Pilot Incapacitation During Landing at Vampula Aerodrome on 24 September 2016

Investigation report: L2016-01

SYNOPSIS

Pursuant to section 2 of the Safety Investigation Act (525/2011), the Safety Investigation Authority decided to investigate the accident which occurred at Tuulikki-Vampula aerodrome on 24 September 2016. Kalle Brusi, MSc, was appointed as team leader for the investigation group, accompanied by aeromedical examiner Adjunct Professor Alpo Vuorio, MD, PhD, and specialist in forensic medicine Antti Virtanen, MD, as expert members of the investigation group. Chief Air Safety Investigator Ismo Aaltonen acted as investigator-in-charge.

The investigation report presents the events before and after the accident. In addition, it addresses the conduct of the rescue operation and analyses the contributing factors. Finally, the report makes safety recommendations which, when implemented, could help avoid similar accidents or at least mitigate their consequences.

The objective of safety investigation is to increase safety and to prevent accidents and incidents and the damage they cause. Safety investigation does not apportion any possible blame or liability. Use of the report for reasons other than improvement of safety should be avoided.

In accordance with the Safety Investigation Act (525/2011) the *person conducting an investigation has the right, for the conduct of the investigation, to receive essential information regarding the health of persons involved in the accident*. This report examined the pilot's medical history in detail in order to establish the cause for the pilot's incapacitation. Many sudden incapacitations are caused by cardiovascular diseases, both in general aviation and commercial aviation. The investigation took into consideration that aeromedical decision-making follows uniform practices in fitness assessments following a heart attack as regards private and commercial pilots and air traffic controllers.

Those involved in the accident and the relevant supervisory authorities were given an opportunity to provide comments on the draft final report. Their comments were taken into consideration in finalising the report. A summary of the comments is at the end of the report. The comments provided by private persons are not published.

The investigation report, including its summary and appendices, is published on the internet page of the Safety Investigation Authority at *www.turvallisuustutkinta.fi (Finnish) and www.sia.fi (English)*

Investigation L2016-01
Investigation Report 7/2017
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Cover photo: Finnish Police; an individual has been edited out of the photo.

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1 FACTUAL INFORMATION

1.1 History of the flight

The accident occurred on Saturday, 24 September 2016 to the pilot of a Cessna 172N aircraft, registration OH-COV. Prior to the accident flight the pilot flew the aircraft from Eura aerodrome in Kauttua to Tuulikki-Vampula aerodrome in Huittinen. The pilot had to hand-start the engine by swinging the propeller before departing from Kauttua. During the engine start process the pilot took a 15 minute break and then took off for the flight at 11.47. The flight lasted approximately 15 minutes.

At 12.21 the pilot took off from Tuulikki-Vampula aerodrome for a local flight. During the flight the pilot reported that he would land earlier than planned because he did not feel well. During the landing, a little before reaching runway 28, the aircraft almost collided with a trench. The passenger warned the pilot of this and the pilot quickly corrected the situation. Following this, the aircraft drifted to the right and off the runway (Figure 1). The right wing collided with a light fixture at the side of the runway. The pilot again steered the aircraft back towards the runway and applied the brakes. At the taxiway intersection the pilot failed to sufficiently turn the aircraft; as a result the aircraft went diagonally across the taxiway into a ditch at low speed. This happened at 12.36.

Almost immediately after deplaning the pilot collapsed to the ground. The passenger called 112 (the emergency number) at 12.38. The doctor that arrived in the ambulance pronounced the pilot dead at 13.36.

