China Airlines Flight CI 5233 Occurrence Investigation Report

Executive Summary

On March 04, 2010, China Airlines flight CI 5233, a B747-400 freighter, B-18723, took off from Anchorage International Airport, USA at 06:38 (13:38 on March 03rd local time) for Taoyuan International Airport, Republic of China.

When entering the required data into Runway Analysis System, the pilot took the Max Landing Weight as Max Take-Off Weight obtained from Computerized Flight Plan; which led the calculation to provide erroneous take-off thrust, take-off reference speed and take- off model. The aircraft did not obtain enough lift required for take-off, the angles of ground and attack were too large; which caused that the tail had ground contact.

During the take-off roll, the pilot had stick shaker warning, then released stick and set the manual thrust to MAX to continue the take-off. In the air the pilot inspected the instruments of cabin pressure and engines which were normal. After landing at 16:48, maintenance personnel checked and found the rear section of aircraft belly had substantial damage.

Findings Related to Probable Causes

1. When entering the required data into Runway Analysis System, CM 1 used the data from Computerized Flight Plan but took the max landing weight mistakenly as max take- off weight. Then CM 2 did not cross check to confirm the accuracy of the input data, and did not review all the data after retrieving take off performance figures from Runway Analysis System; so it was not discovered that the max take-off weight that was entered by mistake caused the mal-calculation of take-off thrust, -reference speed and -model.

2. CM 2 entered the erroneous take-off thrust provided by Runway Analysis System into Flight Management System which failed to calculate take-off reference speed; so the columns of V_1, V_R, V_2 on the page of the take-off speed showed '- - - ' and the pilot did not understand the meaning of '- - - ', at the end he decided to use the take-off reference speed calculated by Runway Analysis System to enter into Flight Management System.

3. CM 3 has checked Runway Analysis Manual during taxiing to verify the accuracy of the calculation done by Runway Analysis System. However the source of ‘max take-off weight’ was from the system and not from Weight and Balance Sheet nor Computerized Flight Plan. Therefore it was discovered that the take-off reference speed calculated by Runway Analysis System was much lower than the actual figure that the aircraft should have used.

4. When taking off the aircraft speed reached the V_R value calculated by Runway Analysis System, 2 seconds later the aircraft started to roll. Because the actual roll speed of 149 knots/hour was lower than the correct value of 166 knots/hour, the aircraft did not have enough lift required for take-off and angles of ground and attack way too large; which caused the aircraft tail to touch ground.

<u>Findings Related to Risks</u>

1. The pilots might not fully understand the regulations of CAL B747-400 Flight Operation Manual related to input of Runway Analysis System and the timing to conduct it. So CM 1 entered the data in advance during performing ‘FMS-CDU initialization’ operation procedure, at the same time CM 2 was entering the required data for the initialization of Flight Management System and did not perform cross-check to the data entered in the Runway Analysis System.

2. In CAL B747-400 Flight Operation Manual there were no detailed procedures and verifications to the data input into runway analysis system. Training or/and the requirement of tests should be reinforced so the pilots would rigorously perform the verification procedure.

3. Boeing Flight Crew Operation Manual described the reason why the take-off reference speed was shown as ’- - - ’, one of the reasons to be that the performance calculation from Flight Management System was restrained, however the manual did not further explain the reason of being restrained. Pilots would still have difficulty to understand that it was due to the data fed into Flight Management System to be unreasonable.

4. After take-off the pilots had a discussion about the probability of aircraft tail touching ground. But they did not have solid information of aircraft tail touch ground as a basis for consideration of the risk, and was afraid to be suspected by the airlines, so both pilots agreed to continue the flight to Taipei and changed the course level from flight level 360 provided by flight plan to 320, did not perform relevant procedures, so they neglected the notes of cabin pressurization.

5. The flying, on duty, and off-duty time of the pilots were compliance with CAL and CAA relevant regulations. However CM 1 and CM3 still had conditions and symptoms of fatigue formation. It might have been fatigue that affected their performance.

6. Flight crew required to improve their CRM capability concerning communication, coordination, cross-checks, decision-making, response to fatigue, and alertness to situations.

7. The aircraft's force of the flight operation is compressive stress at aircraft belly area, so the skins would have less impact. Due to the abrasion damage, skins became thinner together with the blade effect from the edge of the pores. Because of the carrying cross-sectional area reduced and the part increased, it entails a risk of circumferential stress overload.

<u>Other Findings</u>

1. The aircraft maintenance record within 3 months prior to the date of the occurrence did not show any anomalies.

2. The licenses of the pilots were compliance with civil aviation regulations, no evidence to show any affects from medication and alcohol at the time of the occurrence.

3. For CAL flight documents, it contains numerous significant parameters and figures on the same page, like max take-off weight related documents of Computerized Flight Plan and Weight and Balance Sheet, their layout were fixed or similar, if pilots were not cautious when reading, it would increase the chance for miss-reading.

4. CAL Runway Analysis Manual has no information for the column of flaps 10, so when CM 3 would like to check the manual to verify the accuracy of the take off reference speed calculated by runway analysis system, he could not obtain a solid figure to proceed the matching but used the information contained into the column of flaps 20 for reference.

5. When loss of speed warning was activated, CM 1 set the thrust to the max; which led the aircraft obtain the max thrust to increase the air speed to avoid the deterioration of the situation.

6. Though neither ICAO nor national civil aviation regulations in R.O.C. mandated to establish fatigue risk management system, CAL has established part of the control mechanism for pilot fatigue hazards. CAL should pay continuous attention to international trend to promote the airline's fatigue management.

FLIGHT SAFETY RECOMMENDATIONS

To China Airlines

1. Reinforce flight operation related trainings and tests concerning the timing to perform the take off performance calculation and the procedures for verification, to reduce the risk that pilots maybe use erroneous data for calculations. (ASC-ASR-11-05-001)

2. Review and reinforce the design Runway Analysis System or to use alternative take off performance calculation to reduce the probability that pilots may entered the wrong data. (ASC-ASR-11-05-002)

3. Review and improve the format of Weight and Balance document to reader friendly to reduce the probability that pilots may miss-reading any data. (ASC-ASR-11-05-003)

4. Reinforce trainings and requirements to pilots for acknowledgement of abnormal display from Flight Management Computer (FMC). (ASC-ASR-11-05-004)

5. Reinforce cognitive training to pilots for the danger of aircraft tail touching ground to promote pilots' alertness to similar situations. (ASC-ASR-11-05-005)

6. Promote the airline's response, policies and mechanism of the pilot's decision making, to ensure pilots to prioritize flight safety when making decisions. (ASC-ASR-11-05-006)

7. Pay continuous attention to international trend related to fatigue management, to promote the control mechanism of fatigue hazards. (ASC-ASR-11-05-007)

8. Reinforce the flight crew's resource management training related to communication and coordination, cross-checks, decision-making, response to fatigue and alertness to situations. (ASC-ASR-11-05-008)

<u>To Civil Aeronautics Administration, Ministry of Transportation and Communications</u>

1. Supervise airlines to review per the existing operation procedures if the pilot's data input and cross-checks are functioning well to avoid any similar cases to occur again. (ASC-ASR-11-05-009)

2. Counsel the airline to pay attention to international trend about fatigue management to promote their control mechanism of fatigue hazards. (ASC-ASR-11-05-010)

3. Supervise the airline to promote their mechanism of response and request pilots to prioritize flight safety when making decisions. (ASC-ASR-11-05-011)

4. Supervise the airline to reinforce the flight crew resource management training related to communication and coordination, cross-checks, decision-making, response to fatigue and alertness to situations. (ASC-ASR-11-05-012)