National Transportation Safety Board
Office of Research and Engineering
Washington, D.C. 20594

Performance Study

Specialist Report
Marie Moler

A. INCIDENT

Location:	San Francisco, California
Date:	July 7, 2017
Time:	2356 PDT
Airplane:	Airbus A320, C-FKCK, ACA759
NTSB Number:	DCA17IA148

B. SUMMARY

On July 7, 2017, about 2356 Pacific daylight time, Air Canada flight 759 (ACA759), an Airbus A320, Canadian registration C-FKCK, was cleared to land on runway 28R at San Francisco International Airport, San Francisco, California, but instead lined up on parallel taxiway C, where four air carrier airplanes (a Boeing 787 followed by an Airbus A340, another Boeing 787, and a Boeing 737) were awaiting takeoff clearance. ACA759 overflew the first airplane on the taxiway and descended below 100 ft above the ground, and the ACA759 flight crew initiated a go around. The flight was operated under the provisions of 14 *Code of Federal Regulations* Part 129 as an international scheduled passenger flight from Toronto/Lester B. Pearson International Airport, Toronto, Canada, with 135 passengers and 5 crewmembers on board. Night visual meteorological conditions prevailed at the time of the incident. The airplane was not damaged, and no injuries were reported.

C. PERFORMANCE STUDY

The airplane was equipped with a flight data recorder (FDR) and a cockpit voice recorder (CVR). The FDR recorded acceleration, speed, altitude, attitude, engine and control parameters, latitude, and longitude. CVR data was not recovered from the time of the incident.

Data from the airport surveillance radar (ASR-9) at Metropolitan Oakland International Airport (OAK), about 10 nautical miles (NM) away from the incident, were used in this study. ASR-9 data updates every 4.5 seconds and has an inherent uncertainty of ±2 Azimuth Change Pulses (ACP) = ± (2 ACP) x (360º/4096 ACP) = ±0.176° in azimuth, ±50 ft in altitude, and ±1/16 NM in range.

Also discussed in this report is the video footage of the incident from a security camera. The four airplanes on the taxiway were United Airlines flight UAL1, a Boeing B787-9; Philippine Airlines flight PAL115, an Airbus A340-300; United Airlines flight UAL863, a Boeing B787-9; and United Airlines flight UAL1118, a Boeing B737-900. These airplanes will be referred to as UAL1, PAL115, UAL863, and UAL1118 in this report.

Weather Observations

A Meteorological Terminal Aviation Routine Weather Report (METAR) was recorded at 2356 PDT, the time of the incident. Winds were 9 kts from 290°, visibility was 10 statute miles, and clear. The temperature was 61 °F, the dewpoint was 48 °F, and the pressure was 29.92 inHg. Night visual meteorological conditions prevailed at the time of the incident.

Security Video

A security camera from Terminal 2 at SFO captured the incident and the video was provided to the NTSB. The incident occurred in the top quarter of the field of view, which is shown in its entirety in Figure 1. ACA759 is highlighted with a green arrow. The reflection of the airplane's lights can be seen on the water below. UAL1, PAL115, and UAL863 are visible in the frame.