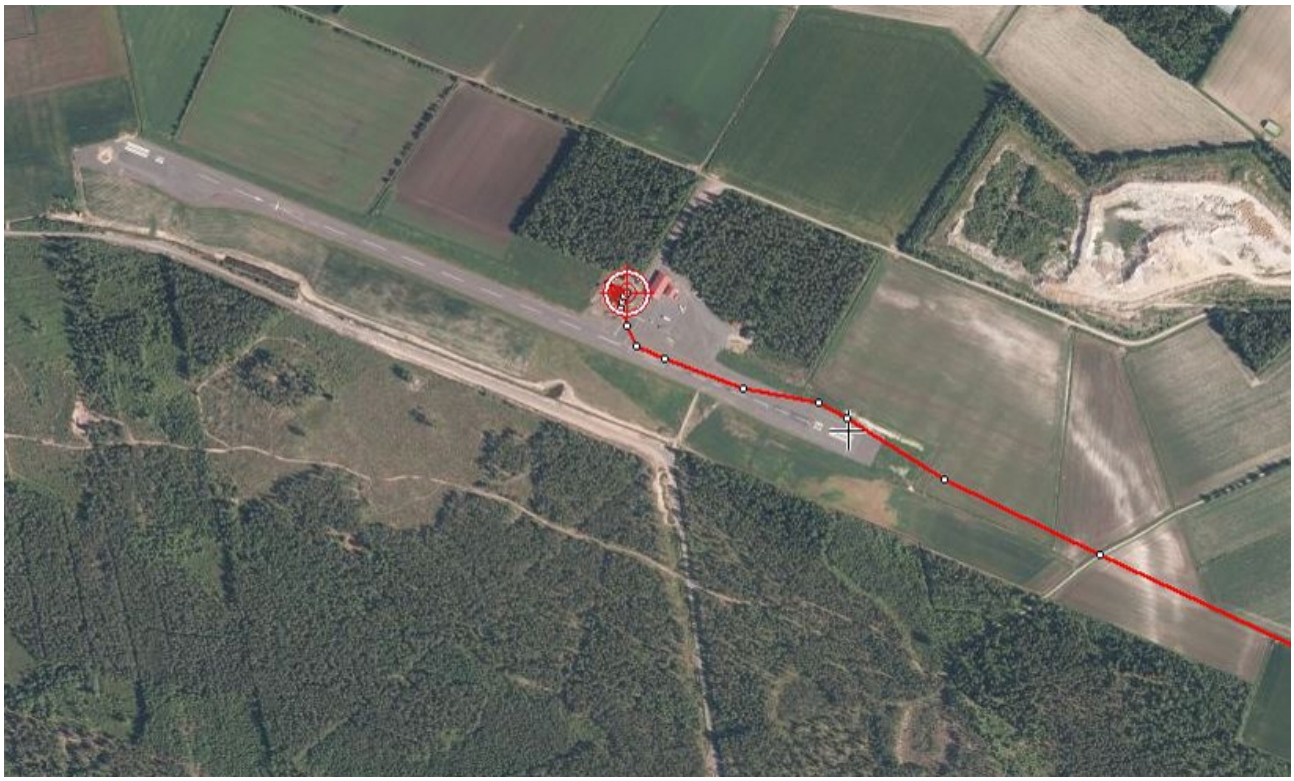

Figure 1. Aerial photo of Vampula aerodrome. The track of the flight and the taxiing was drawn by using GPS data. (Base map: KTJ/Ministry of Justice/ National Land Survey of Finland)

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A photo sequence taken by Vampula's CCTV cameras. Photos **1** and 2 show the low approach. Photo 3 shows the touchdown at the side of the runway. Photo 4 shows the correction back towards the runway. Photos **5** and 6 show the taxiing into the ditch at low speed. (All rights reserved: Leevi K. Laitinen)

1.2 Injuries to persons

The pilot died as a result of the sudden attack. While the passengers did not sustain any injuries, one of them had a sudden attack during the course of the events and had to be hospitalised immediately following the accident. Hence, in accordance with ICAO definitions, the passenger was seriously injured[1].

1.3 Damage to aircraft

The aircraft sustained significant damage. No detailed damage assessment was made. Among other things the right wing, the propeller and the engine mount were damaged.

1.4 Other damage

The light fixture at the side of the runway broke when the right wing collided with it during the landing.

1.5 Personnel information

The pilot was 65 years old. He held a Private Pilot Licence PPL(A)[2]. The required rating for the flight was valid. The required class 2 medical certificate had expired on 3 October 2015. The Light Aircraft Pilot Licence (LAPL) medical certificate was valid until 3 October 2016. For this reason, the pilot was not medically certified for this flight. He had flown altogether 19 flights since 3 October 2015.

Table 1. The pilot's flying experience

Flight experience	Last 24 hours	Last 30 days	Last 90 days	Total hours and landings
All types	Approx 30 min 2 landings	Approx 30 min 2 landings	Approx 2 h 20 min 10 landings	498 h 30 min 501 landings

1.6 Aircraft information

The aircraft was a four-seat Cessna 172N, designed for general aviation. Its registration was OH-COV and it was airworthy.

The aircraft was fitted with a recording GPS device. The recorded data were used in establishing the history of the accident flight. In addition, the previous flight's information was determined from the recording.

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1 ICAO Annex 13. Chapter 1. Definitions

2 The PPL(A) is a Private Pilot Licence for Aeroplanes.

1.7 Meteorological information

From 11.30 to 12.30 the temperature varied between +9 °C and +10 °C. The weather was cloudy or nearly overcast. It did not rain. The measured ten-minute average wind at Kokemäki was 3–4 m/s, gusting to 5–6.5 m/s. The winds were north-westerly (300–320 degrees).

1.8 Aerodrome information

Tuulikki-Vampula aerodrome (EFVP) is situated in Huittinen. Aerodrome coordinates are N 61° 2' 18.774" E 22° 35' 35.176".

1.9 Rescue operation and survival aspects

Two phone calls were made from the accident site. The first call was received by the Pori Emergency Response Centre (ERC) at 12.38. During both phone calls the ERC operators tried to establish the site and the type of the accident as well as the number and condition of the casualties. In addition, the caller was requested to contact the ERC again, should the situation change.

The first alarm was given at 12.40, approximately 90 seconds from the beginning of the emergency call. The ERC, following its risk assessment of an "air accident, medium size", launched a rescue operation. The dispatched units included: the Rescue Chief, four rescue units, a HEMS helicopter, an EMS physician in a Mobile Intensive Care Unit (MICU), the EMS Supervisor, four EMS (ambulance) units and a Border Guard helicopter. At 12.46 the ERC reported the occurrence to the Aeronautical Rescue Coordination Centre (ARCC).

