

AI2007-3

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

POLICE DEPARTMENT OF NAGASAKI PREFECTURE

BELL 206L-3, JA6114

TWO EMERGENCY LANDINGS DUE TO ENGINE STOPPAGE,
IN FLIGHT

INCIDENT A; KAMIKAWACHI-CHO, KAWACHI-GUN,
TOCHIGI PREFECTURE, JAPAN

AT ABOUT 11:09 JST, JULY 15, 2004

AND

INCIDENT B; UTSUNOMIYA AERODROME, JAPAN

AT ABOUT 13:53 JST, SEPTEMBER 20, 2004

November 30, 2007

Aircraft and Railway Accidents Investigation Commission
Ministry of Land, Infrastructure and Transport

The investigation for this report was conducted by Aircraft and Railway Accidents Investigation Commission, ARAIC, about the aircraft serious incident of POLICE DEPARTMENT OF NAGASAKI PREFECTURE BELL 206L-3, JA6114 in accordance with Aircraft and Railway Accidents Investigation Commission Establishment Law and Annex 13 to the Convention of International Civil Aviation for the purpose of determining cause of the aircraft accident and contributing to the prevention of accidents and not for the purpose of blaming responsibility of the accident.

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Norihiro Goto,
Chairman,
Aircraft and Railway Accidents Investigation Commission

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October 26,2007

**Adopted by the Aircraft and Railway Accidents Investigation Commission
(Air Sub-committee)**

| | |
|-----------------|-----------------------|
| Chairman | Norihiro Goto |
| Member | Yukio Kusuki |
| Member | Shinsuke Endo |
| Member | Noboru Toyooka |
| Member | Yuki Shuto |
| Member | Akiko Matsuo |

1. THE PROCESS AND PROGRESS OF THE SERIOUS INCIDENT INVESTIGATION

1.1 Summary of the Serious Incidents

Incident A and Incident B fall under the category of “continued stoppage of an engine during flight” as stipulated in clause 7, article 166-4 of the Civil Aeronautics Regulations in Japan and as such, are classified as Aircraft Serious Incidents.

1.1.1 Incident A

On Thursday July 15, 2004, the Bell 206L-3 “Long Ranger”, JA6114 which is operated by Nagasaki Police Department took off from Utsunomiya aerodrome at about 10:23 for a test flight with the pilot in command (PIC) and two persons (mechanics) on board. While the aircraft was in flight performing an autorotation test near Kinugawa glider field (Kinugawa field), Kamikawachi-Cho, Kawachi-Gun, Tochigi Prefecture, the engine suddenly stopped at about 11:09, and the aircraft made an emergency landing at Kinugawa field.

| | |
|-------------------------------|------|
| Injuries to persons on board: | none |
| Damage to the aircraft: | none |

1.1.2 Incident B

On Monday September 20, 2004 (a national holiday), the aircraft took off from Utsunomiya aerodrome at about 13:35 for a test flight with the same PIC and one person (mechanic) on board as in Incident A. While the aircraft was flying over the runway of Utsunomiya aerodrome performing an autorotation test, the engine suddenly stopped at about 13:53, and the aircraft made an emergency landing at Utsunomiya aerodrome.

| | |
|-------------------------------|------|
| Injuries to Persons on board: | none |
| Damage to the aircraft: | none |

1.1.3 The Management of the Investigations

Incident B occurred during a test flight to investigate Incident A. Consequently,

the investigations of these two serious incidents were combined into a single investigation based on the investigation in progress of Incident A. This serious incident investigation report is the combined report of the investigations of these two serious incidents.

1.2 Outline of the Serious Incident Investigation

1.2.1 The Organization of the Investigation

- (1) On July 16, 2004, the Aircraft and Railway Accidents Investigation Commission (ARAIC) assigned an Investigator-in-Charge and an investigator to investigate Incident A. An additional investigator was further assigned on July 20, 2004.
- (2) On September 21, 2004, the ARAIC assigned an Investigator-in-Charge and two investigators to investigate Incident B
(Those three investigators were the same persons as described in (1) above.).

1.2.2 Representatives of Foreign States

A representative of Canada, the state of design and manufacture of the aircraft, and a representative of the United States of America, the state of design and manufacture of the engine of the aircraft, participated in the serious incident investigations.

1.2.3 The Implementation of the Investigation

- (1) The investigation of Incident A

| | |
|--------------------|--|
| July 16, 2004 | On-site investigation, aircraft investigation and witness interviews |
| July 21, 2004 | Bench test of the engine |
| July 24, 2004 | Bench test of the fuel control accessories |
| September 8, 2004 | Bench test of the engine |
| September 16, 2004 | Ground test of the engine reinstalled in the aircraft |

(2) The investigation of Incident B

| | |
|--------------------|--|
| September 21, 2004 | On-site investigation, aircraft investigation and witness interviews |
| September 23, 2004 | Aircraft investigation and ground test run up |
| October 7, 2004 | Ground test run up |
| October 8, 2004 | Test flight for autorotation |
| November 4, 2004 | Bench test and teardown inspection of the fuel control accessories (Power Turbine Governor (PTG), fuel pump and fuel nozzles). |
| December 7–8, 2004 | Bench test and teardown inspection of the Gas Producer Fuel Control (GPFC) |
| February 18, 2005 | Investigation of engine combustion liners |
| March 14–21, 2005 | Test flight for autorotation |

As described in 2.7.10, the result of the investigation performed by the engine manufacturer was reflected on this final report.