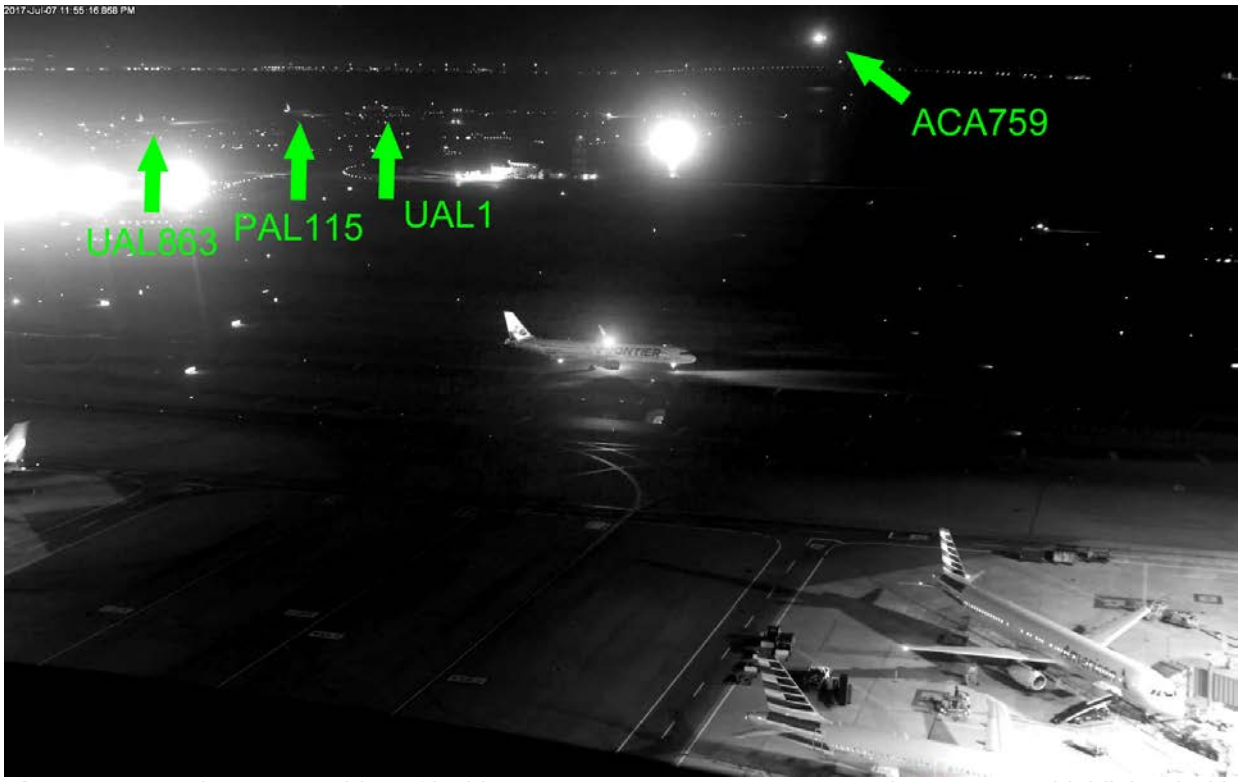

Figure 1. Security camera video of incident. ACA759, UAL1, PAL115, and UAL863 are highlighted with green arrows.

The next four figures (Figure 2 - Figure 5) show the incident sequence. All airplanes are highlighted with green arrows in Figure 2 as ACA759 passed over the seawall (the reflection in the water was no longer visible). The next figure shows the incident airplane passing over the first airplane (UAL1) on the taxiway. About this time the crew of PAL115 turned on their landing lights which illuminated the taxiway ahead of them and UAL1. In Figure 4, the lights from ACA759 illuminated the fuselage of PAL115. Figure 5 shows the lowest apparent altitude point as ACA759 passed over PAL115. Also in this figure, the attitude of the airplane has changed to be nose up. Subsequent frames of the video show the incident airplane gaining altitude over the taxiway and passing over UAL863.

Figure 2. ACA759 crosses the seawall. UAL1 lights flashing on (they are flashing off in Figure 1).

Figure 3. ACA759 crosses over UAL1. PAL115 turns on landing lights, illuminating UAL1.

Figure 4. ACA759 landing lights illuminate PAL115.

Figure 5. ACA759 passes low over PAL115. Incident airplane is now pitched up and climbing.

Altitude Corrections

The altitude values used in this report are a combination of recorded pressure altitude and radio altitude. Pressure altitude, which has an uncertainty of ± 50 ft, is corrected and used for altitudes greater than 2000 ft AGL (above ground level). Radio altitude measures the distance between the radar antenna in the airplane and the ground directly below it. According to Airbus, the radio altimeter should be set so that it reads 0 ft at airplane touchdown with an estimated average pitch of 6°. For this airplane, the radio altimeter recorded a value of -2 ft upon its final touchdown on runway 28R, after the fly-over. The radio altimeter record was therefore adjusted + 2 ft for the offset. The resulting altitude therefore reflects the approximate height of the wheels of the main landing gear above the ground. The wheels of the landing gear are approximately 5 ft below the bottom of the fuselage. No adjustments were made for the pitch of the airplane. It is important to note that the altitudes shown in this report have uncertainty associated with them due to uncertainty inherent in the altimeter system, the pitch of the airplane, and the offset adjustments made in this study.

The lowest adjusted radio altitude (nominally indicating the bottom of the landing gear, the fuselage would be an additional 5 ft higher), which occurred as the airplane passed over PAL115, was 60 ft. Measurements were made using an image of the security camera footage to confirm this altitude reading. The image when ACA759 and PAL115 are closest is quite small in the camera frame, so measurements made from the pixilated image are approximate. The vertical stabilizer of the A340 was well illuminated and is 8.2 m (26.9 ft) tall (Figure 6). Assuming ACA759 passed directly over PAL115[1], the distance between the two airplanes in the image was measured to be 13.5 ft. Allowing for uncertainty, this measurement was bracketed to be between 10 and 20 ft of air gap. An A340 is 55 ft tall, so the altitude of the fuselage of ACA759 as it passed over PAL115 was between 65 and 75 ft. This is consistent with the adjusted radio altitude.

[1] This assumption was made to simplify the calculation. While ACA759 was likely not directly above PAL115, additional geometric calculations would not have added accuracy to the measurement due to the low resolution of the image.