The first rescue unit arrived at the site at 12.51. Three rescue units and four EMS units, including the Mobile Intensive Care Unit, were dispatched all the way to the site. The first ambulance arrived at the target 12.56. The rescue units were tasked to prepare for initial fire extinguishing and to prevent a fire by switching off the main power and shutting off the fuel supply. In addition, the fuel that leaked into the ditch was removed by an oil absorbent boom. Some rescue units had no task; they were standing by. The EMS units participated in providing medical care to the pilot and in checking the condition of the passengers. The EMS Supervisor managed the situation remotely until the EMS physician arrived at the site.

1.10 Medical and pathological information

Pursuant to the Safety Investigation Act (525/2011) the *person conducting an investigation has the right, for the conduct of the investigation, to receive essential information regarding the health of persons involved in the accident*.

1.10.1 The pilot's medical history

The pilot had his first aeromedical examination in 1995 and, following this, he held a valid medical certificate almost without interruption. Prior to the accident the pilot had had three heart attacks.

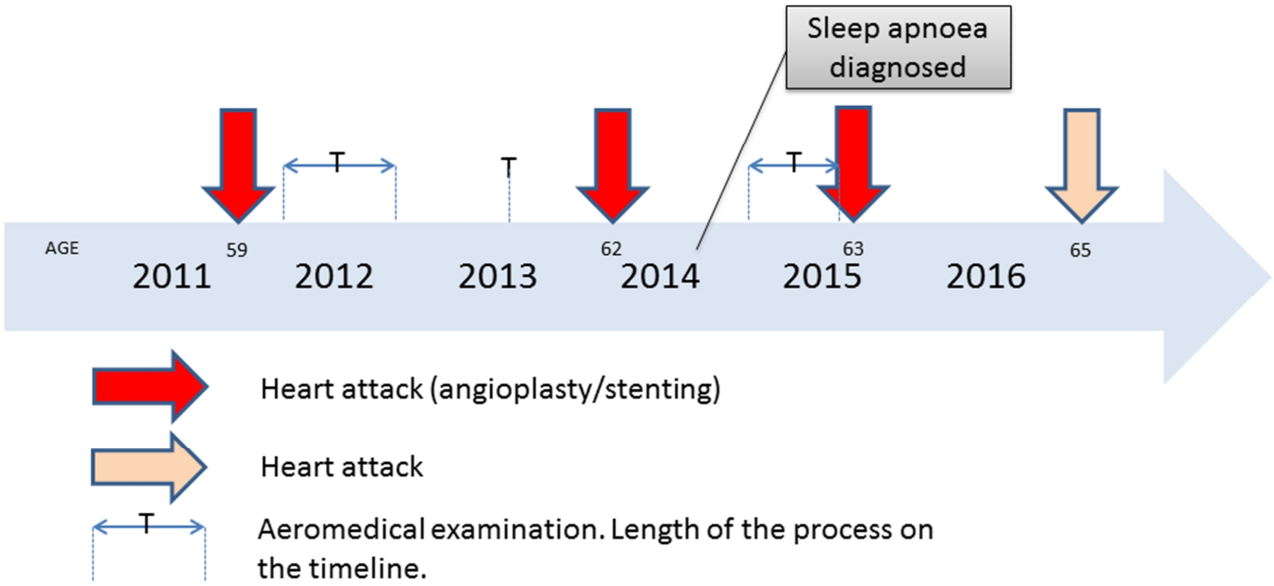

Figure 2. The pilot's heart attacks and aeromedical examinations shown on a time-scale.

Heart attack in 2011

The pilot had his first heart attack in March 2011, at the age of 59. Prior to this he had no history of heart disease. Balloon angioplasty was performed in three different places on the narrowed left coronary artery; they were then stented[3]. Following the procedure the pilot received medication to halt the progress of coronary heart disease and was placed on anticoagulants for 12 months. He also had an echocardiogram examination during the period of his hospitalisation.

In a follow-up examination in May 2011 at the hospital the pilot was reminded to visit an aeromedical examiner (AME) before continuing to fly. In August 2011 the pilot booked an appointment at an AME for the purpose of obtaining a class 2[4] medical certificate. The AME recommended that the certification be granted. The licensing authority handled the application and demanded, as additional information, that copies of the medical records, the

[3] Stenting means placing a device made of metal mesh, in conjunction with balloon angioplasty, at the site of a narrowing coronary artery to keep the artery open.