1.2.4 Comments from Persons relevant to the Cause of the Serious Incidents

Comments were submitted from the persons associated with the incidents.

1.2.5 Consultation with Participating States

The comments on the draft report were invited from the Participating States.

2. FACTUAL INFORMATION

2.1 Flight history

2.1.1 According to the statements of the three persons on board the aircraft, the PIC and two mechanics, the outline of the progress of the flight until Incident A occurred was as follows.

On July 15, 2004, the Bell 206L-3 “Long Ranger”, JA6114(hereinafter called

“the aircraft”), which is operated by Nagasaki Prefecture Police Department took off from Utsunomiya aerodrome at 10:23 for a test flight with the PIC and two mechanics on board. After taking off, the aircraft performed satisfactory transponder check, engine power check and other checks in the airspace around Utsunomiya aerodrome, and then flew to the vicinity of Kinugawa field to perform a test flight for autorotation (autorotation test). The PIC planned to perform the autorotation test between altitudes of 3,000–2,000ft while approaching the Kinugawa field runway from the north. At about 11:09, the N2 (Power Turbine speed) indication rose slightly when the collective pitch lever was lowered fully down to enter autorotation, so the PIC waited until N2 stabilized at 100% before closing the throttle to the idle position. At that time, the PIC confirmed that the Nr (Main Rotor speed) indication was within the green arc (normal operating range). Soon after that, at an altitude of around 2,800ft, the red “engine out” warning light illuminated accompanied by the engine out aural warning sound. At that time, the mechanic, who was sitting in the front seat, noticed that the TOT (Turbine Outlet Temperature) indication was 350°C which was lower than about 400°C that is the normal temperature of idle, and he informed the PIC. The PIC opened the throttle fully to increase power and to check the engine condition, but the engine did not respond. At that time, the TOT indication had further decreased to 250°C. The PIC judged that the engine had flamed out and decided to make an emergency landing at Kinugawa field, and reported to Utsunomiya Approach Control Facility saying “Utsunomiya Tower, JA6114, Emergency Landing. Making autorotation landing at Ujiie glider field (another name of Kinugawa field)”. The aircraft made an emergency landing at Kinugawa field at 11:10. During the time, neither the PIC nor the mechanics checked the N1 (Gas producer turbine speed) indication.

The serious incident occurred about 1km northwest of Kinugawa field at an altitude of around 2,800ft at about 11:09.
(See Figure 1 and Photograph 1)

2.1.2 According to the statements of the two persons on board the aircraft, the PIC and the mechanic, who were the same persons as in the case in 2.1.1, the outline of the progress of the flight until Incident B occurred was as follows.

On September 20, 2004, the aircraft took off from Utsunomiya aerodrome at 13:35 for a test flight with the PIC and a mechanic on board. The PIC planned to perform repeated autorotation tests over the runway at Utsunomiya aerodrome during descent from an altitude of 2,800ft to 500ft, carrying out up to six autorotation tests during each descent. He planned to carry out around 50 autorotation tests within 1 hour

35 minutes flight time. The mechanic planned to record all instrument indications, N1, N2, Nr, TOT, etc. during the autorotation tests using a video tape recorder (VTR).

After taking off, the PIC performed the five autorotation tests during a single descent from an altitude of 2,800ft–1,000ft, and intended to successively perform a sixth test (the 59th autorotation from the first autorotation on September 17, 2004) while continuing to descend to 500ft. However, shortly after entering autorotation, the red “engine out” warning light illuminated accompanied by the engine out aural warning. At the same time, the N1, N2, and TOT engine instrument indications all decreased suddenly. The PIC judged that the engine had flamed out and decided to make an emergency landing on the runway of Utsunomiya aerodrome, and reported to Utsunomiya Aerodrome Control Facility saying “Utsunomiya Tower, JA6114, Flame Out, Flame Out, Emergency Landing, Main Runway”. The aircraft made an emergency landing on the runway at Utsunomiya aerodrome at 13:53.

The serious incident occurred at about 13:53 at an altitude of about 1,000ft over the runway of Utsunomiya aerodrome.

(See Figure 2 and Photograph 2)

2.2 Crew Information

| | |
|--|--------------------------|
| PIC: Male, aged 39 | |
| Commercial Pilot License (Rotorcraft) | Issued December 13, 1989 |
| Ratings | |
| Single turbine engine (land) | Issued December 13, 1989 |
| Class 1 Airman Medical Certificate | |
| Term of Validity | until April 17, 2005 |
| Total flight time | |
| (1) At the time of Incident A | 3,461 hours 02 minutes |
| (2) At the time of Incident B | 3,499 hours 22 minutes |
| Flight time during the previous 30 days | |
| (1) At the time of Incident A | 28 hours 35 minutes |
| (2) At the time of Incident B | 26 hours 40 minutes |
| Total flight time on the same type of the aircraft | |
| (1) At the time of Incident A | 25 hours 30 minutes |

| | |
|---|---------------------|
| (2) At the time of Incident B | 29 hours 30 minutes |
| Flight time during the previous 30 days | |
| (1) At the time of Incident A | 0 hours 25 minutes |
| (2) At the time of Incident B | 3 hours 15 minutes |

