having discussed some training issues, thought that the Embraer 145 had landed and began to taxi towards Y2. As they were about to cross Runway 23 the commander saw the Embraer 145 about to touch down and reversed the aircraft back towards Y1.

The RIMCAS (Runway Incursion Monitoring and

Confliction Alerting Sub-system) which was in use at the time of the incident did not provide an alert due to the operating mode selected.

History of the flight

The DHC-6 crew had reported for duty at 0810 hrs following a 14 hour rest period. They were scheduled for a six-sector 10-hour duty day and had completed the first and second sectors at the time of the incident.

The aircraft departed Campbeltown Airport for the return sector to Glasgow. The transit from Campbeltown was at FL050 in IMC with the co-pilot as the pilot flying (PF).

The weather at Glasgow was good with the 0920 hrs METAR giving a surface wind of 290°/09 kt, visibility in excess of 10 km, lowest cloud scattered at 2,200 ft, temperature +15°C, dew point +10°C and the QNH was 1005 hPa. The flight crew carried out a descent and when

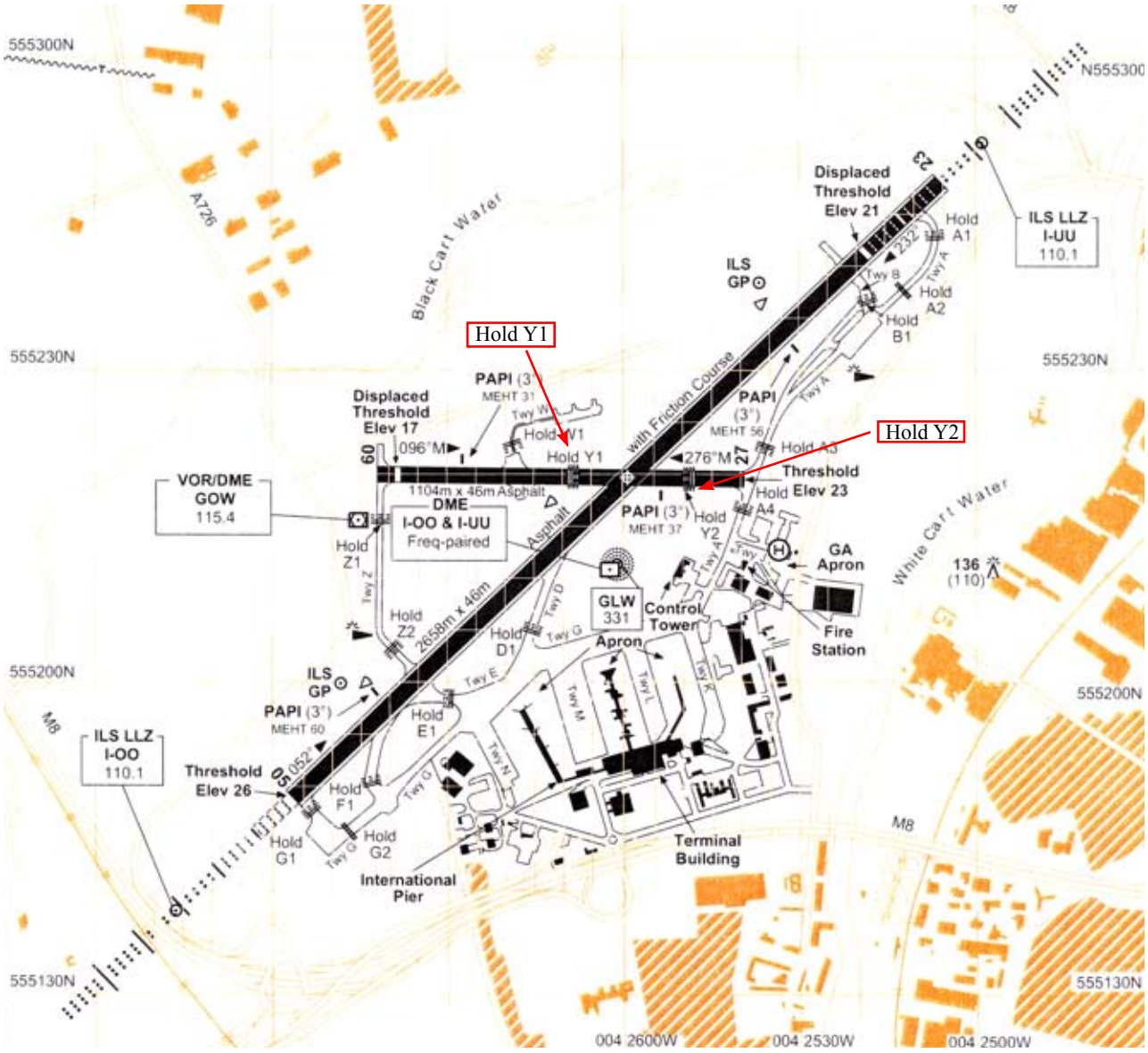


Figure 1

Glasgow International Airport

in good VMC, requested a visual approach to Runway 27. This was the normal practice in order to provide the most expeditious routing. When this was approved by ATC the crew positioned for a left base join to Runway 27. Having received the appropriate clearance a normal landing was made. The aircraft touched down to the east of the intersection with Runway 23 with the landing roll taking it west of the Y1 holding point. ATC cleared the aircraft to "BACKTRACK RUNWAY TWO SEVEN AND HOLD AT YANKEE ONE". The commander took control and taxied the aircraft, stopping at Y1. He did not apply the parking brake but held the aircraft stationary using the toe brakes.

