

Executive Summary

BN-2 Occurrence Investigation

On August 30, 2012, a RAC's BN-2B-26 aircraft, registration number B-68801, contracted by Real World Engineering Consultants Inc. (Real World) to perform an aerial photogrammetry mission with a captain, a first officer and an aerial photographer on board. The flight plan was to take off from Songshan Airport, requested for instrument departure and visual flight rules to conduct aerial photogrammetry mission in Hualien and Taitung area, the aircraft planned to land at Taitung Airport after the mission accomplished.

The aircraft took off at 0726, approximately 18 minutes after took off, the flight crew changed flight mode from instrument flight rules to visual flight rules. At 0827, the aircraft entered Hualien County Fenglin, Guangfu, and Wanrong aerial photograph area, maintain 8,300 feet to 8,500 feet altitude and continued climbing to Jhuosi, Hualien County photo area at 0919. From 0837 to 0843, Taipei Approach informed the flight crew 'Radar can't cover you.....make sure maintain visual flight'. There were about 7 times communication blockage between the aircraft and Taipei Approach during 0755 to 0913 period. The Kaohsiung Approach Control contacted the aircraft at 0913:39 and lost contact with the aircraft at 0914:20 after the last communication.

At 0920:55, the aircraft was at 260 degrees, 31.5 km mountain area from Yuli, Taitung and began to turn right heading 280 degrees. The last recorded Light Detection and Ranging (LIDAR) device data was 262 degrees, 35.9 km west of Yuli's mountain area with coordinates of 23 ° 20 '25.01 " latitude and 121 ° 01' 50.03" longitude. At the time of the last recording, the aircraft was at 9,572 feet with about 69 knots ground speed, 250 degrees heading, the climb rate was 874 ft / min and the pitch was 23.5 degrees.

At 0940, Taipei Mission Control Center (MCC) received ELT (Emergency Locator Transmitter) signals, about the same time, Japan Coast Guard informed Rescue Command Center, Executive

Yuan (RCC) of the same ELT signals. After verification with Civil Aeronautics Administration, Ministry of Transportation and Communications (CAA), RCC confirmed that the aircraft had lost contact. At 0955 on September 1, 2012, the search and rescue aircraft discovered the aircraft crashed at altitude about 9,568 feet of the original forest, about 20 kilometers southwest of Jhuosi, Hualien County. Three crew members on board were killed, and the aircraft was destroyed.

After receiving the notification, ASC immediately contacted relevant agencies for verification, assigned Investigator-In-Charge and organized Go team to stand by at the command center in Hualien. After the search and rescue mission was completed, ASC's Go team took National Airborne Service Corps helicopter to the occurrence site and launched occurrence investigation according to the Aviation Investigation Act. Parties to the investigation are the CAA, RCC, Roc Aviation Company, Aerospace Industrial Development Corporation, Real World Engineering Consultants Inc., National Transportation Safety Board (NTSB), USA and Air Accidents investigation Branch (AAIB), UK. The investigation report was published after approval by ASC council members at the 14th Council Meeting.

Findings related to probable causes:

1. After completing the aerial photogrammetry of Morakot No.16 measuring line, the aircraft turned 280 degrees to the right and attempted to climb to get out of the valley area. During climbing, the pitch of the aircraft was remained more than 20 degrees for a few seconds, the aircraft might nearly close to stall and activated stall warning. The aircraft performance might not be able to fly over the obstacles ahead under this condition, the aircraft flew into trees and crashed.
2. When completing the aerial photography of Morakot No.16 measuring line from the north to the south, the aircraft could not be able to fly over mountains ahead between the directions of 9 to 3 o'clock with the aircraft best climb performance. Despite the available climbing distance was longer when flight crew chose to turn to the right, the area

geography was not favorable for circling climb or turn around to escape the mountain area safely.

3. The on board personnel choose to perform an aerial photogrammetry at Morakot when weather condition was permitted after completing the aerial photography at Wanrong Woods without any advance planning due to the Morakot aerial photography had been behind schedule.