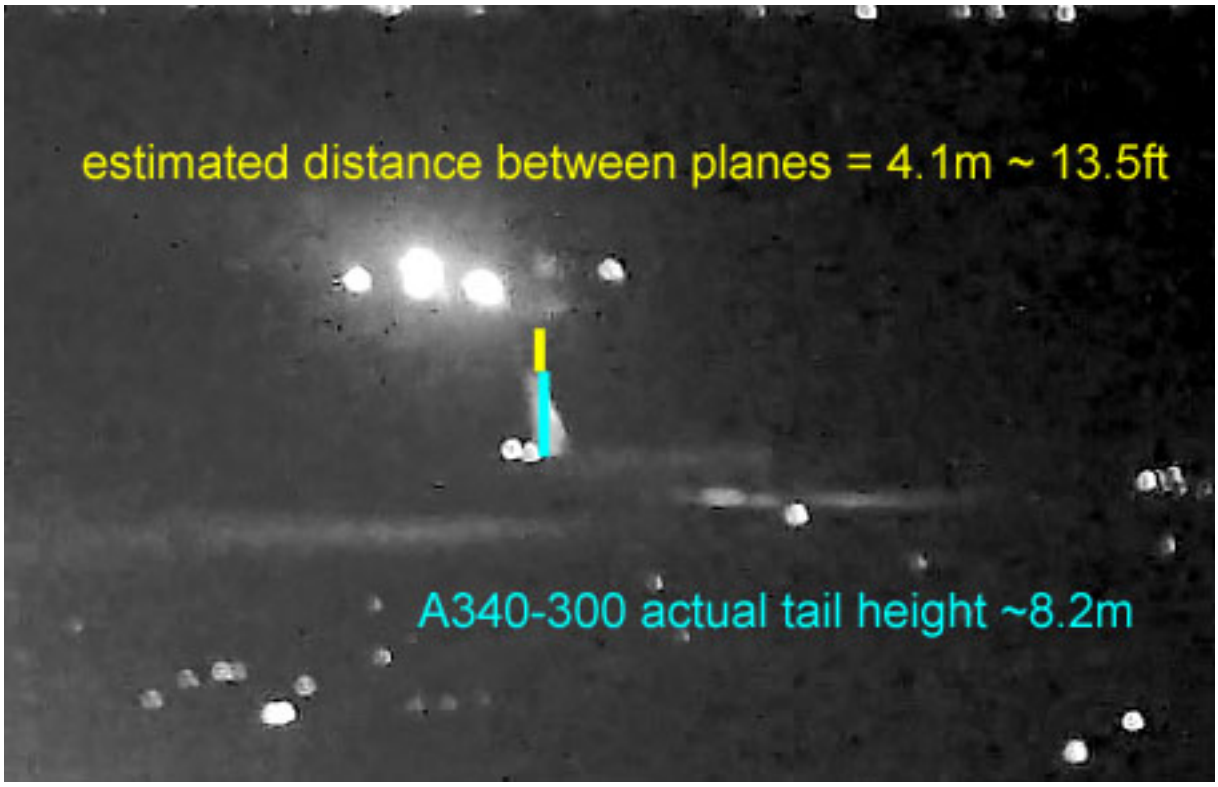

Figure 6. Security camera video of incident.

Incident Approach and Go-Around

The airplane was on Air Canada's FMS Bridge Visual Runway 28R approach[2] which is shown overlaid with the flight path in Figure 7. The flight path is from the latitude and longitude recorded on the airplane, shifted 200 ft east to agree with the OAK radar, with overflight animations provided by the FAA of the incident, and with the subsequent landing on 28R. The descent, flyover of taxiway C, go-around, and subsequent landing on 28R are shown.

[2] Air Canada provided their approach plate for 28R. FMS stands for Flight Management System.