[4] Private pilot medical certificate requirements are based on EASA Part MED regulations. The medical certificate is valid for 12 months for persons older than 50.

result of a stress echocardiogram[5], a 24-hour ECG monitoring[6] test and the cardiologist's[7] evaluation be produced by October 2011. The licensing authority ordered the required medical records straight from the hospital. The pilot underwent a 24-hour Holter monitor test in September. Additionally, in November he also underwent an exercise ECG examination[8] under medications during which no indications of oxygen deprivation in the heart muscle could be found. The previously-required stress echocardiogram was not done. Following these tests, in March 2012 the AME recommended that the medical certification be granted. The licensing authority issued the medical certificate with the condition that, in addition to the aeromedical examination, for the next medical examination the pilot would have to produce the results of an exercise ECG test and a cardiologist's evaluation.

In February 2013, before the next aeromedical examination, the pilot underwent an exercise ECG under his regular medications. No signs of oxygen deprivation in the heart muscle were found. The summary-part of the test results sufficed as the cardiologist's evaluation. In an aeromedical examination in March 2013 the AME noted that the pilot's health met the requirements for a medical certificate. The condition on which the certification could be revalidated was that, in addition to the aeromedical examination, he would have to produce the results of an exercise ECG and a cardiologist's evaluation. The licensing authority granted the medical certification with the above-mentioned limitation.

Heart attack in 2013

The pilot had his second heart attack at the age of 62 in September 2013. This time the coronary artery was a different one than the one affected in 2011. The heart attack occurred approximately seven months after having received medical certification. The narrowed branch of the left coronary artery was treated with angioplasty/stenting in one place. While the earlier coronary artery stents, put in place in 2011, were still open, clinical manifestations were found across the entire wall of this coronary artery. During the hospitalisation an echocardiogram was performed on the pilot. The test revealed a clear post infarct scar. Also, in the post-mortem examination widespread fibrosis and fibrotic scarring was discovered on the posterior wall of the left ventricle. During the hospitalisation the pilot was reminded to visit an aeromedical examiner (AME) before continuing to fly.

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5 An ultrasound scan, combined with an exercise test.

6 A 24-hour electrocardiogram (ECG). A test to monitor the electrical activity of the heart, aka a Holter monitor test, is used to diagnose arrhythmias. The 24-hour ECG will reveal whether the arrhythmias are of a supraventricular or ventricular nature.

7 Consultant specialised in heart diseases.

8 An exercise ECG is done when coronary heart disease is suspected or when the behaviour of some arrhythmias, or lung performance, is examined. During the test the heart is stressed to the point that any possible narrowing coronary arteries will result in oxygen deprivation in the heart muscle (myocardial hypoxia).

In early 2014 the pilot was diagnosed with severe obstructive sleep apnoea. In response to this Continuous Positive Airway Pressure (CPAP) treatment[9] was initiated.

In July 2014 the pilot had an aeromedical examination. The AME had the results of the echocardiogram, done during the hospitalisation in 2013, and of the exercise ECG under medications, performed in May 2014. The AME granted the medical certification, but the licensing authority did not revalidate it for the time being, due to the pilot being on anticoagulants.

Once the anticoagulant medication ended in October 2014, the pilot had yet another aeromedical examination. At this time the AME was aware of the sleep apnoea, diagnosed in early 2014. The AME granted the medical certification in October 2014 but the licensing authority returned the medical certification back to the AME because of technical reasons. Although, the medical certification was valid from October onwards. As part of the examination the pilot underwent a 24-hour Holter monitor test in January 2015. The pilot also saw a cardiologist. On the basis of these tests, the AME finalised the medical certification in January 2015. The licensing authority checked the AME's medical assessment within the same month but did not have the cardiologist's statement or the result of Holter monitoring.

Heart attack in 2015

The pilot had his third heart attack in late January 2015 at the age of 63. The heart attack was caused by blockage in the very same coronary artery, which had been the cause of the first heart attack. The narrowed branch of the left coronary artery was treated with angioplasty/stenting in one place. In the post-mortem examination fibrotic scar lesions were found on all walls of the left ventricle. During the hospitalisation no mention of the pilot's flying hobby was made in his medical records. This information, however, was mentioned in the records of his two previous heart attack hospitalisations. Following the heart attack the pilot did not contact his AME or the licensing authority. In May 2015 the pilot flew a proficiency check flight to obtain revalidation for a SEP rating[10]. He continued to fly independently in August 2015.

Associated with the treatment of illness the pilot saw a doctor in September 2015. At the time it came up in the conversation that his 'flyer driving licence' was still valid and that he would see the AME in early 2016. During the September visit the doctor was concerned about the effects of low blood pressure to the safety of flight. The pilot revisited the doctor in March 2016 for a follow-up assessment and at that time the doctor recorded that his pilot licence was valid and that the pilot should see the AME in early October 2016. In mid-August 2016 the pilot saw a doctor because he was feeling unwell, but no suspicion of heart symptoms arose during the visit.

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9 Moderate or severe obstructive sleep apnoea (OSA) is primarily treated with a CPAP (Continuous Positive Airway Pressure) device used during sleep.

10 Single-engine piston rating for aeroplanes.

The day of the accident

On the day of the accident the pilot got exceptionally out of breath because of having to 'hand prop' the engine. After the final flight he felt really ill. The EMS unit arrived at the site and, judging by an electrocardiogram, it appeared that he was presently experiencing a heart attack. This would be his fourth heart attack within the period of five and a half years. Despite attempts to resuscitate the pilot, he died.