Findings related to risks:

1. The two paper copies provided by Real World of the measuring lines chart and the contour lines map of Morakot aerial photography area could not directly overlaid, the copy was unfavorable for pilots and the photographer to evaluate the distance between the measuring lines and surrounding ground obstacles. The names of the mountains surrounding measuring lines and altitude markings in the measuring lines chart were not complete.
2. The operator did not to integrate Morakot aerial photography area relevant charts information provided by Real World and therefore when planning for the flight course, the operator missed the opportunity to access the following risks: after completing the aerial photography of the no.16 measuring line from the north to the south, the elevation of the surrounding mountains within the 180 degrees range in front was all higher than the 2,500 meter measuring line elevation and the geography of that area was not favorable for the aircraft to perform circling climb nor turn around.
3. The preparation regulation of the operator' aerial photography mission did not consider specifically the timing and participants for preparing the flight plan, aircraft performance limitation and single-engine malfunction condition. The regulation did not have an evaluation mechanism to examine surrounding ground obstacles within aerial photography area at a safe altitude, chart information required for flight course planning and the concrete items and records of the flight course planning.
4. The captain and the first officer's route check was performed by the Instructor Pilot instead of the Check Pilot or CAA

Designated Examiner, which was not in accordance with the Flight Crew Training Manual.

5. The operator did not establish particular and appropriate flight routes training and check items base on the characteristics of aerial photography mission.
6. The operator did not follow the Flight Crew Training Manual to properly record and manage pilots' flight hours, training and check record.
7. The operator did not follow the Flight Crew Training Manual to provide aerial photographer with Crew Resource Management trainings, aeronautical meteorology and aircraft performance training.
8. Due to weight and balance, aircraft performance, and the limited space in the aircraft, CAA did not perform cockpit flight route check during any of the aerial photography missions.
9. CAA had issued inspection recommendations regarding to the pilot training record management to RAC prior to the occurrence and the RAC responded that the improvement was accomplished. However, many defects were still found in training record during the investigation.

Other findings:

1. The certificates of flight crew were in accordance with civil aviation regulations; rest and activities within 72 hours before the occurrence were normal; no evidence shows that the flight crew was affected by any medication or alcohol in duty. The weight and balance of the aircraft was within the limit.
2. The weather condition in the accident could be scattered to broken cloud with ceiling height about 11 to 12 thousand feet. Visibility was more than 10 kilometers. Therefore the aircraft was in visual meteorological condition.
3. The flight document retrieved from the cockpit of the aircraft did not contain any low level significant weather chart.
4. The Wanrong Woods aerial photogrammetry mission performed by the aircraft didn't apply for MOI's permission to an aerial photogrammetry mission at the time of the occurrence.

5. The Roc Aviation Company offered en-route training for aircraft type conversion purpose to the copilot, but the training plan permitted by CAA before the training did not include the en-route training.
6. The content of aircraft performance and operation limitations in the Roc Aviation Company BN-2 flight operation manual differed from international standard and it did not comply with Aircraft Flight Operation Regulations Appendix 6.
7. When there was no communication with the aircraft and the radar didn't detect the aircraft more than 30 minutes, Kaohsiung Approach controller didn't view it as an aircraft in expiry reporting and notify the Area Control.
8. The aerial photogrammetry data showed that the aircraft climb performance was normal. All the control surfaces were found at the accident site. The examination result of the two engines and all the filaments of warning light bulbs in the cockpit were normal. Hence the possibility of in-flight breakup and system malfunctions are eliminated.
9. The total amount of unsigned pre-flight check records were thirteen within one month before the accident, and the total amount of unsigned post-flight check records were fourteen.
10. The Aerospace Industrial Development Corporation didn't follow the periodic check procedures to make a correction when engine running test record showed the pressure of no. 4 cylinder of left engine was low and the pressure difference of the cylinders were high. Besides, when quality control personnel at AIDC reviewed the records of periodic check, he didn't discover the defect and correct it.
11. It's not necessary for the aircraft to equip CVR and FDR per Aircraft Flight Operation Regulations in Taiwan. The aircraft equipped a precision aerial photogrammetry device, and the recording data include GPS time, latitude, longitude, altitude, ground speed, rate of climb, heading, pitch angle, and roll angle. The aerial photogrammetry device didn't have the characteristics like flight recorders with crash survivability and real time read-write function.
12. The attributes for Lightweight Flight Recorder Systems include: low cost, easy to install which means no need to modify the electrical wiring and fuselage, sufficient parameters of flight data, easy to download and analyze, and with crash survivability. If the general aviation aircraft can install Lightweight Flight Recorder Systems, it will be