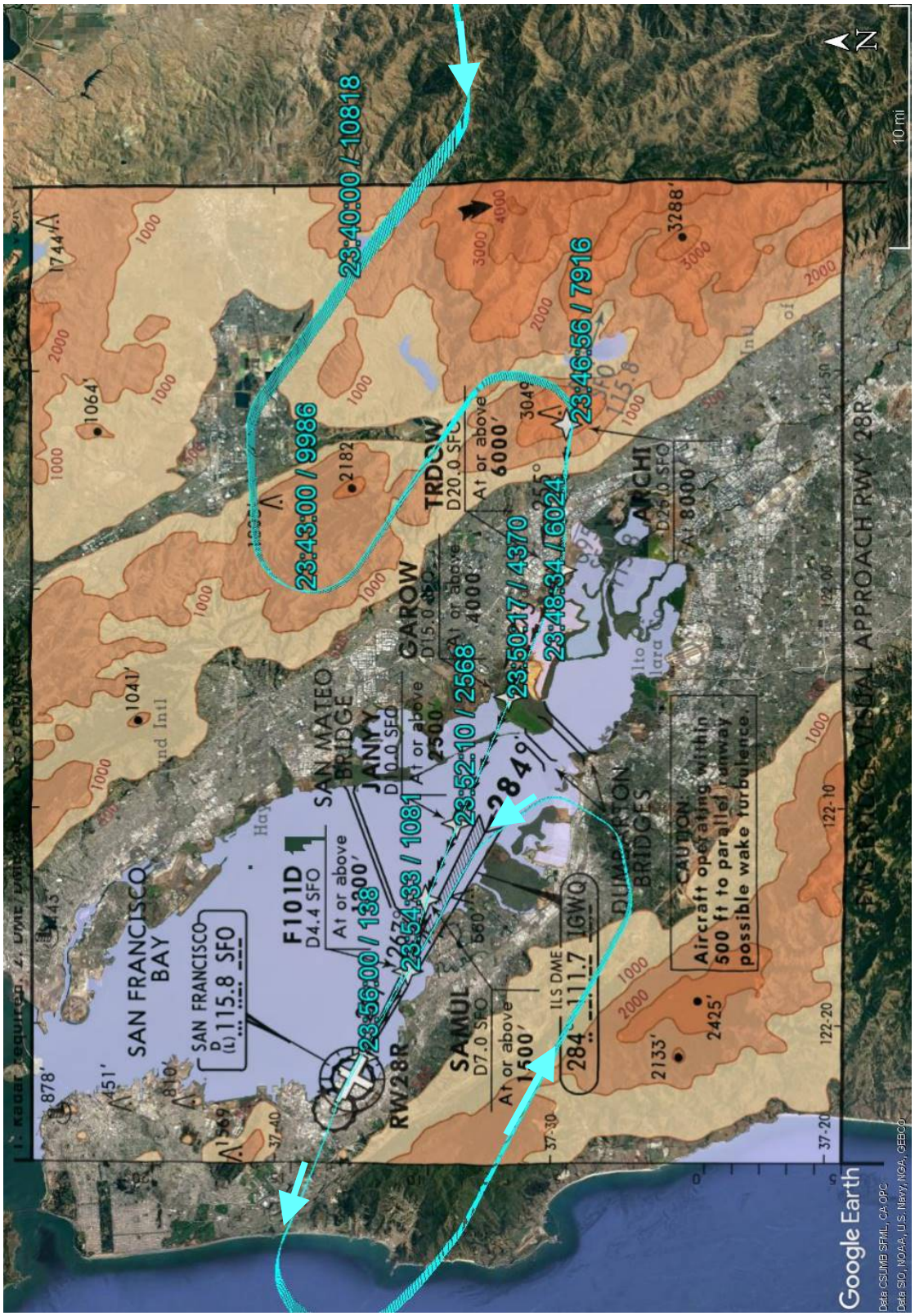

Figure 7. Airplane track with selected PDT times and altitudes marked. FMS Bridge Visual 28R approach plate is overlaid on image.

The airplane's descent from 30,000 ft is shown in Figure 8. The airplane's airspeed slowed from 250 kts to about 140 kts on final approach.