Post-mortem examinations

During the post-mortem examination it was noted that the deceased had suffered from an enlarged heart, which exhibited clinical manifestations in all three main branches of the coronary arteries. There was severe atherosclerotic narrowing at the orifice of the right coronary artery, and the previously installed metal mesh stents holding open the branches of the left coronary artery were still to be found. The clinical manifestations in the branches of the left coronary artery were moderate, continuing all the way to the periphery of the small cardiac arteries. Fibrotic lesions were found on the muscular wall of the heart in the entire coverage area of all main coronary branches. Fibrotic scars were extensively noted on the posterior wall of the left ventricle, the interventricular septum and the anterior wall of the left ventricle. Of these, the lesion on the posterior wall of the left ventricle was already detected in an echocardiogram in 2013. In addition to the old fibrotic lesions, manifestations suggesting a recent myocardial infarct were also found.

Forensic toxicology tests administered on the samples taken from the deceased revealed no alcohol or drugs that affect the central nervous system and which could have impaired the subject's performance or judgment. The samples contained traces of a medicine prescribed to treat the symptoms of coronary artery disease.

1.11 Medical certification

Applicants for, or holders of, private pilot, sailplane and hot-air balloon licences must hold at least a class 2 medical certificate. Class 2 medical certification also includes the privileges and validities of a Light Aircraft Pilot Licence (LAPL) medical certificate.

An LAPL holder is allowed to fly an aircraft with a maximum take-off mass of less than 2000 kg. An LAPL medical certification is sufficient for an LAPL holder. A PPL licence requires a valid class 2 medical certification. A PPL licence does not include an LAPL licence.

Both LAPL and PPL licence holders are allowed to fly the Cessna 172N type aircraft, which was involved in this accident.

1.11.1 Aeromedical examination

PPL licence holders older than 50 years of age must take annual aeromedical examinations. This assessment is done by an aeromedical examiner (AME). The AME assesses the pilot's fitness for flying by using the European Aviation Safety Agency's (EASA) Part-MED

aeromedical regulations as a guideline. Until 2009 the Regulations were known as JAR-FCL[11]. For example, the Regulations define in detail the tests on the basis of which the pilot's fitness to fly is assessed following a heart attack. The present post-heart attack assessment criteria are identical with those of the JAR-FCL.

During an aeromedical examination the pilot fills in a detailed application form. Together the pilot and the AME complete the aeromedical application form and confirm the information with their signatures. Following this, the AME performs the examination which includes, among other things, vision and hearing tests as well as an evaluation of the significance of possible illnesses to the medical certificate. The AME may renew or revalidate the medical certificate, or lengthen the period of validity, only if the applicant has produced all pertinent personal health information as well as other medical examination reports and test results.

1.11.2 Limitations

If the applicant does not meet all of the requirements for the medical certification, the AME must assess whether it is possible to grant the certification with limitations. In this case, the medical certificate issued by the AME will include a limitation, or limitations.

For example, the certificate may include an operational safety pilot limitation (OSL) in which case the holder of the medical certificate always has to fly with someone who holds a pilot's licence. There are only a few OSL-limited pilots in Finland. An OPL-limited pilot is not allowed to transport passengers. The AME can limit the validity period of the medical certificate (TML limitation), or order another special restriction as specified (SSL).

1.11.3 Medical examination protocol

Following an aeromedical examination the pilot receives a signed medical assessment. The present practice came into effect in the spring of 2013. It constitutes the examiner's decision on advising whether the person is fit, unfit or referred to the licensing authority, the Aeromedical Centre (AeMC) or the AME as applicable. The AME can ask for any expert opinions that are required. According to present practice the AME, as a rule, takes the decision whether to grant the medical certification.

This practice entered into force at the same time the Finnish Transport Safety Agency's Traffic Medicine Unit introduced the EMPIC® FCL-M information system in May, 2013. The goal of the system, among other things, is to support decision-making and the management of the big picture. Previously the AMEs would refer the decision to grant the certificate to the licensing authority, which, at the time, used the national information system.

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[11] The JAR-FCL were based on the regulations of the European Joint Aviation Authorities (JAA). Following the adoption of Regulation (EC) No 1592/2002, the main functions of the JAA were absorbed into the European Aviation Safety Agency.

1.11.4 Obligations of the licence holder

Licence holders may not use the privileges of the medical certificate if they know that their state of health is impaired. Moreover, holders of medical certification must, without undue delay, contact an AME or an AeroMedical Centre if they have undergone a surgical operation or an invasive procedure.

1.11.5 Doctors' duty of notification in aviation

With the exception of AMEs, Finnish doctors are not required to notify any diagnosed change in the state of a pilot's health that jeopardises flight safety. However, pursuant to the Aviation Act, they are permitted to notify diagnosed changes in health or consult the aviation authorities. Finland differs from, for example, Norwegian practice where all doctors are required to notify such cases. In Norway the obligation even extends to psychologists and opticians. Doctors have had the duty of notification since 1982, and it has been specifically laid down in the Norwegian Health Personnel Act[12]. The provision has resulted in five annual notifications, on average. Some of the cases, which fall under this category, will probably not be notified. On the other hand, the training provided to doctors regarding the scope of the act did increase the number of annually notified cases.

