FINAL REPORT

CONTACT BETWEEN AIRBUS A320 AND AEROBRIDGE

5 OCTOBER 2012

AIB/AAI/CAS.087

Air Accident Investigation Bureau of Singapore
Ministry of Transport
Singapore

22 August 2014

The Air Accident Investigation Bureau of Singapore

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SYNOPSIS

In the evening of 5 October 2012, an Airbus A320 at Singapore Changi Airport was being prepared to be towed out for departure when the flight crew requested the ground staff to amend the flight crew's load document. The passenger loading bridge was re-docked to facilitate this document amendment. During the re-docking process, the passenger loading bridge contacted the fuselage of the aircraft. The ground crew observed scratch marks on the lower left side of the aircraft fuselage. The damage was 1.2 m aft of the front cabin door, in line with the base of the door opening. A closer inspection of the damage revealed a puncture on the aircraft skin.

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

AIRCRAFT DETAILS

Aircraft type	:	Airbus A320
Operator	:	Tiger Airways
Aircraft registration	:	9V-TRG
Date and time of incident	:	5 October 2012, 1913 hours local time
Location of occurrence	:	Singapore Changi Airport, Bay E7
Type of flight	:	Scheduled passenger flight

1 FACTUAL INFORMATION

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

1.1 History of the flight

1.1.1 The incident aircraft had earlier departed from Singapore Changi Airport at 1412 hours on 5 October 2012 on a scheduled passenger flight to Kuching. Owing to bad weather at Kuching, the aircraft returned to Changi Airport and docked at Bay E7 at 1722 hours.

1.1.2 The aircraft was scheduled to depart again for Kuching the same evening at 1900 hours. According to the First Officer (FO), he did a walk-around inspection as part of the pre-departure check and he did not notice any abnormality.

1.1.3 After all the passengers had boarded the aircraft, the passenger loading bridge (PLB)[1] was returned to the parked position. Around this time, the flight crew made a request to the passenger service staff outside the aircraft to have the flight crew's load document amended. The PLB was required to be re-docked so that the flight crew could hand over their load sheet to the passenger service staff for the amendment to be done.

1.1.4 At about 1913 hours, the PLB was re-docked and the load document was amended and returned to the flight crew. During the PLB retraction, the ground operations crew (consisting of the headset man and the tow-tug operator) noticed some scratch marks on the lower left side of the aircraft fuselage. On closer inspection, they noticed a puncture on the aircraft skin.

1.1.5 The tow-tug operator informed the flight crew of the damage. The flight was subsequently cancelled and the passengers and crew were disembarked.

1.2 Injuries to persons

1.2.1 There was no injury to any person in this incident.

1.3 Damage to aircraft

1.3.1 The scratch marks and skin puncture were located at about 1.2 m aft of the front cabin door, in line with the bottom level of the door opening (see the areas marked as A and B in **Figure 1**.

[1] The PLB was operated by the airport ground handling provider.