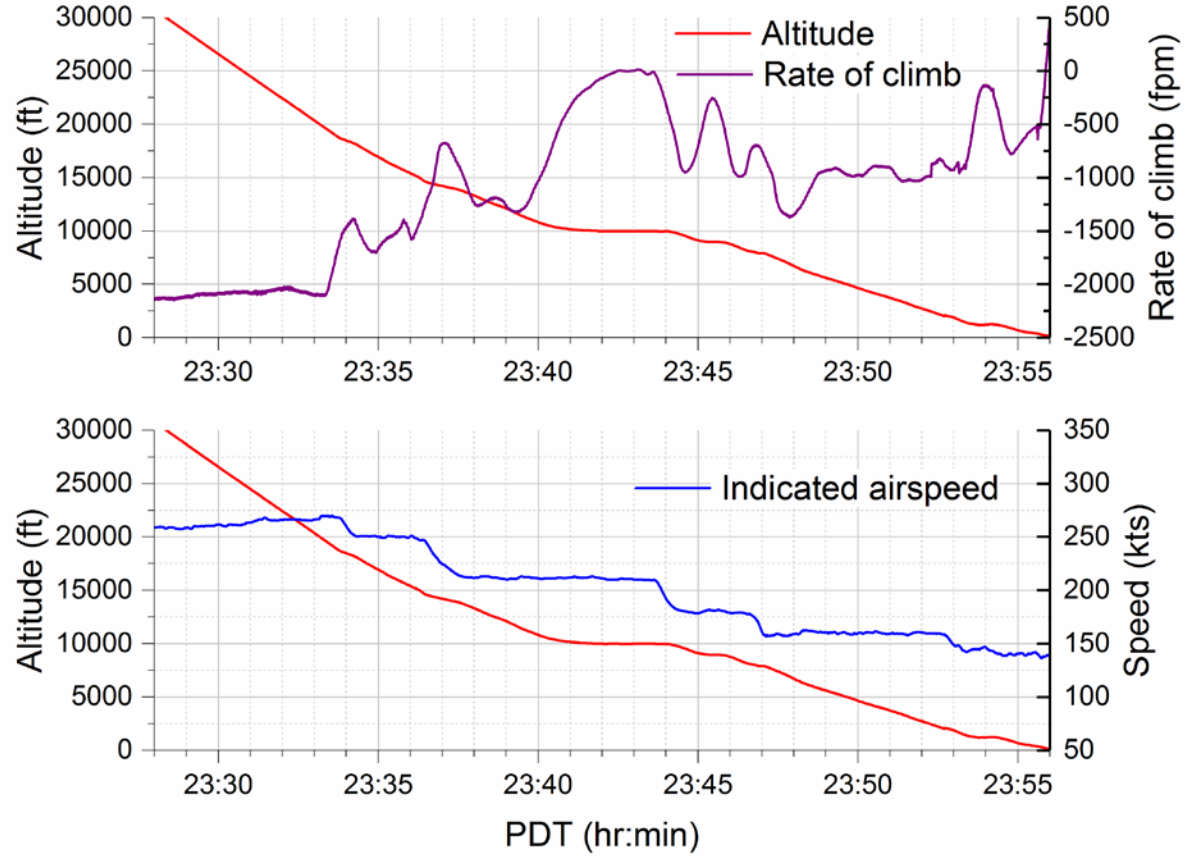

Figure 8. Airplane altitude, rate of climb, and indicated airspeed. Altitude is corrected from the FDR, rate of climb was calculated, and the indicated airspeed was as recorded on the FDR.

Figure 9 shows the airplane's altitude and selected altitude for the descent from 17,000 ft. Prior to 2335 (when the airplane was above 17,000 ft), the selected altitude was 8,000 ft.

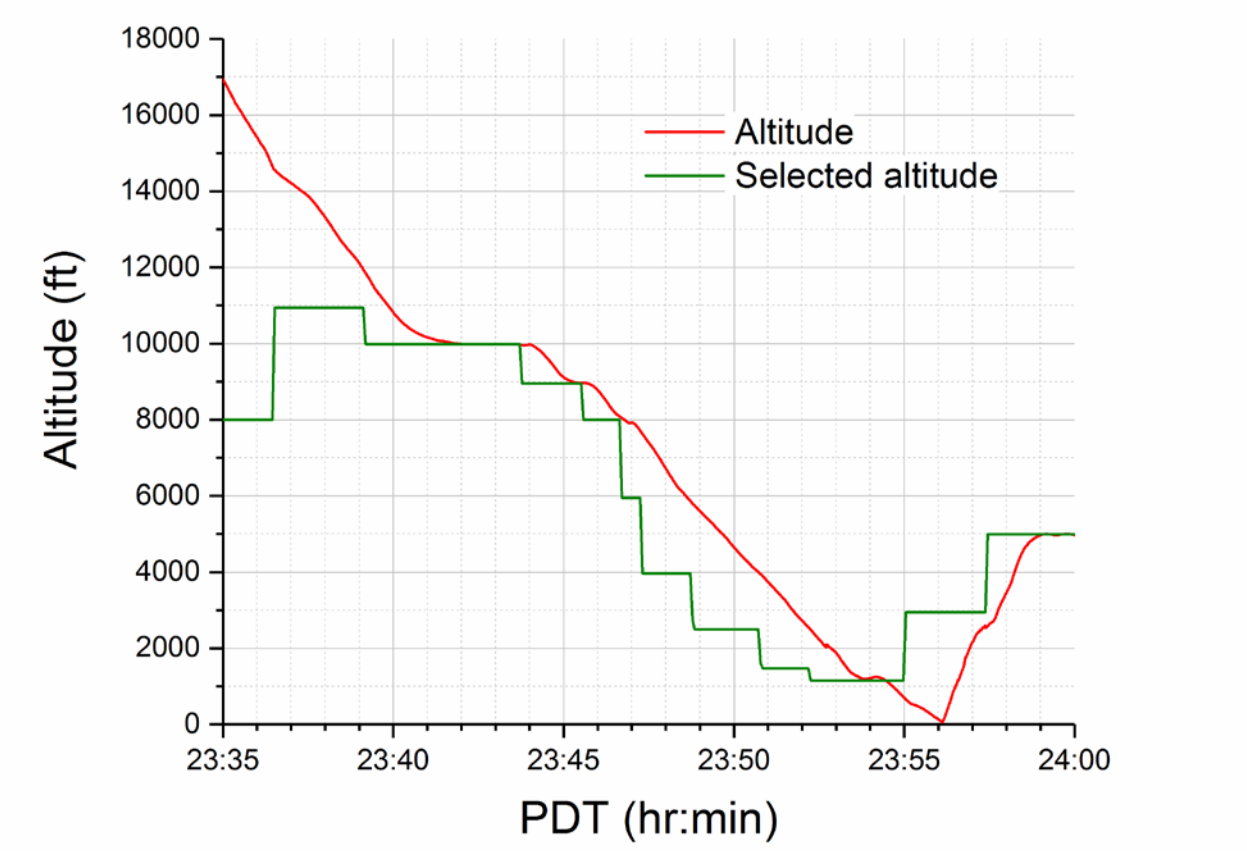

Figure 9. Airplane altitude and selected altitude.

Figure 10 shows the location of the airplane when the tower gave clearance to land at 23:51:11, approximately 11.5 NM from the threshold of runway 28R. The landing gear were lowered at 23:52:46 and both the auto-pilot and flight director were turned off before passing the waypoint F101D.