2.3 Aircraft Information

2.3.1 The Aircraft

| | |
|--|--|
| Type | Bell 206L-3 |
| Serial Number | 51543 |
| Date of manufacture | December 4, 1991 |
| Certificate of Airworthiness | None |
| Aircraft categories | Rotorcraft, Normal Category or Aircraft Category X |
| Total flight time | |
| (1) At the time of Incident A | 4,196 hours 25 minutes |
| (2) At the time of Incident B | 4,201 hours 40 minutes |
| Flight time since scheduled maintenance (600Hr Time Check on July 14, 2004) | |
| (1) At the time of Incident A | 0 hours 25 minutes |
| (2) At the time of Incident B | 5 hours 40 minutes |

2.3.2 The Engine

| | |
|--|------------------------|
| Type | Allison 250-C30P |
| Serial Number | CAE-895616 |
| Date of manufacture | September 24, 1991 |
| Total flight time | |
| (1) At the time of Incident A | 4,196 hours 25 minutes |
| (2) At the time of Incident B | 4,201 hours 40 minutes |
| Flight time since scheduled maintenance (Overhaul on June 29, 2004) | |
| (1) At the time of Incident A | 0 hours 25 minutes |
| (2) At the time of Incident B | 5 hours 40 minutes |

2.3.3 Weight and Center of Gravity

- (3) The weight of the aircraft at the time of Incident A is estimated to have been approximately 3,373lbs, with the center of gravity at 122.1 inches. It is estimated that both values were within the allowable limits (maximum take-off weight 4,150lbs, with an allowable center of gravity range corresponding to the weight at the time of the serious incident of 118.4–127.8 inches).
- (2) The weight of the aircraft at the time of Incident B is estimated to have been approximately 3,430lbs, with the center of gravity at 121.5 inches. It is estimated that both values were within the allowable limits (maximum take-off weight 4,150lbs, with an allowable center of gravity range corresponding to the weight at the time of the serious incident of 118.4–127.8 inches).

2.3.4 Fuel and Lubricating Oil

The fuel on board was aviation fuel Jet A-1. The lubricating oil was Mobil 254.

2.4 Meteorological Information

2.4.1 Aviation weather during the time period relating to Incident A

- (1) The aviation meteorological observations at Utsunomiya aerodrome, which is located approximately 20km south-southwest of Kinugawa field were as follows:

| Time of Observation | 11:00 JST | 12:00 JST |
|----------------------|-----------|-----------|
| Wind Direction | 120° | 180° |
| Wind Speed | 3kt | 7kt |
| Visibility | 7km | 7km |
| Cloud Amount | 1/8 | 1/8 |
| Cloud Type | Cumulus | Cumulus |
| Height of Cloud Base | 2,500ft | 2,500ft |
| Cloud Amount | 3/8 | 3/8 |
| Cloud Type | Cumulus | Cumulus |

| | | |
|-------------------------|------------|------------|
| Height of Cloud Base | 3,500ft | 3,500ft |
| Cloud Amount | --- | 5/8 |
| Cloud Type | --- | Cirrus |
| Height of Cloud Base | --- | 21,000ft |
| Temperature | 31°C | 33°C |
| Dew Point | 22°C | 22°C |
| Altimeter Setting (QNH) | 29.94-inHg | 29.91-inHg |

- (2) According to the PIC, the weather conditions at Kinugawa field at the time of Serious Incident A were as follows:

Weather: clear, Wind direction: south, Wind speed: around 7kt, Visibility: good.

2.4.2 The aviation meteorological observations at Utsunomiya aerodrome during the time period relating to Incident B were as follows:

| Time of Observation | 13:00 JST | 14:00 JST |
|----------------------|------------------|-------------------|
| Wind Direction | 160° | 190° |
| Wind Speed | 6kt | 8kt |
| Visibility | 7km | greater than 10km |
| Cloud Amount | 1/8 | 1/8 |
| Cloud Type | Towering cumulus | Cumulus |
| Height of Cloud Base | 2,500ft | 2,500ft |
| Cloud Amount | 3/8 | 4/8 |
| Cloud Type | Cumulus | Cirrus |
| Height of Cloud Base | 5,000ft | 20,000ft |
| Temperature | 30°C | 30°C |
| Dew Point | 22°C | 22°C |
| Altimeter Setting | 29.97 inHg | 29.98 inHg |

2.5 The Serious Incident Sites

2.5.1 Incident A occurred about 1km northwest of Kinugawa field at an altitude of around 2,800ft. The site of the emergency landing was on the runway of Kinugawa field (length: 600m, width: 25m, surface: unpaved and rolled), which is located on the dry riverbed of the Kinu River in Kamikawachi-Cho, Kawachi-Gun, Tochigi-Prefecture, about 50m from the south end of the runway (about 1.1km south of Ujiie Bridge).

The aircraft came to rest with its nose pointing south approximately parallel to the runway.

(See Figure 1 and Photograph 1)

2.5.2 Incident B occurred over the runway of Utsunomiya aerodrome at an altitude of around 1,000ft. The site of the emergency landing was on the runway of Utsunomiya aerodrome (length: 1,700m, width: 45m) on the centerline around 350m north from the south end of the runway.