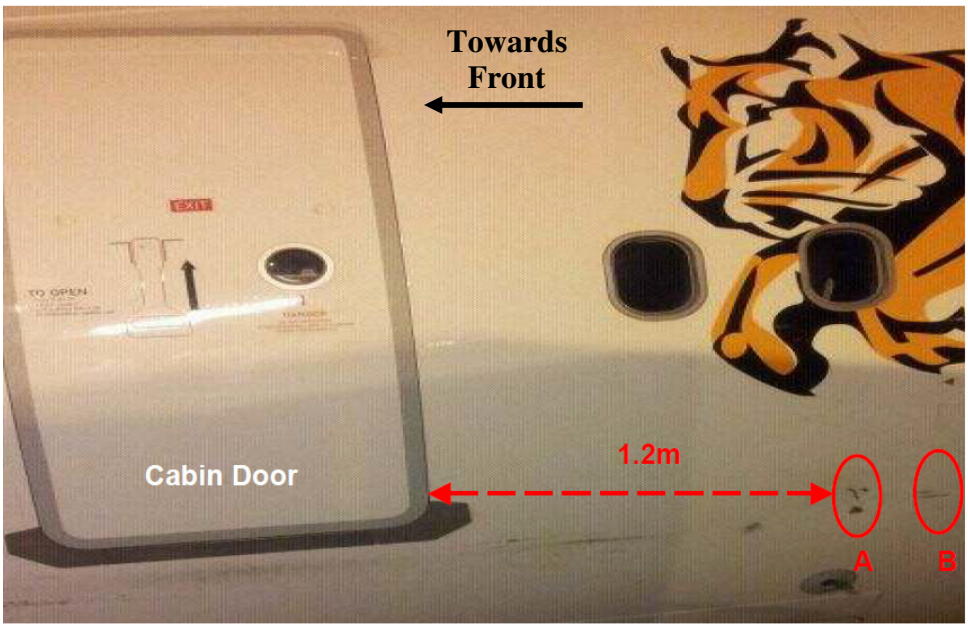

Figure 1: Location of damage on aircraft fuselage

1.3.2 The damage at the area marked A in Figure 2 consists of an 8.8 cm long gouge mark (including the skin puncture) and two scratch patches (see **Figure 2**).

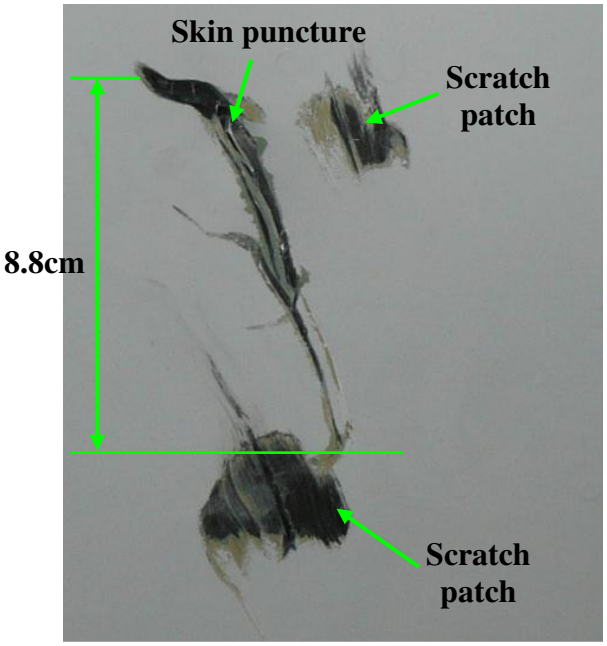

Figure 2: Close-up of damage area A

1.3.3 The damage at the area marked B in Figure 2 consists of two long gouge marks, one measuring 2.2 cm and the other 4.4 cm (see **Figure 3**).

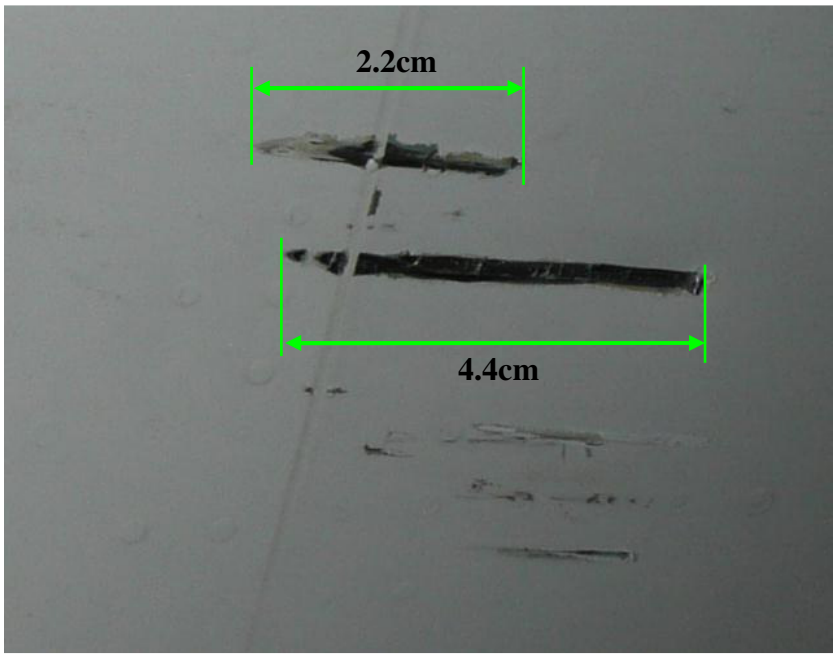

Figure 3: Close-up of damage area B

1.4 **Other damage**

1.4.1 The right side metal plate and padding of the PLB operator cabin (PLB cab) were damaged (see **Figures 4**, **5** and **6**).