1.11.6 Doctors' duty of notification in road traffic

Since 2004 Finnish doctors have had the duty to notify to the authority that issues drivers' licences. As of 1 January 2016 the notification must be made to the police if the driver has been determined to be unfit to drive for at least six months[13]. This legislation is founded on the Government Resolution requiring improvements in the exchange of information between doctors and the authorities. As part of the process, preliminary studies were made before the legislation was enacted and, following this, reports have been published regarding the viability of the Act from the perspectives of various actors.

When the Act was being drafted doctors feared that the duty of notification would negatively impact the doctor-patient relationship, including the preservation of trust in that relationship. This concern has not completely gone away among doctors, even after the Act entered into force. The LINTU Research Programme[14] for establishing the effects of the Act revealed that the notifications being made by doctors on impaired driving fitness have increased. However, the problem is that driving health rarely comes up during a doctor appointment if the purpose of the visit is not directly associated with the right to drive.

The duty of notification seems to work well, especially in the case of drivers older than 65. Still, even then the majority of the notifications are made because of impaired mental

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12 Correspondence with Civil Aviation Authority – Norway in February 2017.

13 Finnish Transport Safety Agency. 3 February 2016. *Assessing fitness to drive: a guide for doctors.*

14 Peräaho, M., Laapotti, S., Katila, A., Hernetkoski, K., (2012). "*Doctor's obligation to inform the police when a driver's fitness to drive is impaired: three views on how the process works.*". LINTU Research Programme. http://www.lintu.info/ILMO.pdf. Retrieved 14.4.2017

functions. The system does not work well for drivers younger than 65 years of age or for those with problems of substance abuse. In the LINTU Research Programme doctors brought up the lack of training on driving fitness assessment. The research also revealed clear variation among doctors regarding their notification threshold.

1.12 Incapacitation

Pilot incapacitation is the term used to describe the sudden inability of pilots to carry out their normal duties. In general aviation incapacitation represents approximately 1.5% of accidents that result in fatalities[15]. Incapacitation can be partial or complete. In partial incapacitation the pilot's functioning is impaired but does not result in a total loss of control of the aircraft. The cause may be a pilot's long-term illness which, when activated, impairs their ability to function. Incapacitation can appear suddenly or gradually. An Australian study found that where medical conditions or incapacitation occurred, the most common cause, 50 per cent of cases, was heart attack[16]. The study also stated that in 10 per cent of the incapacitations the outcome of the event was a fatal accident. According to a recent study, in six per cent of the fatal accidents involving private pilots between 60–63 years of age autopsy reports found causal association between a major disease and the accident[17].

In Britain, professional pilots had 36 cases of incapacitation in 2004[18]. Half of these originated in the circulatory system of the heart or the brain. Six incapacitations were caused by acute heart attacks. Nowadays the ECCAIRS Portal (European Coordination Centre for Accident and Incident Reporting Systems) recurrently receives reports of incapacitations related to cardiac events.

1.13 Risk after recovery from heart attack

Even though stenting treatment reduces the risk of recurrence, the risk of a new heart attack is always present. The highest risk of recurrence is during the first year following the recovery from a heart attack. Even after seven years, the risk of a heart attack is 2-3 times higher than normal. Approximately one in seven heart attack survivors had another heart attack within seven years. It is worth noting that the risk of recurrence grows with age. The treatment for recovering heart attack patients must be effective because they have a high risk of having a heart attack and dying of it.[19]

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15 Booze, C.F., Pidkowicz, J., Davis, A., Bolding, F. (1981). "*Postmortem coronary atherosclerosis findings in general aviation accident pilot fatalities: 1975-77*." Aviation, Space and Environmental Medicine, Vol. 52, pp. 24-27.

16 Australian Transport Safety Bureau (2007). "*Pilot incapacitation: analysis of medical conditions affecting pilots involved in accidents and incidents 1 January 1975 to 31 March 2006*." Aviation Research and Analysis Report – B2006/0170.

17 Vuorio, A., Asmayawati. S., Budowle, B., et al. (2017). "*General Aviation Pilots Over 70 Years Old*". Aerospace Medicine and Human Performance. Vol 88(2), pp. 142–145.

18 Evans, S., Radcliffe, S-A. (2012). "*The Annual Incapacitation Rate of Commercial Pilots*". Aviation, Space and Environmental Medicine, Vol 83, pp. 42-49.

19 Smolina, K., Wright, L., Rayner, M., Goldacre, M.J. (2012). "*Long-Term Survival and Recurrence After Acute Myocardial Infarction in England, 2004 to 2010*.". Circulation: Cardiovascular Quality and Outcomes, Vol. 5, pp. 532-540.