The aircraft came to rest with its nose pointing south parallel to the runway.

(See Figure 2 and Photograph 2)

2.6 Tests and Research to Find Facts

2.6.1 Tests and Research for the Investigation of Incident A

- (1) An investigation of the following items was made at the company which carried out maintenance on the aircraft (the maintenance company). No abnormalities were found as a result.
 - ① Inspection of the fuel filter found no foreign particle contamination.
 - ② Tests of a fuel sample collected from the aircraft's fuel tank found no contamination by water or foreign particles.
 - ③ The rigging of the fuel control accessories (GPFC and PTG) was checked and found to be normal.
 - ④ Inspection of the control systems of the GPFC and PTG found them to be functioning normally.
 - ⑤ No loose fitting of any fuel pipes or pneumatic tubes connections was found. It was also confirmed that there was no interference of these pipes and tubes with other structures.

- (2) The aircraft's engine was bench-tested at the company where the engine was overhauled (the engine overhauler). No evidence of abnormality was found.
- (3) The aircraft's fuel control accessories (GPFC, PTG, fuel pump and fuel nozzles) were bench-tested at the engine overhauler. No evidence of abnormality was found.
- (4) The aircraft's engine was bench-tested at the engine overhauler to investigate whether it would flame out during a simulated N1 RPM undershoot (relating to 2.7.2 below). The N1 RPM undershoot was reproduced, but flame out did not occur.
- (5) The engine was reinstalled on the aircraft at the maintenance company and tested by a ground run. No evidence of abnormality was found as a result. Further, it was also attempted to reproduce the N1 RPM undershoot described in (4) above during the ground test, but it could not be reproduced.

2.6.2 Test and Research for the Investigation of Incident B

The items below were investigated following on from the tests and research relating to the investigation of Incident A.

- (1) An engine ground test run conducted at the maintenance company found no evidence of abnormality.
- (2) That the following inspections carried out on the aircraft at the maintenance company found no evidence of abnormality.
 - ① No leakage from the fuel tank and no leakage or torsion of the fuel pipes was found.
 - ② The engine was tested to check whether it would flame out under a low fuel supply condition by running it for two minutes on the ground with the booster pump off. The engine did not flame out.
 - ③ The fuel spray condition of the fuel nozzles was checked by motoring the engine. It was confirmed that the fuel spray was normal, and that the spray condition followed the throttle control when the throttle was operated.
 - ④ Leakage of engine and aircraft fuel pipes was tested by vacuum pressure. Normal conditions were confirmed.
 - ⑤ The thickness of the shims on the fuel nozzles was found to be normal.
 - ⑥ A pressure check of the Pc (Compressor Discharge pressure) line was normal.
 - ⑦ The rigging of engine control system was found to be normal.

- ⑧ The torques of the B nut couplings of the fuel pipes, lubrication oil pipes and pneumatic tubes were found to be normal.
 - ⑨ The Pr (Regulated Air Pressure) line was found to be free from clogging.
 - ⑩ The fuel nozzles were disassembled and the screens were inspected and found to be in a normal condition.
- (3) The engine's GPFC was replaced with a unit leased from the maintenance company at the engine overhauler, a ground test run was carried out. The engine functioned normally and no abnormality was found. Another pilot then made an autorotation flight test over the runway of Utsunomiya aerodrome, and flame out occurred on the 33rd autorotation test.
- (4) The aircraft's fuel control accessories (PTG, fuel pump and fuel nozzles) were bench-tested and inspected by disassembly at the engine overhauler. No evidence of abnormality was found.
- (5) The aircraft's GPFC was bench tested and inspected by disassembly at the GPFC manufacturer. No evidence of abnormality was found.
- (6) The engine combustion liners were checked at the engine overhauler, and no evidence of abnormality was found.
- (7) The engine was reinstalled in the aircraft and a ground test run was conducted at the maintenance company. No abnormality was found as a result. Continuing from the ground test, an autorotation flight test was carried out at Utsunomiya aerodrome in accordance with the operating procedures in the "Service News" bulletin described in 2.7.6. No abnormality was found as a result.

2.7 Other Relevant Information

2.7.1 The aircraft's engine had received its third overhaul before Incident A occurred. During that overhaul, all turbine blades in stages 1 to 4 were replaced in accordance with the aircraft's Engine Overhaul Manual. All fuel control accessories were also overhauled at the same time.

2.7.2 The aircraft's Operation and Maintenance Manual (the Maintenance Manual) describes as follows regarding practice for autorotation descent and landing.

Practice Autorotation Descent and Landing:

To make a practice autorotation landing at minimum engine power,

position the throttle in the GROUND IDLE position and observe the following conditions.

- (1) During autorotation, avoid a pausing or creeping movement of any throttle increase or decrease between IDLE and FULL OPEN. If the movement is not made at a firm and continuous rate, N1 rpm undershoot and/or oscillation (which may cause a momentary, false Engine Out warning indication) may occur.*

2.7.3 According to the engine manufacturer, even if N1 rpm undershoot or oscillation described in 2.7.2 above had occurred on the aircraft's engine, fuel flow would always have been maintained at a sufficient level to prevent flame out.