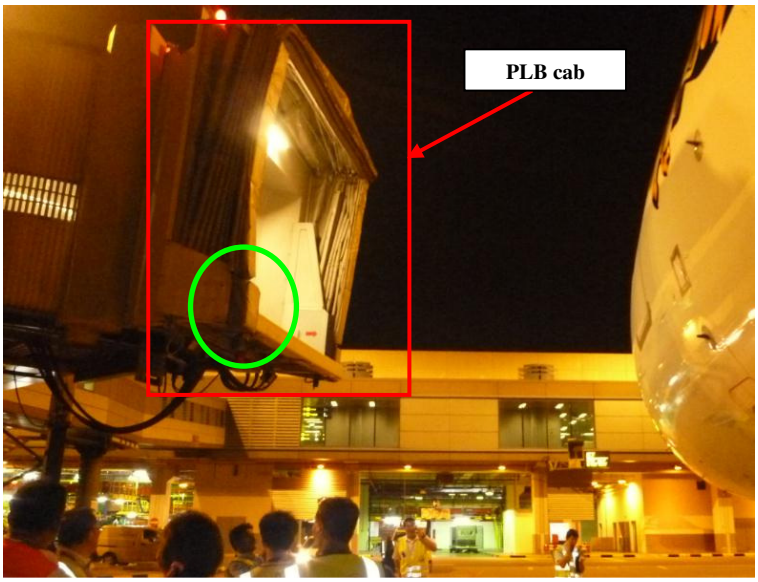

Figure 4: Damage area (green circle) on PLB cab

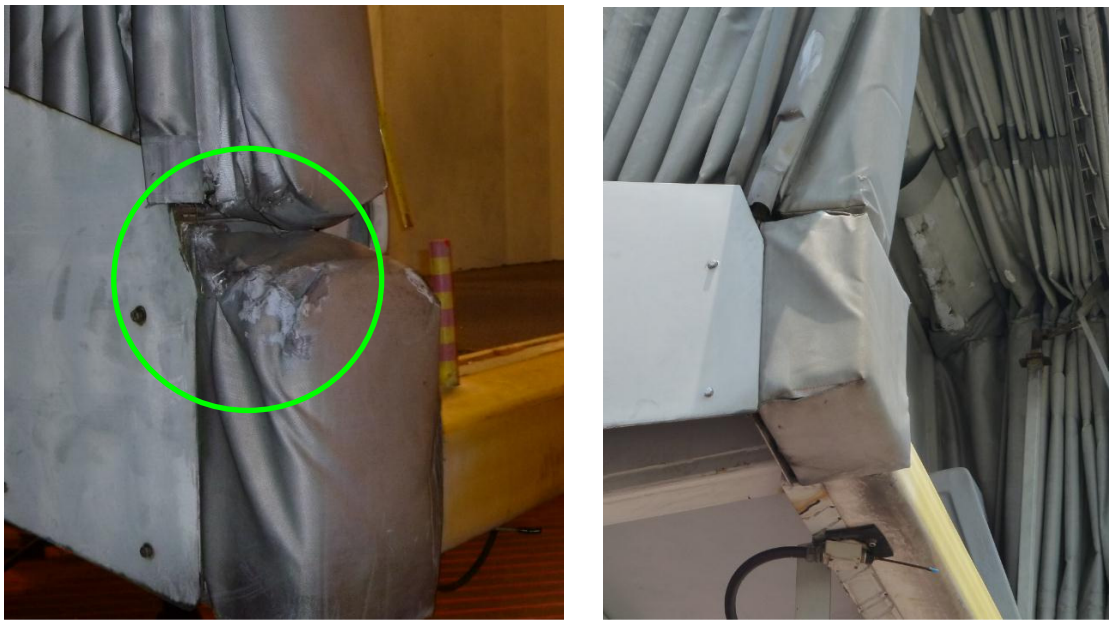

Figure 5: (Left) Damaged padding on incident PLB
(Right) Undamaged padding on normal PLB

