

# **B-68802 Occurrence Investigation**

## **Executive Summary**

On April 16, 2015, a Roc Aviation Company BN-2B-20 aircraft, national registration number B-68802, executed a ferry flight mission from Fongnian Airport (RCFN) to Songshan Airport (RCSS). Except the instructor pilot and copilot, the flight departed with one additional copilot and one maintenance personnel, totally four people on board.

The occurrence aircraft took off at about 1210 Taipei local time. After take-off, the aircraft encountered dual generator warning lights on during climb. The flight crew contacted Kaohsiung Approach and requested radar vector to return to RCFN for aircraft maintenance. On final approach, the aircraft encountered left engine failure. At 1227:08, the flight crew established communication with the RCFN tower. The RCFN tower requested the aircraft kept visual contact and joined west route for a final approach. The flight crew explained to the tower about the failures of aircraft left engine and generator, and was cleared to land on runway 04 as requested. After the flight crew conducted emergency procedures, the aircraft was landed at RCFN uneventfully and there was no injury to the persons on board.

After the aircraft landed, the investigation team examined and found that number 3 cylinder of left engine was separated from crankcase and was protruded outwards caused burst and deformation of left engine right hand side inboard cowlings.

According to the Republic of China (ROC) Aviation Occurrence Investigation Act, and the content of Annex 13 to the Convention on International Civil Aviation, the Aviation Safety Council (ASC), an

independent aviation occurrence investigation agency, was responsible for conducting the investigation. The organization or agency been invited to join the investigation team included: Civil Aeronautics Administration of Ministry of Transportation and Communications, Roc Aviation Company, National Transportation Safety Board of the United States of America, Air Accidents Investigation Branch of the United Kingdom, engine manufacturer, Lycoming and aircraft manufacturer, Britten Norman.

In accordance with the procedures, the draft final report was reviewed at ASC's 43<sup>th</sup> Board meeting on March 29, 2016. The draft report then distributed to related organizations and agencies for comments. After comments were collected and integrated, the draft final report was revised and approved by the ASC's 44<sup>th</sup> Board meeting on April 26, 2016.

Based on the factual information gathered during the investigation and the results of analysis, eight findings were obtained and three flight safety recommendations were issued as stated below.

### **Findings as the result of this investigation**

The ASC presents the findings derived from the factual information gathered during the investigation and the analysis of the occurrence. The findings are presented in three categories: **findings related to probable causes**, **findings related to risk**, and **other findings**.

The **findings related to probable causes** identify elements that have been shown to have operated in the occurrence, or almost certainly operated in the occurrence. These findings are associated with unsafe acts, unsafe conditions, or safety deficiencies associated with safety significant

events that played a major role in the circumstances leading to the occurrence.

The **findings related to risk** identify elements of risk that have the potential to degrade aviation safety. Some of the findings in this category identify unsafe acts, unsafe conditions, and safety deficiencies including organizational and systemic risks, that made this occurrence more likely; however, they cannot be clearly shown to have operated in the occurrence alone. Furthermore, some of the findings in this category identify risks that are unlikely to be related to the occurrence but, nonetheless, were safety deficiencies that may warrant future safety actions.

**Other findings** identify elements that have the potential to enhance aviation safety, resolve a controversial issue, or clarify an ambiguity point which remains to be resolved. Some of these findings are of general interests that are often included in the ICAO format accident reports for informational, safety awareness, education, and improvement purposes.

### **Findings Related to Probable Causes**

1. A post occurrence examination found that 5 out of 8 stud bolt nuts were not at their positions. During engine overhaul, under torque condition might exist when number 3 cylinder was installed. This caused insufficient tightness of number 3 cylinder and crankcase connection. The accumulated flight hours of left engine were more than 1,400 hours. Long term operation of engine and axial movement of piston led to the looseness of stud bolt nuts. Some stud bolt nuts might be separated before the occurrence to produce vibration at the mating surface of number 3 cylinder and crankcase during engine operation. Subsequent bending or fracture of stud bolts thus caused the

separation of number 3 cylinder from crankcase and then damaged to left engine. (1.16.1, 1.18.3, 1.18.4, 2.2.1, 2.2.3)

### **Findings Related to Risk**

1. The flight crew did not follow the procedures of the Aircraft Operation Manual to declare emergency immediately when encountering engine failure. The flight crew did not apply standard callout procedures and accurately express the situation of aircraft and flight crew's intention to Kaohsiung Approach Control Tower and Fongnian Tower. As a result, controllers could not realize aircraft condition at that time to provide timely assistances. (1.18.2.1, 1.18.2.2, 1.18.2.3, 2.4.2)

### **Other Findings**

1. No abnormal log entries were found after reviewing maintenance records for the previous 3 months before the occurrence. The airworthiness directives were all controlled in compliance with time constraints of the aircraft. (1.6.3, 2.1)
2. The dimensions of number 3 cylinder barrel conformed to the specifications as specified in the Lycoming Service Instruction No. 1047B. (1.16.1, 2.2)
3. After left engine number 3 cylinder separated from crankcase, normally operated pistons drove crank which caused piston travelling out of number 3 cylinder during down stroke. The upper and lower compression rings sprang from the piston gauges and hit number 3 cylinder resulted in the breakage of both rings. (1.16.2, 1.18.3, 2.2.2)
4. The piston was travelled out of number 3 cylinder which resulted in vibration and decrease of rotational speed of left engine. Thereafter

the output voltage of left generator been driven by left engine fell to below  $25.5\pm 0.5$  volts caused left generator warning light illuminated. After left generator failure, the live right generator instantaneously carried the whole aircraft electrical loads. These loads might approach the single generator maximum load of 50 amperes which resulted in the output voltage of the right generator below  $25.5\pm 0.5$  volts thus caused the illumination of right generator warning light. After the flight crew reset generator, the right generator warning light was extinguished and aircraft electrical supply returning to normal. (1.6.3.3, 1.18.2.3, 2.3)

5. The temporary loss of aircraft electrical power, the reset standby time and the interrogation interval of Mode-C transponder caused no altitude records of the air traffic control radar data during the period from 1223:20 to 1226:20. (1.6.3.4, 1.11.3, 1.18.1.2, 2.3)
6. The flight crew landed the aircraft in tailwind condition by using Fongnian Airport runway 04 during emergency situation. In addition to the runway length was more than triple of the occurrence aircraft's landing distance, the flight crew could be guided by approach tower controller to the shortest route to land the aircraft. With regard to the operational characteristics of key left engine failure and weather conditions at that time, the usage of runway 04 to land the aircraft was much more conformable to safety consideration than using runway 22. (1.7.2, 1.18.1.1, 1.18.1.2, 2.4, 2.4.1)

## **Safety Recommendation**

### **To Roc Aviation Company**

1. Enhance the promulgation to flight crew following company's manuals to declare emergency immediately when encountering engine failure condition. (ASC-ASR-16-05-001)

**To Civil Aeronautics Administration, Ministry of Transportation and Communications**

1. Supervise Roc Aviation Company to enhance the promulgation to flight crew following company's manuals to declare emergency immediately when encountering engine failure condition. (ASC-ASR-16-05-002)

**To Lycoming engine**

1. It is recommended that Lycoming follows the suggestions of Special Airworthiness Information Bulletin NE-14-13 issued by the Federal Aviation Administration to control overhaul quality of 540 series engine. (ASC-ASR-16-05-002)