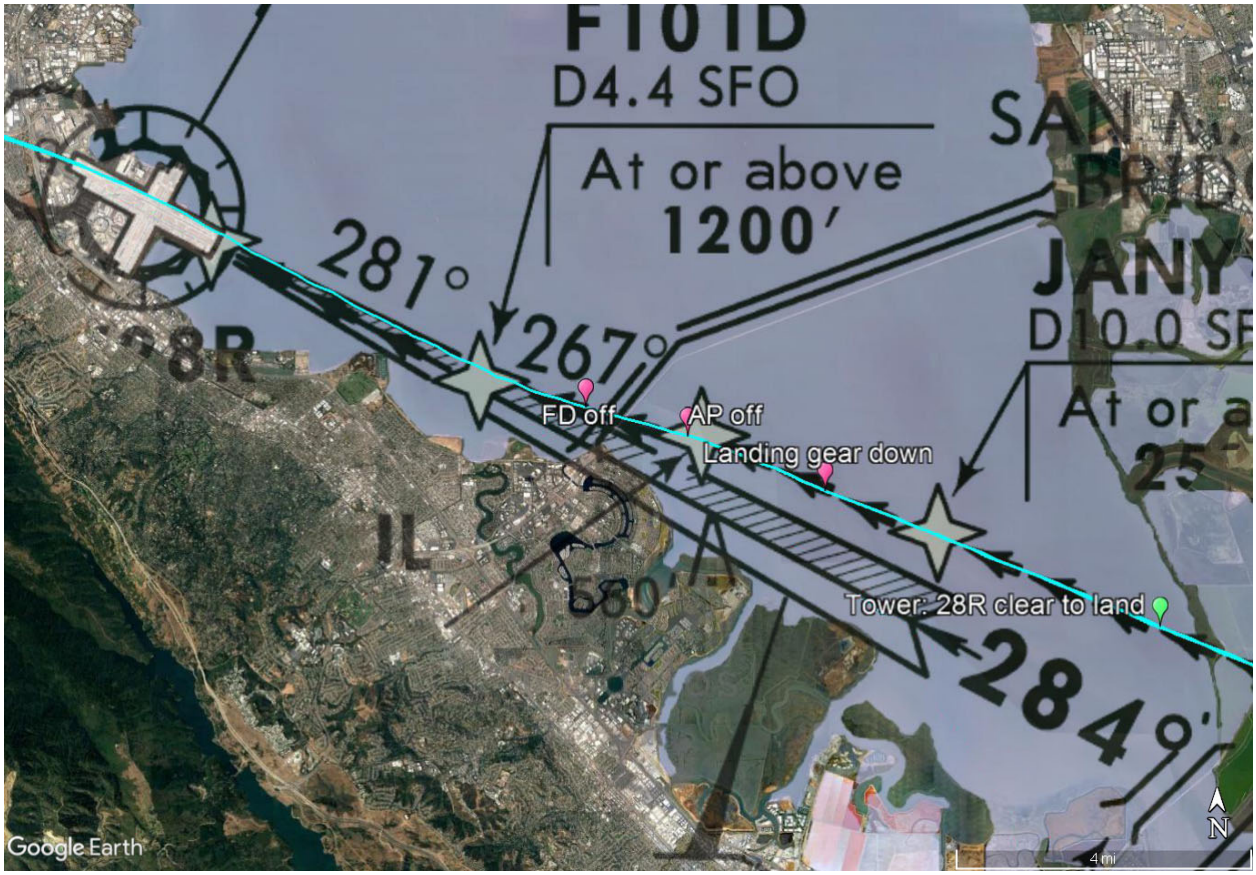

Figure 10. Airplane track with selected events noted.

Figure 11 shows the airplane's track from waypoint F101D to taxiway C. The airplane's track lined up with taxiway C rather than 28R. The distance between the centerline of taxiway C and 28R is approximately 490 ft. Taxiway C and 28R are on the same heading. The airplane's localizer was not tuned to the frequency used for the approach to 28R.

Figure 11. Airplane track with approach tracks to 28R and taxiway C. F101D is shown at the scale of FMS Bridge Visual Runway 28R chart.

At 23:55:44, about 4000 ft from the airport seawall (see Figure 12), ACA759 asked the tower to confirm that runway 28R was clear. The tower confirmed that runway 28R was clear and ACA759 responded at 23:55:58, 800 ft from the seawall. Figure 12 shows this air traffic control (ATC) exchange. Four airplanes are shown on the taxiway in their approximate locations at the time of the overflight[3].

Figure 12. Airplane track with approach tracks to 28R and taxiway C with ATC conversation.

[3] Approximate locations and headings were derived from FAA imagery and security video.

Just after ACA759 responded to the tower, an unidentified voice was heard on the radio asking "Where's this guy going?" at 23:55:59, with a second unidentified radio call of "He's on the taxiway" at 23:56:03.