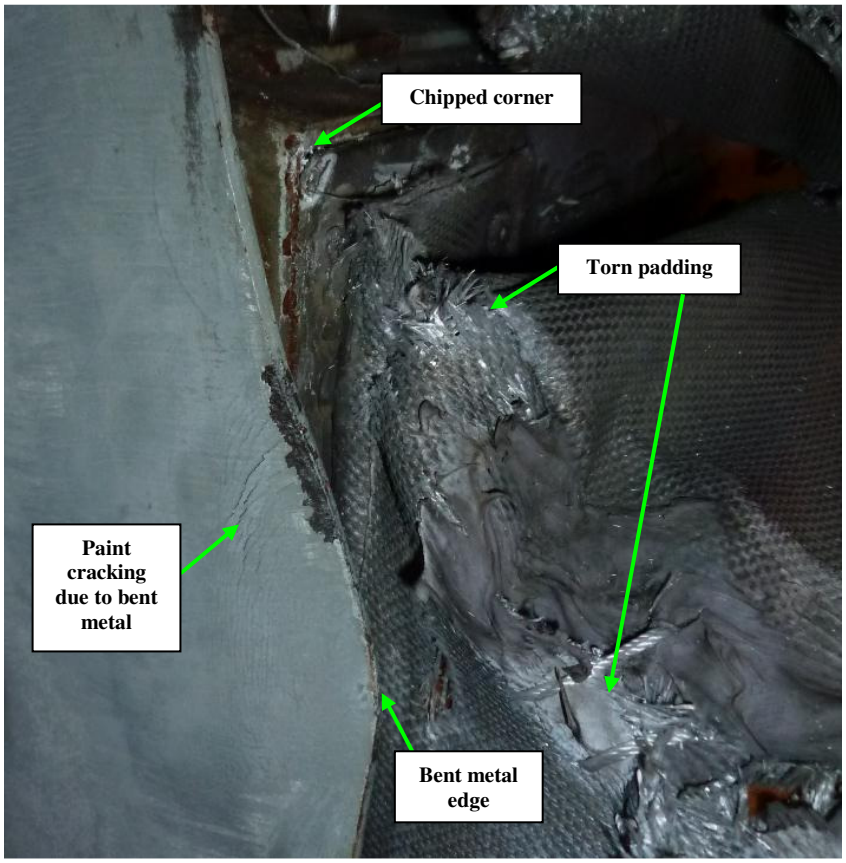

Figure 6: Details of the damaged padding of PLB

1.5 Personnel information

PLB operator	Male
Age	48
PLB Licence issued by Changi Airport Group	Valid till June 2013
Experience operating the PLB	Since 2009

1.6 Flight recorders

1.6.1 The recording of the Cockpit Voice Recorder shows that the flight crew was carrying out pre-flight checks prior to the occurrence. The recording also includes the flight crew discussion about the need to amend the load document, and the flight crew's verbal request to the PLB operator to re-dock the PLB for the document amendment.

1.6.2 The Flight Data Recorder had not started recording.

1.7 CCTV video footage

1.7.1 CCTV video footage of the PLB docking operations during the first receipt, at 1722 hours, of the aircraft at Bay E7 and of the undocking and re-docking during the departing incident flight was obtained from the aerodrome operator. The video footage shows that the PLB cab had contacted and "rocked" the aircraft fuselage several times during that re-docking process.

1.7.2 It is observed that, when the PLB cab was being re-docked, the PLB cab was tilting left and making an angle with the aircraft fuselage (see **Figure 7**).

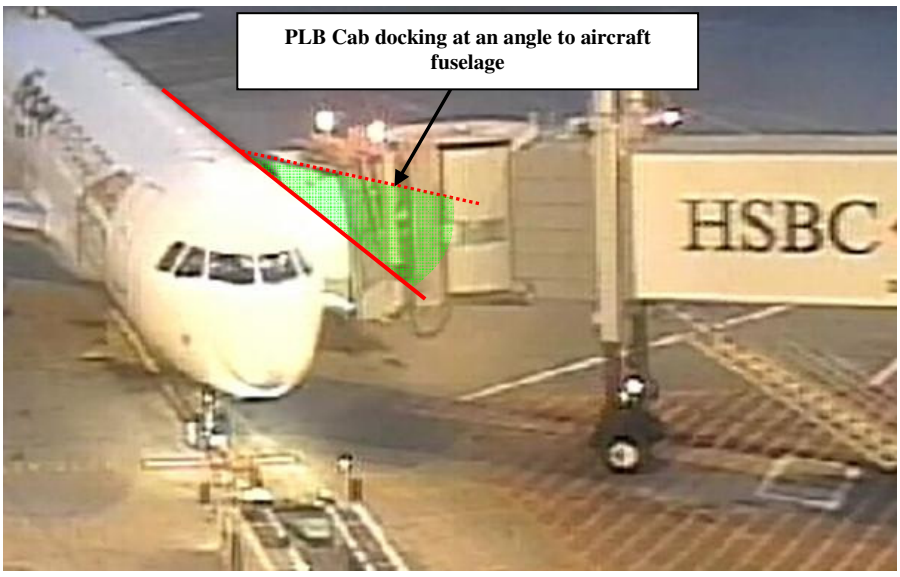

Figure 7: Docking position of PLB at the time of the occurrence

1.7.3 After the occurrence, another PLB operator re-docked the PLB to facilitate the disembarkation of passengers. At this instant, it was observed that the PLB cab was almost parallel to the aircraft fuselage prior to opening of the front cabin door (see **Figure 8**).