2.7.4 For the autorotation flight test in Incident A, the PIC had planned to enter autorotation at 3,000 ft by lowering the collective pitch level to full down then closing the throttle lever to reduce the engine to idle power, and to descend in that condition to 2,000 ft.

On the other hand, for the autorotation flight test in Incident B, the PIC planned to enter autorotation at 2,800 ft in the same way as above, then after confirming the aircraft to be in autorotation to increase engine power again, and to repeat above mentioned procedure six times while descending to 500 ft.

2.7.5 VTR recordings relating to Incident B

The aircraft's instrument indications and the actions of the PIC at the time that Incident B occurred were confirmed by VTR recordings as follows.

- (1) The N2 indication just before Incident B occurred was around 102%, which is greater than the usual indication of around 100% in normal autorotation. The torque indication just before Incident B occurred was around 20%, lower than the usual indication of around 30% in normal autorotation.
- (2) When Incident B occurred, the PIC had carried out the same actions as in Incident A, first lowering the collective pitch lever then closing the throttle lever. The flame out occurred immediately after the throttle lever was closed.
- (3) The PIC did not mishandle the throttle lever on the occurrence of the Incident B in the way described in the Maintenance Manual that might cause N1 rpm undershoot or oscillation as mentioned in 2.7.2.
- (4) The N1, N2 and TOT indications all decreased rapidly when Incident B occurred.

2.7.6 In view of the two serious incident occurrences, the engine overhauler

established operating procedures to prevent flame out, obtained agreement from the engine manufacturer, and issued a “Service News” bulletin (dated March 14, 2005, subject: 250-C30 series, To prevent flame out at autorotation training and testing) to operators of the same engine model as the aircraft’s engine.
(See Attachment)

2.7.7 An engine automatic re-light system had not been fitted on the aircraft.

2.7.8 According to the aircraft’s manufacturer, apart from these two serious incidents, cases of engine flame out during simulated autorotation on the same model of aircraft resulting in engine stoppage had occurred three times worldwide during a total flight time of 3,908,215 hours (current on May 1, 2005). The resulting investigations did not find anything that allowed the cause to be identified.

2.7.9 Permits for the test flights on the two serious incidents and for the test flights described in 2.6.2(3) and (7) had been obtained under the provisions of Civil Aeronautics Law article 11.

2.7.10 Combustion liner testing done by the engine manufacturer

Two occurrences happened in which an engine suddenly stopped during engine running on the ground when the power was decreased from full throttle to ground idle. The first one happened on July 7, 2005 (Thursday) to JA6144, the same type as the serious incident aircraft, which is operated Ibaraki Prefecture Police Department and the second one happened on October 7, 2005(Friday) to JA6114, the serious incident aircraft. The engines of both aircraft were equipped with low-smoke type liner (part number: 23066675) in the combustors. The engine manufacturer conducted the lean blow out engine testing with above mentioned liners and one test cell slave liner, and issued on June 29, 2007 the investigation report (Japan Police B206L3 Helicopter Model 250-C30P Engine Low Smoke Liner Lean Blow Out Investigation EDR21992 JUNE 2007) which shows that the engine did not exhibit susceptibility to lean blow out^{*1} with either three liners mentioned above.

^{*1} lean blow out means a condition where the flame in the combustion chamber goes out during rapid intentional deceleration of the engine to a min flow condition.

3. ANALYSIS

3.1 The PIC had valid airman proficiency and valid airman medical certificates in accordance with applicable regulations.

3.2 The aircraft had been maintained in accordance with applicable regulations.

3.3 It is estimated that the weather conditions at the time when the two serious incidents occurred did not directly contribute to the two serious incidents.

3.4 As a result of the investigations described in 2.6.1 and 2.6.2, the aircraft, the engine, and the fuel control accessories were all in normal condition and were functioning normally, and no abnormality was found that could have caused the two serious incidents.

Further, discrepancies leading to the cause of this serious incident were not found from the result of the investigation, as described in 2.7.10, conducted by the engine manufacturer in response to the events of sudden stop on the ground of the same type engine as that of this serious incident.

3.5 As described in 2.6.2(3), when another pilot carried out an autorotation flight test after the aircraft's GPFC was replaced with a unit leased from the engine overhauler, the flameout recurred. It is estimated that the flameout occurred not because of any faults or the characteristics of the aircraft's GPFC.

3.6 Regarding the engine stoppage by the flameout accompanied during autorotation flight tests in both serious incidents, from the fact that all of the N1, N2 and TOT instrument indications decreased rapidly and then the engine stopped according to the statements of the PIC and the mechanic on board and the VTR recordings described in 2.7.5, it is estimated that this was caused by insufficient fuel being supplied to the engine at the time.

The cause of insufficient fuel supply to the engine could not be found.