At 23:56:05 the throttles were advanced. The airplane continued to descend until 23:56:08 as the engines increased power and the airplane pitched up. The minimum recorded and corrected altitude was 60 ft[4]. At the time the airplane was passing over or near PAL115. The airplane began climbing. At 23:56:10 the tower called for a go-around. The airplane passed over two more airplanes as it continued to climb.

Figure 13. Airplane track with ATC conversation.

[4] See paragraph on page 2 about uncertainty in the reported altitudes.

The initiation of the go-around at 23:56:05 was determined by the timing of the advancement of throttles (22.5° to 42°) and N1 (57% to 94%) and the control column shown in Figure 14. Engines and elevators were fully transitioned to their go-around position by 23:56:08.

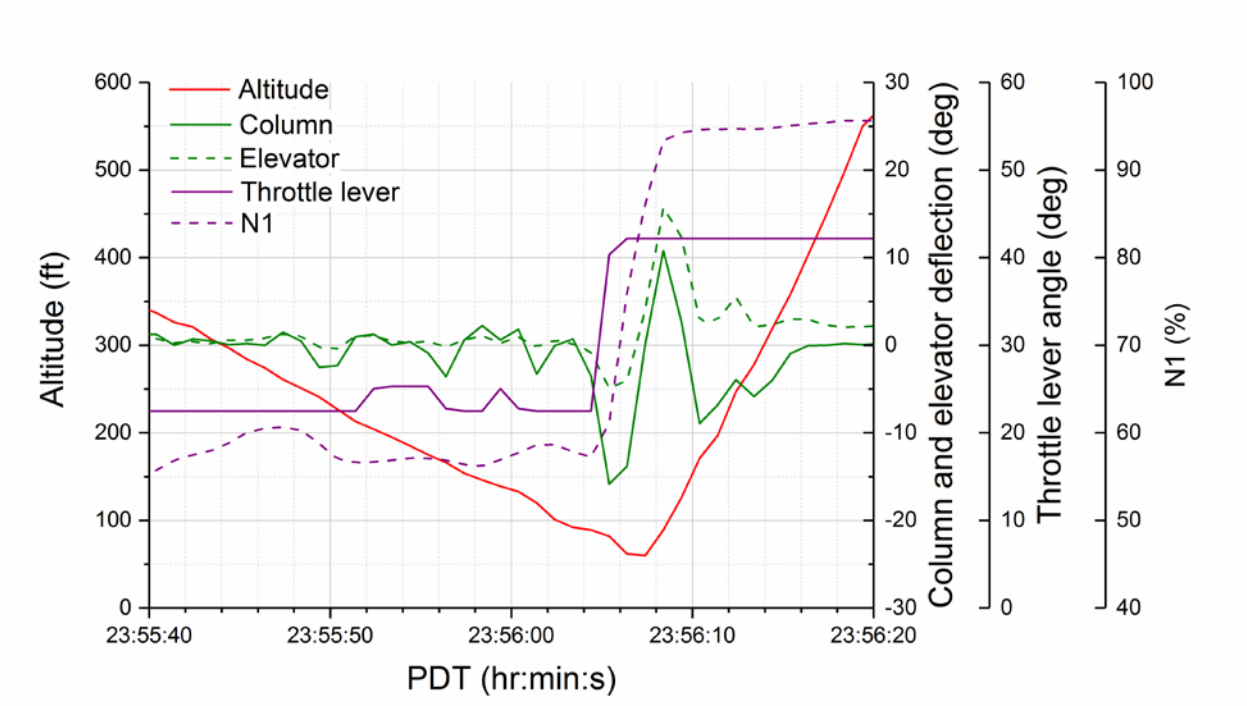

Figure 14. Airplane altitude, column, elevator, throttle lever angle, and N1 from FDR.

Figure 15 shows that the airplane continued to descend about another 30 ft for the three seconds it took the engines and elevators to transition to go-around. The landing gear were raised at 23:56:23. During these three seconds, as the airplane rotated to climb, it moved over 600 ft down the taxiway and passed over PAL115.