Figure 8: Docking position of PLB after occurrence (performed by another operator)

1.7.4 It was also observed that, during the first receipt of the aircraft at 1722 hours, the docking position of the PLB cab was almost parallel to the aircraft fuselage prior to opening of the front cabin door (see **Figure 9**).

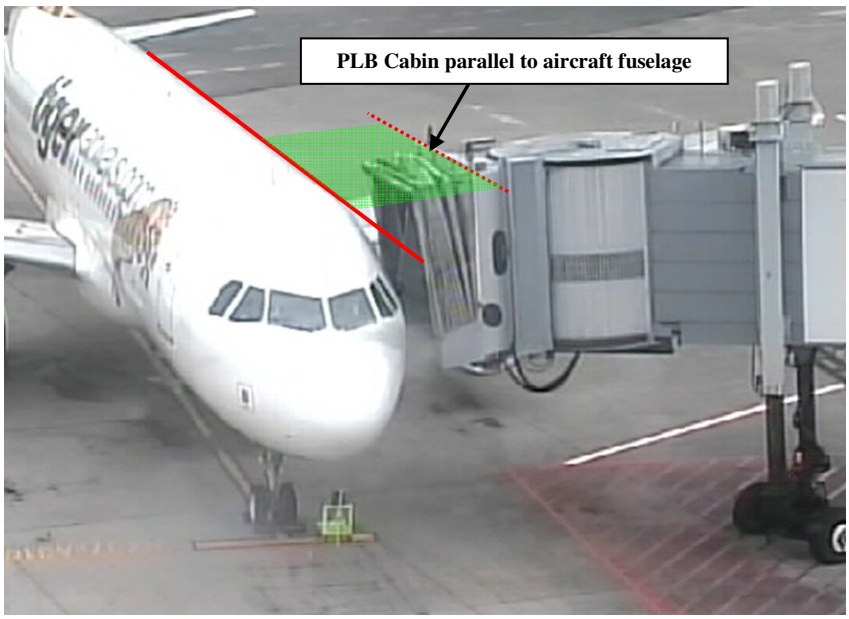

Figure 9: Docking position of PLB on first receipt of aircraft at Bay E7

1.8 Test and research

1.8.1 Simulation exercise with mock-up of aircraft fuselage

1.8.1.1 A simulation exercise was conducted to replicate the PLB docking process during the occurrence. The simulation involved a normal docking and a non-parallel docking with PLB docked at an angle to a mock-up fuselage.

1.8.1.2 For the normal docking, the PLB cab was positioned parallel to the aircraft fuselage, and there was no contact between the PLB cab and the aircraft during the docking operation (see **Figure 10**).

1.8.1.3 For the non-parallel angle docking, the PLB cab was positioned at an angle to the mock-up fuselage (see **Figure 11**). It was observed that the gap between the PLB cab and the mock-up was too wide for safe crossing of passengers. Although the gap produced in the simulation was larger than the gap seen in the incident footage, it should be noted that the simulation serves as a reference to demonstrate what a non-parallel docking would look like and to replicate any unsafe conditions that may exist as a result of a non-parallel docking scenario.

Figure 10: Normal docking position of PLB during simulation

Figure 11: Non-parallel docking position of PLB during simulation

1.8.1.4 It was observed in the non-parallel docking scenario that the PLB cab's right padding was highly compressed against the fuselage, and the PLB's side metal plate came in contact with the fuselage (see **Figure 12**).