1.14 Recovering from heart attack in terms of aeromedical decision-making

In addition to aeromedical regulations many countries have guidelines for the purpose of making it easier to apply the legislation. Aeromedical guidelines explain how the AME's fitness assessment must take someone recovering from a heart attack into account.

1.14.1 International Civil Aviation Organization (ICAO) guidelines

The ICAO's Manual of Civil Aviation Medicine[20] states that *One of the major purposes of medical examinations…is to assess the probability of a medical condition resulting in in-flight incapacitation. Based only on such an assessment can the authority objectively consider certification that is compatible with generally accepted flight safety standards… The medical examiner is in many cases handicapped in making such an assessment, because adequate predictive epidemiological data are not available for the condition itself or, if they are, they cannot be readily applied to the flight environment. This situation is, however, improving. Figures for the risk of a future cardiac event in an individual recovering from a common cardiac problem such as myocardial infarction are available*[21]. During the past thirty years several aviation cardiology conferences have been held in Europe. The goal has been to improve aeromedical decision-making with regard to heart diseases. ICAO provides guidance in terms of cardiac risk assessment in the ICAO Manual of Civil Aviation Medicine.

In short, it can be said that the most recent epidemiological evidence regarding the prognoses of modern cardiology treatments, such as stenting, makes it possible to assess the risk of renewed cardiac events as regards recovering patients. This facilitates dividing pilots into different risk categories.

1.14.2 The aeromedical guidelines of the European Aviation Safety Agency (EASA)

In general, European countries comply with Commission Regulation (EU) No 1178/2011[22]. The EASA's Acceptable Means of Compliance (AMC Part-MED and AMC Part-ATCO.MED) and the (Finnish language) guidance material of the Finnish Transport Safety Agency's Traffic Medicine Unit state the following:

At least 6 months from the ischaemic myocardial event, the following investigations should be completed: an exercise ECG…an echocardiogram…a myocardial perfusion scan or stress echocardiogram…further investigations may be necessary, among other things, to assess the risk of any significant arrhythmias. In addition, it is stated that *the whole coronary vascular tree*

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20 ICAO. (2012). "*Manual of Civil Aviation Medicine*". Annex 1, Chapter 6 – 6.3.2.5.1. Doc 8984 3rd edition. ISBN 978-92-9231-959-5.

21 ICAO. (2012). "*Manual of Civil Aviation Medicine*". Part 1. Chapter 3. Medical standards and prevention of pilot incapacitation 3.1.38 – 3.1.41. Doc 8984 3rd edition. ISBN 978-92-9231-959-5.

22 COMMISSION REGULATION (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

should be assessed as satisfactory by a cardiologist, and particular attention should be paid to multiple stenoses and/or multiple revascularisations[23].

On the basis of the Regulation and the guidance material, there is no difference in classes 1, 2 and 3 when being considered 6 months after recovery from a heart attack for a medical certificate but the guidance material includes follow-up to be performed after 6 months and there are differences in procedures due to the specific needs of each type of medical certificate. Class 1 comprises both airline and commercial pilots and class 3 air traffic controllers. Nevertheless, there are differences among the types of medical certificate when it comes to follow-up after recovery from a heart attack.

1.14.3 The guidelines of the UK Civil Aviation Authority

The UK Civil Aviation Authority has drawn an illustrative flowchart[24] of the European guidelines. Medical certification can be granted when all tests have been successfully completed. If the applicant passes an exercise ECG test but no myocardial perfusion imaging and echocardiogram have been done, medical certification can be granted with an operational safety pilot limitation. Britain complies with EASA Regulations.

1.14.4 Special features in the guidelines of the Australian Civil Aviation Safety Authority (CASA)

The guidelines remind the AME to assess the annualised percentage risk of recurrence and incapacitation. Also, it says that certification with permanent safety pilot (class 2) restriction may be required. Additionally, the need for anticoagulation therapy should be assessed[25]. CASA's Aviation Medical Examiner's Handbook also includes an approach for aeromedical risk assessment[26].

1.14.5 Special features in the guidelines of the Canadian Civil Aviation Safety Authority (Transport Canada)

Transport Canada provides that if a major coronary heart disease is located in the left coronary artery, it is likely that the prognosis of the pilot's coronary heart disease is poor, even following treatment. [27]

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[23] Revascularisation, i.e. restoring circulation with balloon angioplasty/stenting or coronary bypass surgery.

[24] CAA UK (2015) *Class 1/2 certification - Coronary artery disease* https://www.caa.co.uk/WorkArea/DownloadAsset.aspx?id=4294973025. retrieved 4.1.2017

[25] CASA *Coronary artery disease – suspected or confirmed* http://services.casa.gov.au/avmed/guidelines/coronary_artery_sus_conf.asp. retrieved 4.1.2017

[26] CASA *Aviation Medicine Handbook* 12.4. http://services.casa.gov.au/avmed/dames/handbook/12.4.asp. Retrieved 4.1.2017

[27] Transport Canada. *Handbook for Civil Aviation Medical Examiners*. Transport Canada. https://www.tc.gc.ca/eng/civilaviation/publications/tp13312-2-cardiovascular-chapter1-2333.htm. Retrieved 4.1.2017

Coronary heart disease is a multi-factor illness. The examination of individual risk factors alone should not lull anyone into a false sense of security. The risk assessment utilises, among other things, the Framingham coronary heart disease risk score.