The ATC clearance for the DHC-6 was "AFTER THE LANDING EMBRAER, YOU CAN CROSS RUNWAY TWO THREE YANKEE ONE TO YANKEE TWO", which was correctly read back by the co-pilot. Whilst waiting for the Embraer to land, the commander, who was a training captain, took the opportunity to explain some training points to the co-pilot. These required illustrating on a piece of paper which meant both pilots were looking inside the flight deck. Having completed the discussion, the commander thought that they had been stationary for some time. He could not see the Embraer and decided that it had probably passed him. In order not to delay operations he cautiously moved forward to cross Runway 23. As he approached the edge of the runway, he saw the Embraer 145 to his left, about to touch down. He immediately selected the power levers into the 'Beta' range and reversed the aircraft back towards the Y1 holding point.

The landing Embraer flight crew saw the DHC-6 just before touch-down but thought the aircraft was stationary. They did not identify it as a hazard and carried out a normal landing.

RIMCAS operation

At the time of the incident the DHC-6 was on the Tower frequency under the control of the Aerodrome controller. The controller had available a monitor which displayed the Surface Movement Radar (SMR). Overlaid on the SMR picture was the RIMCAS defined area which covered the surface area of Runway 05/23. Within the defined area, the movement of any aircraft or vehicles that might conflict or collide would activate an alert.

The controller was able to select either Runway 05/23 or 09/27, or both runways as the runway(s) in use. The dimensions of the defined area then varied depending on the operating mode selected. There are three RIMCAS modes available; 'Visual', 'Low Visibility Procedures' (LVP) and 'Cross Runway' operations.

With Visual mode selected for Runway 05/23, only the runway surface area is monitored as shown in Figure 2. When LVP mode for Runway 05/23 is selected the additional areas of the holding points to the runway edge as well as the runway(s) surface is monitored as shown in Figure 3. When both Runways 05/23 and 09/27 are in use, the Cross Runway operations mode should be selected. With Runway 05/23 and Cross Runway mode selected, an additional defined area covers the 09/27 runway surface between the Y1 and Y2 holding points as well as the Runway 05/23 surface area. This area is shown in Figure 4.

When a runway incursion or a potential conflict is registered by RIMCAS, a visual and audible alert is given in the Visual Control Room.

The use of SMR and RIMCAS is only required during Low Visibility Procedures (LVPs). When Visual control operations are being carried out, RIMCAS is used as additional information only.

At the time of the incident visual operations were in progress and only Runway 05/23 was in use with the Visual mode selected on the RIMCAS. After the DHC-6 had landed, Runway 09/27 was being used as a taxiway and not as a runway so no Cross Runway mode was required. Without the Cross Runway mode selected, no alert was activated when the DHC-6 crossed the Y1 holding point towards the runway. The defined area covered by the Cross Runway operations mode, which would have created an alert when the DHC-6 crossed Y1 is shown at Figure 3.

The visual controller and ATCO colleagues were not aware that when only Runway 05/23 or 09/27 was in use with Visual mode selected, the areas between the holding points and the runway edge were not defined

Figure 2

Visual mode

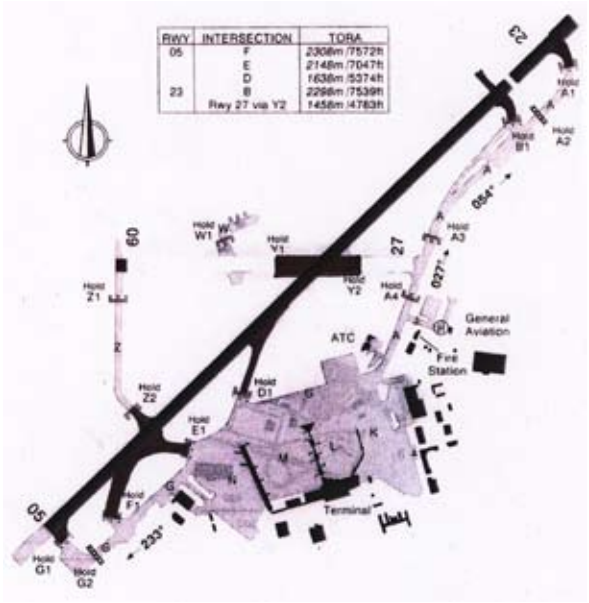
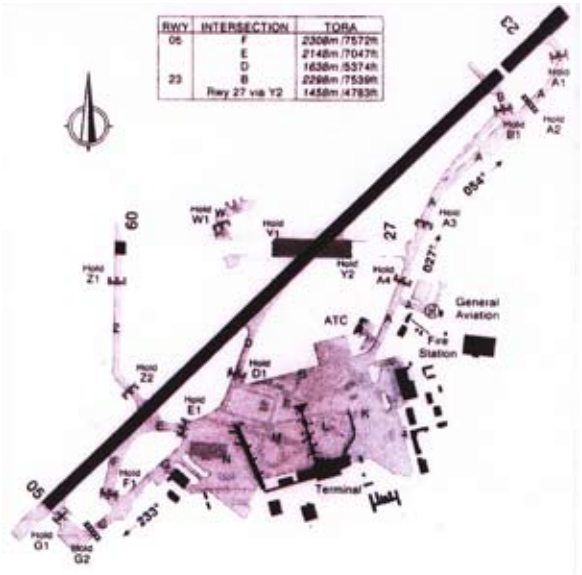