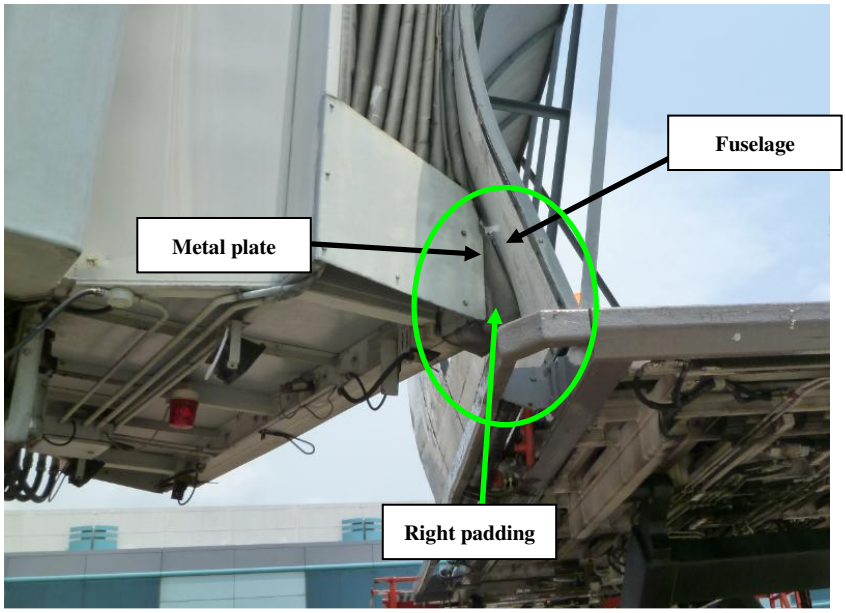

Figure 12: The PLB right padding and metal plate contacted the aircraft fuselage during non-parallel docking simulation

1.8.2 Metallurgical examination of recovered metal debris

1.8.2.1 Several debris fragments were recovered from the damaged right padding on the PLB cab. The locations of the debris are shown in **Figure 13** below.

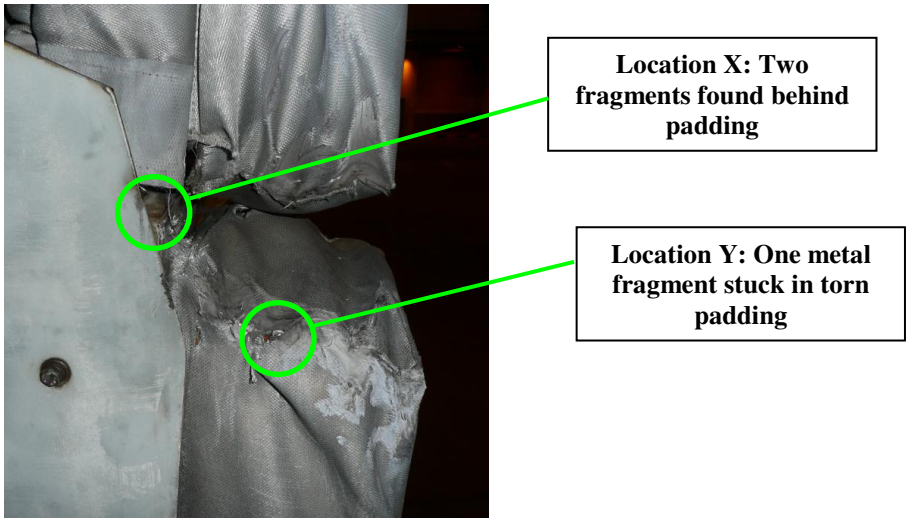

Figure 13: Metal fragments found on PLB cab padding

1.8.2.2 For the purpose of this report, the locations where the two fragments were found are referred to as Location X (behind the padding) and Location Y (the lower padding).

(a) At Location X, one fragment had a silver metallic appearance and the other had a white coated surface.

(b) At Location Y, the larger silver metallic fragment had a green coated surface (see **Figure 14**).