beneficial for flight task monitoring and occurrence investigation.

13. Three crew members received fatal injuries when the aircraft made impact with the terrain, there was no possibility to survive before search and rescue team arrived in scene.
14. There was no defined principle in TAMCC operation manual to provide ELT signal information to MOTC or CAA.
15. The content related to response plans and procedures during aircraft accidents in “Disaster Prevention and Protection Act” emphasize on the rescue modes and response operation at the crash site. The search and rescue operation when the aircraft is still missing and the responsibility of each relevant organization is not clarified, such that the relevant organizations would have difficulties in coordination in any search and rescue operations.
16. Part of the information in “SMALL AIRCRAFT VFR CORRIDOR FLIGHT INFORMATION CHART” made by CAA was not in accordance with ICAO Annex 4, Chapter 17 – VFR Aeronautical Charts.

The Aviation Safety Council issued a total of 16 safety recommendations.

Safety Recommendations to Roc Aviation Company:

1. A complete flight course planning was needed prior to perform an aerial photography mission; No mission shall be carried out if it is not adequately planned.
2. Implement relevant regulations and actual performance preparation prior to aerial photography mission, including: verify the approval of the aerial photography plan, timing and flight course planning participants, safety precautions of flight course planning, aircraft performance and safety consideration of single-engine malfunction, evaluate the necessity of examining surrounding ground obstacles within aerial photography area at safety altitude, required chart information, weather information and concrete items and recording methods of flight course planning.

3. Implement integration and application of relevant aerial photography area chart information to assist pilots and aerial photographers to acknowledge the information of geography, ground obstacles altitude, distance between measuring lines and ground obstacles.
4. Implement internal control to ensure that all pilot trainings are planned according to the Flight Crew Training Manual.
5. Implement pilots' flight route training and check to meet flight route and aerial photography missions requirement.
6. Examine the qualification of route check examiner and ensure the qualification is in accordance with the regulations.
7. Implement internal control mechanism regarding to pilots' flight hours, training and inspection of relevant record management to improve the integrity and accuracy of records.
8. Implement aerial photographers training regulations and establish training items specific to their responsibilities and keep training records.
9. Ensured aircraft maintenance record filled and kept in accordance with the regulations.

**Safety Recommendations to Aerospace Industrial
Development Corporation:**

Ensured maintenance personnel perform aircraft maintenance according to the operation standard, reinforce Quality Check personnel's inspection to ensure aircraft maintenance quality.

Safety Recommendations to CAA:

1. Supervised the operator and other general aviation operators' preparation of aerial photography missions, personnel's training, and pilots' records management.
2. Re-examine the feasibility of performing general aviation operator flight route check when performing an aerial photography mission.
3. Re-examine the feasibility for general aviation operators to implement Annex 6 of Aircraft Flight Operation Regulations.

4. Produce visual flight chart in accordance with ICAO standard to assist the operator to produce visual flight plans and visual flight operation.
5. Study the feasibility of installing simple flight recorder system to facilitate monitoring of flight missions and occurrence investigation of national general aviation industry.

Safety Recommendations to Office of Disaster Management, Executive Yuan:

Re-examine and coordinate the amendments of the emergency procedures in 'Operation Plan of Air Disaster Management', especially the related organization' authorization and responsibilities of searching operation.