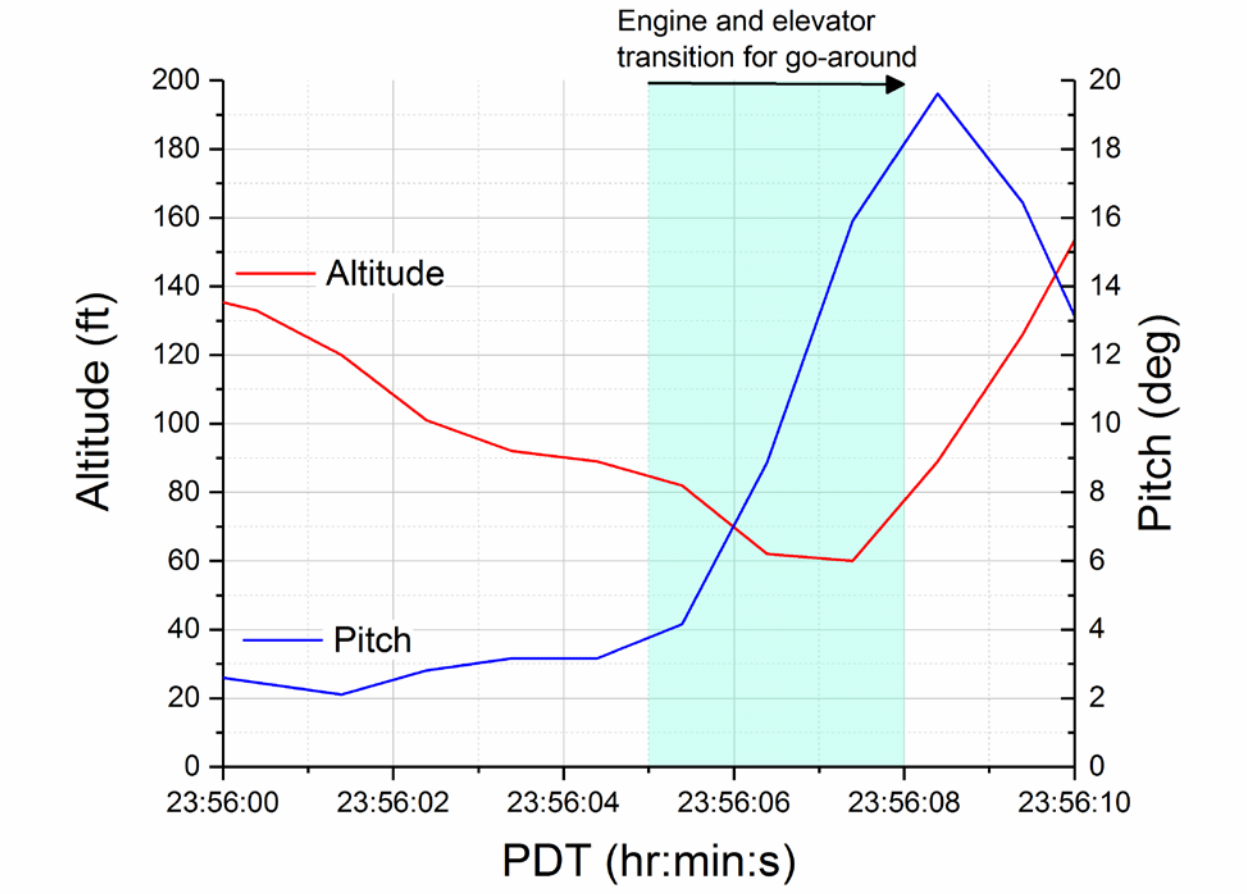

Figure 15. Airplane altitude and pitch during transition to go-around.

Table 1 summarizes the events leading to the go-around over taxiway C. The first column is the event, the second is PDT time, and the fourth is the altitude. The third column shows the distance from the seawall at the edge of the airport which is about 400 ft before the paved surface of the taxiway. Altitudes below 100 ft are highlighted in orange and shown to the nearest foot, but as discussed earlier, these altitudes likely have greater than ± 1 ft uncertainty.

Table 1. Timeline, distances, and altitudes for approach and go-around events.

	Time	Distance from airport seawall	Altitude
Tower: Cleared to land 28R	23:51:11	- 11.5 NM	3500 ft
Landing gear down	23:52:46	- 7.7 NM	2000 ft
Auto-pilot off	23:53:28	- 6 NM	1300 ft
Flight director off	23:54:02	- 4.8 NM	1200 ft
Passed F1010D and lined up with taxiway C	23:54:28	- 3.6 NM	1100 ft
ACA759: Confirm runway clear?	23:55:44	- 4000 ft	300 ft
Tower: No one but you	23:55:52	- 2300 ft	200 ft
ACA759: Okay	23:55:58	- 500 ft	150 ft
Other airplane 1: Where's this guy going?	23:55:59	- 500 ft	150 ft
Other airplane 2: He's on the taxiway	23:56:03	+ 450 ft	100 ft
Passed over UAL1	23:56:03	+ 450 ft	100 ft
Initiated go-around	23:56:05	+ 850 ft	89 ft
Passed over PAL115	23:56:07	+ 1250 ft	60 ft
Began climb	23:56:08	+ 1550 ft	89 ft
Tower ordered go-around	23:56:10	+ 1700 ft	130 ft
Passed over UAL863	23:56:11	+ 2200 ft	200 ft
Passed over UAL1118	23:56:12	+ 2600 ft	250 ft

D. CONCLUSIONS

At 23:54:28, ACA759 passed F101D and lined up with taxiway C rather than runway 28R. At 23:55:44, the crew asked the tower to confirm that runway 28R was clear. The airplane passed over UAL1 before initiating a go-around at 23:56:05. The lowest altitude was recorded as ACA759 passed over PAL115, as the airplane transitioned for a go-around. The airplane began gaining altitude at 23:56:08. The tower ordered a go-around at 23:56:10.

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Marie Moler
Specialist – Airplane Performance
National Transportation Safety Board