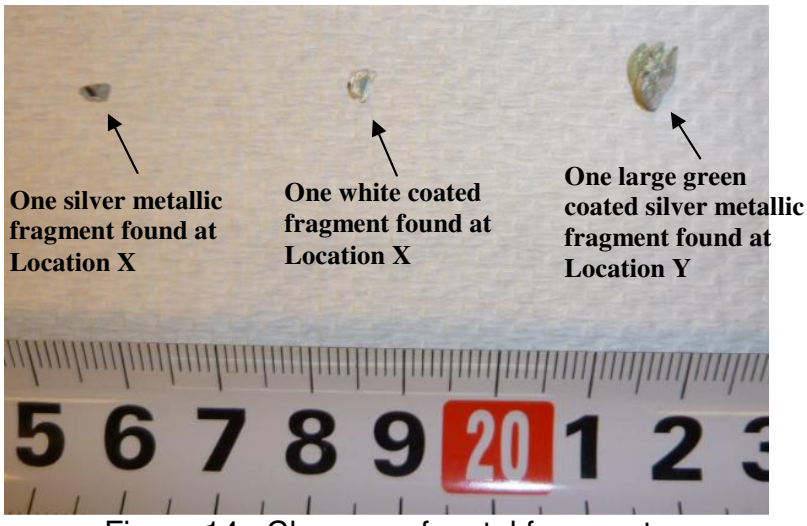

Figure 14: Close-up of metal fragments

1.8.2.3 In order to ascertain the nature of the metal fragments, and whether the fragments had originated from contact with the aircraft fuselage skin, the fragments were sent to a test house to determine their elemental composition through energy dispersive x-ray (EDX)[2] analysis.

1.8.2.4 The elemental composition of the three fragment samples were compared with that of the original damaged aircraft skin (see **Figure 15**).

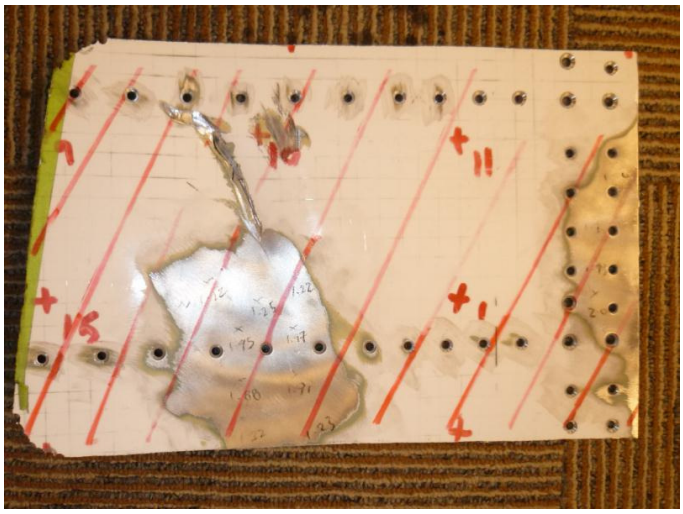

Figure 15: Cut out of the damaged aircraft skin

1.8.2.5 It was found that:

(a) the elemental composition of the two fragment samples from the silver metallic fragment from Location X and the green coated silver metallic fragment from Location Y was similar to that of the aircraft skin, which was 2024 aluminium alloy; and

(b) the fragment sample from the white coated metallic fragment from Location X did not match the aircraft skin[3], but contained titanium and other elements like silicon, aluminium, iron and oxygen. The sample had an EDX spectrum similar to titanium dioxide, TiO_2 which is commonly used as a white pigment in paint.

[2] Energy dispersive x-ray analysis (EDX) is an x-ray technique used to identify the elemental composition of materials. EDX works by detecting x-rays that are produced by a sample when placed in an electron beam, these characteristic x-rays will allow the identification of elements present in the sample. The EDX technique is non-destructive.

[3] The aircraft manufacturer confirmed that there was no titanium alloy in the area of damage.

1.9 Additional information

1.9.1 PLB training and operating procedures

1.9.1.1 The airport ground handling provider provided a two-day training for the PLB operators. The training consisted of lectures and practical sessions with the mock-up fuselage. The trainee would then be tested by the aerodrome operator, who would issue a permit to operate the PLB if the trainee passes a practical test.

1.9.1.2 A more experienced PLB operator would be attached to the new PLB operators for their first 3 to 5 actual operations.

1.9.2 PLB operating procedures

1.9.2.1 The PLB operating procedure for operators requires the PLB cab to be stopped at 1.5 m from the aircraft door before performing adjustments such as aligning the PLB cab parallel with the aircraft fuselage. A final stop of the PLB cab is done at 0.5 m from the aircraft door for final adjustments before proceeding with docking and door opening.

1.9.2.2 From inside the PLB cab, the PLB operator uses a black marking on the floor to gauge correct alignment with the front cabin door. For a satisfactory docking, the black marking is to be aligned with the left edge of the aircraft front cabin door (see **Figure 16**). The PLB operator told the investigation team that during the initial phase of the re-docking, the black marking was not aligned with the left edge of the cabin door but he subsequently readjusted the PLB cab and got the black marking to be 15 cm to the right of the cabin door edge. Although the black marking was not aligned, the PLB operator felt it was sufficiently safe to allow the opening of the door.