Figure 3

LVP mode



Dark areas indicate monitored surfaces

Figure 4

Cross Runway operations

areas. The actual defined area in the Visual mode is shown at Figure 2 but their perception of the defined area is illustrated at Figure 3.

RIMCAS procurement and training

During the procurement process, National Air Traffic Services (NATS) identified the RIMCAS defined areas to be covered by the selectable modes. These areas were in keeping with those normally supplied by the manufacturer and so the defined areas required by the client were those delivered by the manufacturer.

When the SMR and RIMCAS systems were installed, all Glasgow Airport ATCO's received training prior to its use. The initial training was provided by the manufacturer for six controllers who then cascaded the training down to their remaining colleagues.

During the introduction of RIMCAS at Glasgow Airport, the controllers had noted a significant number of spurious alerts. These were due partly to taxiways falling within the defined areas when certain runway/mode combinations were selected, and also partly to the ATCOs lacking familiarity with the system. This was especially the case when both Runways 05/23 and 09/27 were selected in the Visual mode or during LVP mode selection. Even when aircraft were moving in accordance with a safe clearance, aircraft taxiing on the different runways or on some taxiways which cross the runway thresholds initiated alerts. The main concern was that frequent spurious alerts may dilute the value of an alert when a real incursion or conflict was detected.

In order to minimise the number of spurious alerts, the use of the Cross Runway mode was initiated only whilst aircraft were operating from both Runway 09/27 and Runway 05/23. This mode was to be de-selected once an aircraft had landed or departed; this was the situation at the time of the incident.

Analysis

DHC-6

The runway incursion by the DHC-6 was caused by its flight crew diverting their attention from monitoring outside activity to discussing training matters. When the commander looked up he had a false sense of the length of time they had been at the Y1 holding point. Not wishing to delay airport operations he believed that the Embraer 145 must have landed and passed the runway intersection whilst he was debriefing. Consequently, the DHC-6 commander believed that he was following his ATC clearance to cross the active runway after the landing Embraer. His cautious move forward and his continued 'look out' meant that he was able to see the landing aircraft as it was about to touch down and he was able to stop his aircraft before it entered Runway 23. The capability of the DHC-6 to reverse allowed the commander to move away from Runway 23 and back towards holding point Y1.

Air Traffic Control

The Aerodrome controller was controlling traffic and issuing clearances by monitoring visually the activity on the airfield as required. RIMCAS was adjacent to the controlling position and selected to Runway 05/23 in the Visual mode. Cross Runway operations was not selected because once the DH-6 had landed, Runway 09/27 was serving as a taxiway.

The controller had seen the DHC-6 stop at the Y1 holding point and remain there stationary. When checking that Runway 23 was clear prior to issuing the landing clearance to the Embraer 145, the DHC-6 was still at the holding point. Although the Y1 holding point is clearly visible from the visual controller's position, the 'cautious' taxi forward probably had insufficient apparent movement to attract attention and because the aircraft did not fully encroach the runway, the runway appeared clear.

In keeping with colleagues, the controller would have expected a RIMCAS alert when the DHC-6 crossed the Y1 holding point. This did not occur because neither Cross Runway nor LVP modes were selected. As has been previously stressed, RIMCAS is only used to assist the controller during visual operations. Clearly, when Runway 05/23 only was selected, the level of protection afforded by RIMCAS in the normal Visual mode was not as comprehensive as that expected by the controllers.

Conclusion

Whilst holding on the north side of the active runway the DHC-6 commander sought to illustrate his training points to the co-pilot. By being 'head down' on the flight deck he became distracted and lost his sense of time and situational awareness regarding the landing Embraer 145. He concluded that if debriefing points needed to be illustrated, this was best conducted once the aircraft was parked and the engines shut down.

Safety action

NATS took immediate action to ensure that controllers had the correct understanding of the capabilities of the RIMCAS. This particularly included the defined areas covered by the various RIMCAS modes which were available. Shortly after the incident, NATS also extended the operational areas of the RIMCAS system to include an area beyond the runway edge towards each holding point. This action has not resulted in an increase in false or spurious alerts.