3.7 As described in 2.7.3, according to the engine manufacturer, even if N1 rpm undershoot or oscillation occurred, sufficient fuel flow would be always have been

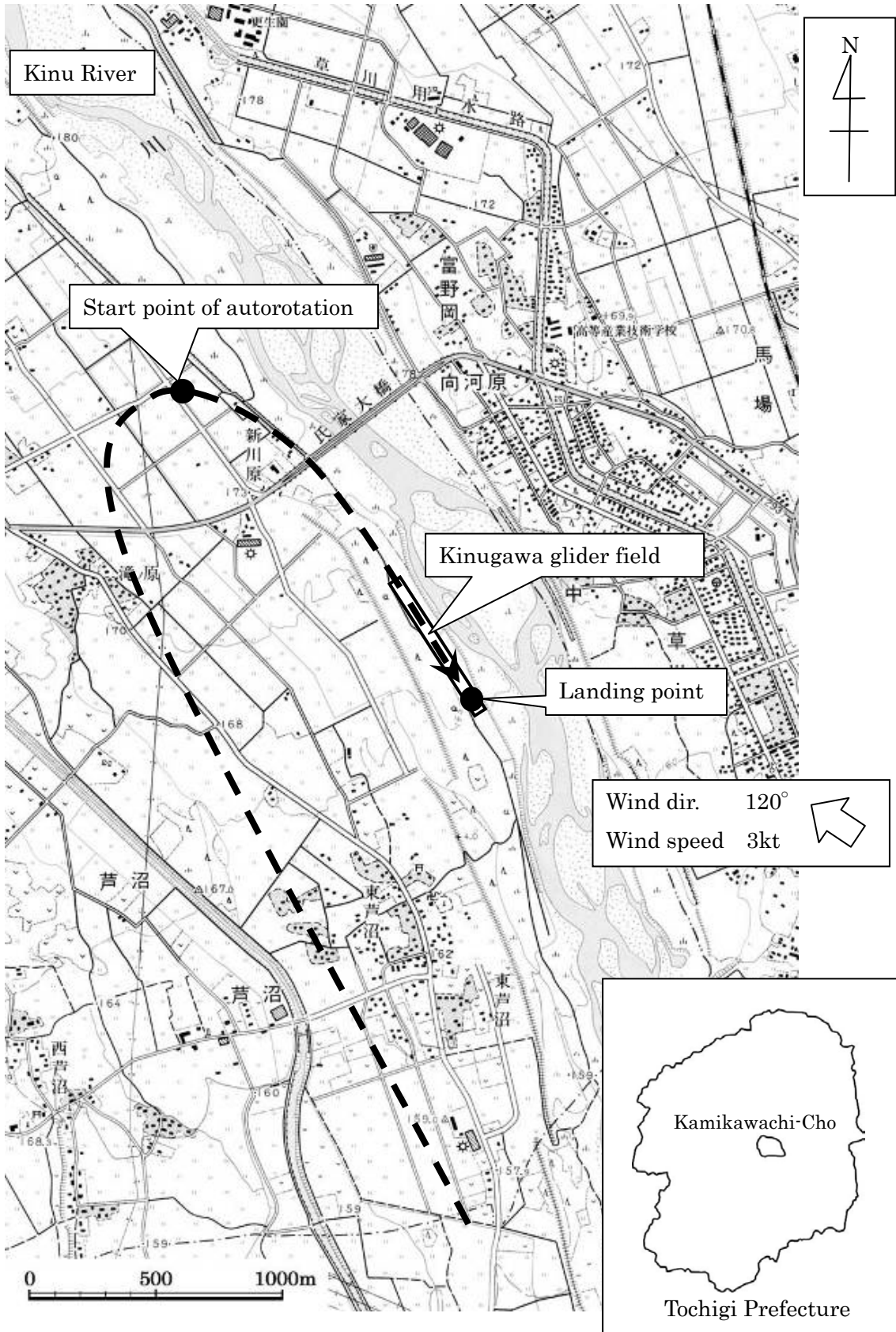
maintained to prevent flameout. However, given that the N1,N2 and TOT indication decreased when Incident B occurred as described in 2.7.5(4), it is thought that it cannot be concluded that the level of fuel flow is always maintained to prevent flame out.

4. PROBABLE CAUSE

It is estimated that in both of the two serious incidents, “continued stoppage of an engine during flight” occurred during autorotation test flight because necessary amount of fuel has not been supplied to the engine.

The cause why necessary amount of fuel has not been supplied to the engine could not be found.

Figure 1 Estimated Flight Route (1)



Source: The National Land Agency 1/25,000

Figure 2 Estimated Flight Route (2)