Figure 16: Position of black marking aligned with left edge of front cabin door during normal docking with the mock-up fuselage

1.9.3 Safety-interlocking sensors under the PLB cab

1.9.3.1 There are two safety-interlocking sensors under the PLB cab, one on the left and one on the right. They are installed to prevent the PLB from moving once the sensor rods have come into contact with an obstacle. The position of the two end sensors are shown in **Figure 17**.

1.9.3.2 It is noted that in the non-parallel docking scenario when the PLB cab's right padding had already contacted the aircraft fuselage, the end sensor closest to the fuselage (i.e. the one on the right) was not touching the fuselage and was therefore not activated as shown in **Figure 18**. Thus the PLB cab could still be manoeuvred further forward towards the aircraft fuselage.

Figure 17: Position of the two safety-interlocking sensors under the PLB cab

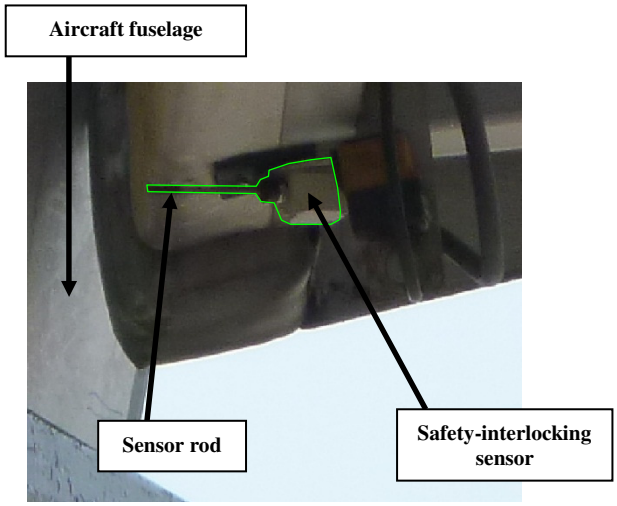

Figure 18: Details of the safety-interlocking sensor and its relative position from the aircraft fuselage, the sensor did not activate even after the PLB cab's right padding had contacted the aircraft fuselage in a non-parallel docking

2 ANALYSIS

2.1 Evidence from the CCTV footage shows that the PLB made contact with the aircraft during the re-docking process. The contact is also evidenced from the debris fragments found on the PLB cab's damaged right padding.

2.2 The safety-interlocking sensors under the PLB cab were designed to work when the PLB is relatively parallel to the aircraft fuselage. In a PLB non-parallel position, the sensor rod would be much farther from the fuselage and would not have prevented the PLB cab from contacting the fuselage.

2.3 Thus, as the non-parallel PLB cab was approaching the aircraft fuselage, the effectiveness of the PLB's safety-interlocking sensors was compromised. The sensor on the right side was unable to detect the closing in of the PLB onto the aircraft fuselage.

3 CONCLUSIONS

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

3.1 Evidence shows that the PLB cab had contacted the fuselage during the re-docking. The PLB cab was not parallel to the fuselage. It was tilting towards the left at an angle when it approached the aircraft, resulting in the lower corner of the right edge of the PLB cab coming into contact with the fuselage.

3.2 In the non-parallel docking position, the safety-interlocking sensors under the PLB cab did not prevent the PLB cab from contacting the fuselage.

4 SAFETY ACTIONS

During the course of the investigation and through discussions with the investigation team, the following safety actions were initiated by the airport ground handling provider and the aerodrome operator.

4.1 Following the incident, the airport ground handling provider has taken the following safety actions:

- Amending the PLB training manual to include a warning to PLB operators that highlights the importance of ensuring that the PLB cab is parallel to the aircraft fuselage, particularly when making adjustments when the bridge is 1.5 m and 0.5 m away from the aircraft. The amendment includes also a warning that non-parallel docking can cause damage to the aircraft fuselage.

- Emphasising to PLB operators that the PLB cab has to be parallel to the aircraft fuselage to ensure that the safety-interlocking sensors is effective in detecting potential contact with the aircraft.

4.2 The aerodrome operator is currently in the process of replacing all their older PLBs (similar to the incident PLB) with a newer model of PLB equipped with an auto-docking safety feature. This feature can guide the PLB cab to within 0.5 m from the aircraft and can reduce manual operational errors.

5 SAFETY RECOMMENDATIONS

5.1 In view of the safety actions taken by the airport ground handling provider and the aerodrome operator, no safety recommendation is proposed.