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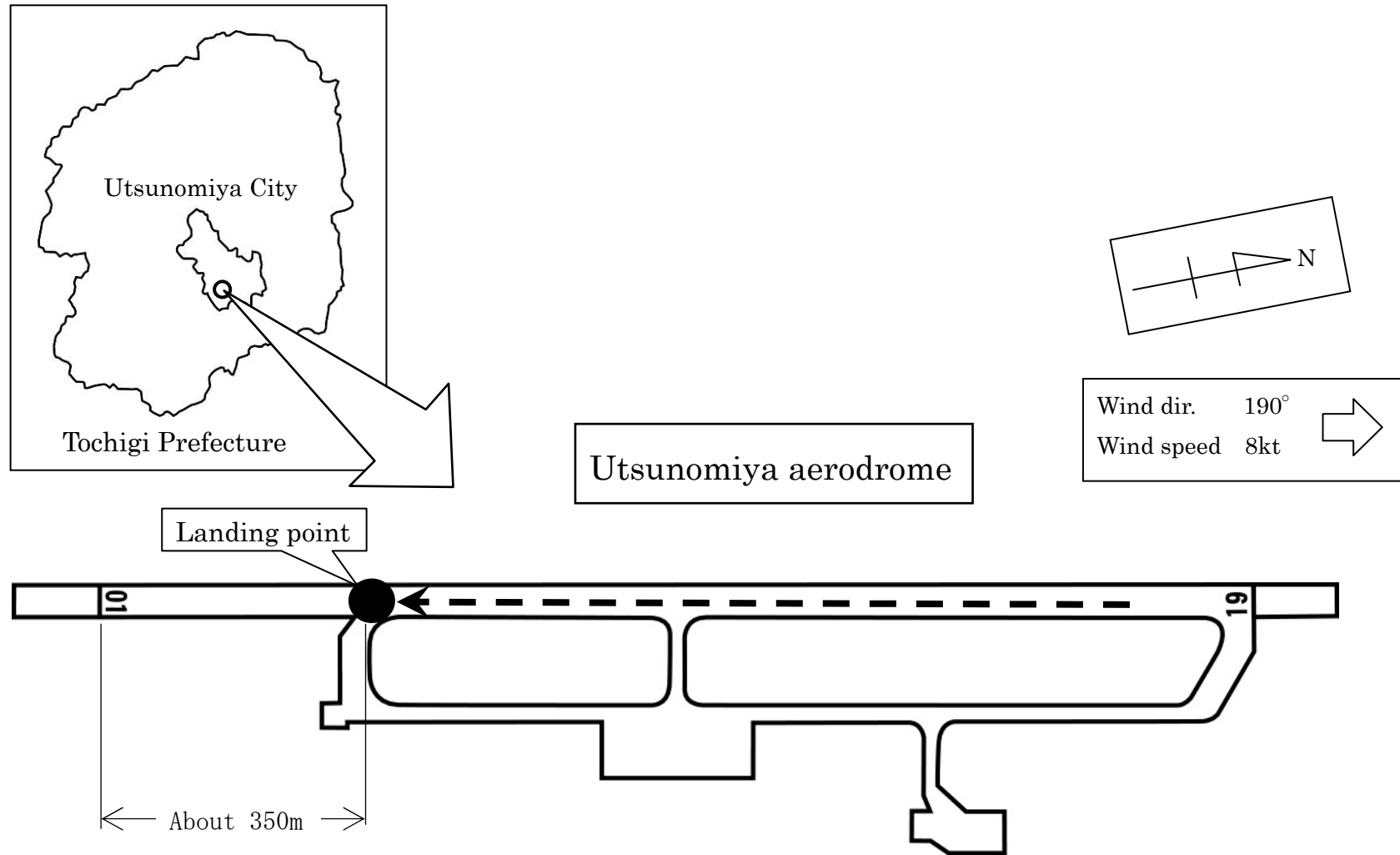
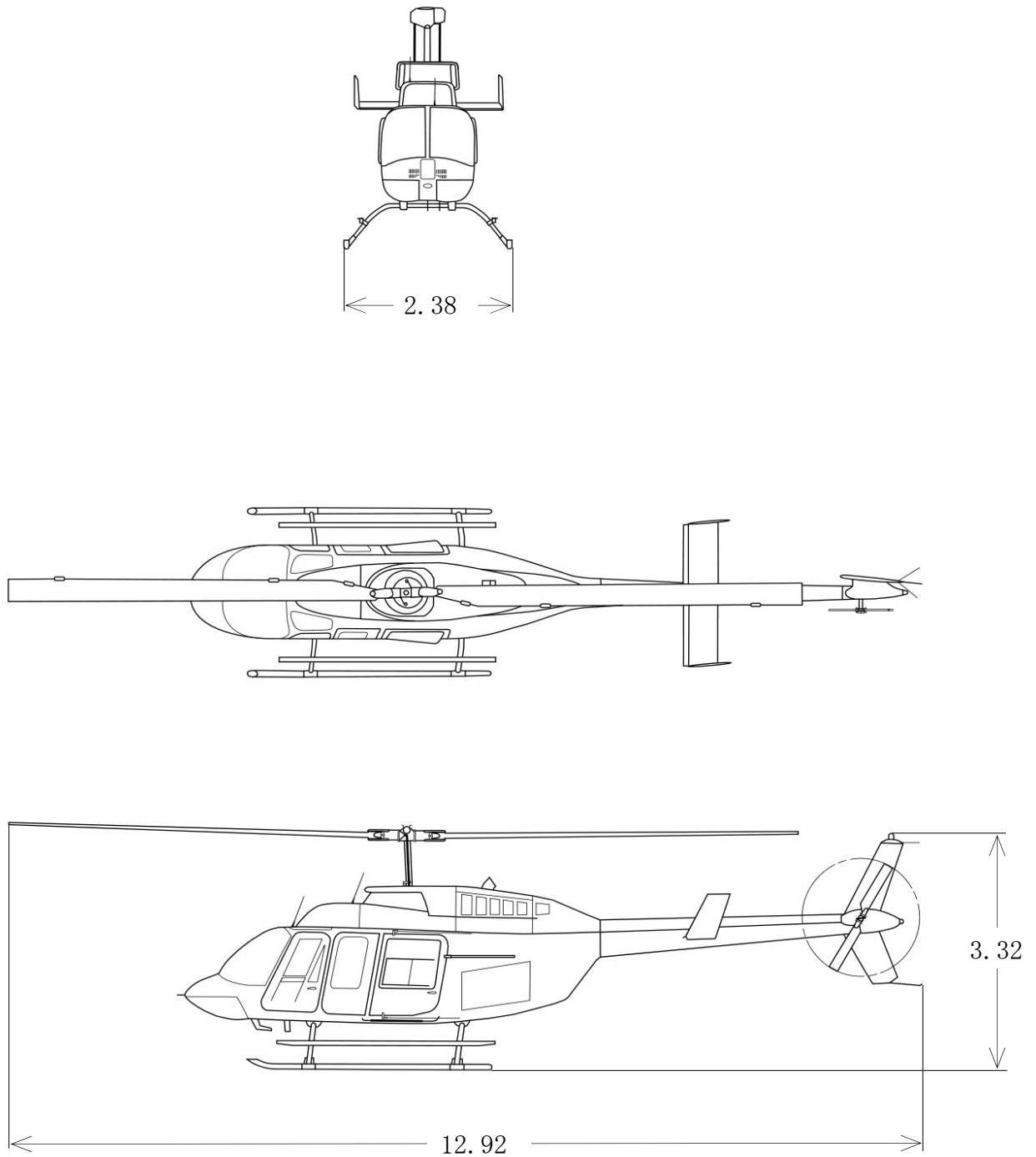


Figure 3 Three angle view of Bell 206L-3

Unit : m



Photograph 1 The aircraft (1)



Photograph 2 The aircraft (2)



SERVICE NEWS

No. SN-250-081

Dated March 14, 2005

Subject: 250-C30 series, To prevent engine flame out at auto rotation training or testing

The purpose of this Service News is to inform operators the description of recent flame out incidents happened on 250-C30P engine, and to inform operators the procedures to prevent excess fuel flow reduction when practice auto rotation entry for minimize the possibility of flame out considered from engine fuel system operation.

1. Description of the Incident:

Recently, during practice auto rotation entry the helicopter installed 250-C30P engine experienced engine flame out 3 times. From video tape recorded at flame out incident, first the collective lever was lowered and next the throttle was retarded to idle. Immediately after that it is assumed that the engine flame out occurred. Also the N2 rpm was high as 100 to 102% rpm and the torque was low as 20% from video recorded.

2. Investigation Result:

As a flame out investigation, the engine was tested on test bench and the fuel system components were functionally tested and disassembled. There were no defect and abnormality on these components. Also, the GPFC, main component of the fuel system was investigated by Honeywell who is the manufacturer of the GPFC. No abnormality was found on the GPFC.

3. Difference of fuel flow change between operation procedures

The cause of the flame out is not clear at this time. But, to prevent excess fuel flow reduction during practice auto rotation entry is believed to be effective to reduce flame out possibility. Followings are the consideration of the difference of fuel flow reduction by the operating procedure.

(1) Procedure of retarding throttle to idle after collective lever lowering

Lowering of the collective lever will lower the setting rpm of the PTG. If the rotor rpm was maintained steady, the PTG senses that the N2 rpm is above the setting point, and sends a signal to the GPFC to reduce fuel flow. If the N2 rpm is higher, the signal becomes stronger. On this condition, if the throttle is retarded to idle quickly, the GPFC will receive both signals which request fuel flow reduction. This will cause large fuel flow reduction from the GPFC. Also, on this condition if the throttle is moved very slowly or paused before idle position, opening of Pr-Pg* valve is delayed which result in under shoot of N1 rpm below idle because of delay of fuel

flow recovery caused by continuously transmitted fuel reduction signal to the GPFC from the PTG. So, if the collective lever is lowered first, it is necessary to pay much attention to operate the throttle.

(2) Procedure of operating collective lever after throttle retarding

If the throttle is first retarded to idle, the GPFC will decrease the fuel flow and decelerate the gas generator (N1). If the throttle is quickly retarded to idle, the fuel flow reduction becomes large amount but the throttle is moved slowly, the fuel flow reduction becomes small and limited amount. Also, on this condition, certain load is being applied to the power turbine, so the fuel flow reduction signal from the PTG is weak. So, fuel flow reduction affected by the PTG signal becomes small and limited even if the throttle is moved slowly. When the throttle reaches around idle, Pr-Pg valve will be actuated and disable the PTG signal. After that, any collective lever operation which will change N2 rpm does not affect to the GPFC fuel flow. So, this procedure will result in less fuel flow reduction compared to the previous procedure.

4. Procedure to minimize fuel flow reduction during practice auto rotation entry

Snap throttle operation at high N2 rpm during practice auto rotation entry will cause large amount of fuel flow reduction. Following procedure will help to prevent large amount of fuel flow reduction and reduce possibility of engine flame out during practice auto rotation.

- (1) When entering to practice auto rotation, first retard the throttle slowly to idle.
- (2) Next, operate the collective lever to maintain Nr rpm at required value.

Above things are believed to be effective to prevent engine flame out during practice auto rotation entry considered from engine fuel system operation.

*: Note in the Aircraft and Railway Accidents Investigation Commission

Pr: Regulated Air Pressure

Pg: Governor Pressure