1.14.6 Summary of the special features in international guidelines

In general, it can be said that different aviation authorities require quite similar tests for their aeromedical follow-up assessments. The Australian regulations, especially, emphasise the overall risk assessment. The Canadian regulations remind that the prognosis of the pilot's coronary heart disease, when located in the left coronary artery, is unfavourable.

1.15 Obstructive sleep apnoea and coronary heart disease

Heart patients are 2–3 times more likely to suffer from obstructive sleep apnoea (OSA) than those that do not have coronary diseases, even when the common factors are considered. The EASA AMC Part-MED mentions that a person being examined for OSA must undergo a satisfactory cardiological evaluation before a fit assessment may be considered. Untreated OSA patients have an increased risk to have a heart attack at night or while asleep compared with non-OSA heart attack patients[28]. Research shows that treated OSA may reduce night-time oxygen deprivation in the heart muscle and coronary heart disease, at least among men. This finding, however is yet to be confirmed, pending sufficiently qualitative research on the subject[29] [30] [31] [32] [33] [34]. The results of a wide clinical trial published in 2016 found that CPAP treatment does not significantly reduce the likelihood of a cardiovascular event[35].

1.16 The role of the Safety Management System in aeromedical decision-making

Decision-making processes and documentation constitute important areas of the Safety Management System (SMS). Aeromedical decision-making processes are based on EASA Part-

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28 Kuniyoshi. FH., Garcia-Touchard. A., Gami. AS., et al. (2008). "*Day-night variation of acute myocardial infarction in obstructive sleep apnea* " Journal of the American College of Cardiology, Vol 52, pp. 343-346.

29 Peled, N., Edward, G. A., Giora. P., et al. (1999). "*Nocturnal ischemic events in patients with obstructive sleep apnea syndrome and ischemic heart disease*" Journal of the American College of Cardiology, Vol 34, pp. 1744-1749.

30 Milleron, O., Pillière, R., Foucher, A., de Roquefeuil, F., et al. (2004). "*Benefits of obstructive sleep apnoea treatment in coronary artery disease: a long-term follow-up study*". European Heart Journal, Vol 25, pp. 728-734.

31 Marin, JM., Carrizo, SJ., Vicente, E., et al. (2005). "*Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study*". The Lancet, Vol 365, pp. 1046-1053.

32 Doherty, LS., Kiely, JL., Swan, V., McNicholas, WT., (2005). "*Long-term effects of nasal continuous positive airway pressure therapy on cardiovascular outcomes in sleep apnea syndrome*". Chest, Vol 127, pp. 2076-2084.

33 Somers, V. K., White, D. P., Amin, R., et al. (2008). "*Sleep Apnea and Cardiovascular Disease*". Circulation, Vol 118, p. 1080-1111.

34 Pulmonary Medicine 2013. Dx.doi.org/10.1155/2013/768064. De Torres-Alba, F., Gemma, D., Armada-Romero, E., et al. (2013). "*Obstructive Sleep Apnea and Coronary Artery Disease: From Pathophysiology to Clinical Implications*". Pulmonary Medicine, Vol 2013, Article ID 768064, 9 pages.

35 McEvoy, RD., Antic NA., Heeley E., et al. (2016*). "CPAP for Prevention of Cardiovascular Events in Obstructive Sleep Apnea"* New England Journal of Medicine, Vol 375, pp. 919-931.

MED regulations. The SMS system[36], or parts of it, can be applied in managing aeromedical decision-making processes. Then, it will be possible to standardise and clarify the process, for example, with the help of flowcharts and algorithms[37] [38]. The European Society of Aerospace Medicine is about to propose such an operational model to the EASA[39]. In 2015 ESAM it was proposed that Part-MED be amended to include an algorithm-based decision-making tool for assessing recovery from heart attack[37]. The point of departure is a pilot-oriented decision-making process which proceeds, step by step, on the basis of test results. The conclusions would primarily be made by cardiologists that provide aeromedical assessments to the licensing authority.

Medical risk assessment is an integral element of successful decision-making. It is particularly important to be able to evaluate the overall risk of diseases and, consequently, make a decision on a follow-up plan. If the risk is considerable, one must consider limitations as part of the follow-up action. In this case the pilot being assessed is either able to continue flying under sufficient limitations or the medical certificate is temporarily or completely revoked. The Australian aviation authority has provided guidelines for this risk assessment process.

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36 FAA *Safety Management System Basis.* https://www.faa.gov/about/initiatives/sms/explained/basis/. Retrieved 15.2.2017.

37 Maire, R., Muff, S., (2015). "*Proposal for a change of the EASA-Medical-Requirements within the Acceptable Means of Compliance*". http://www.esam.aero/esam-papers/coronary-artery-disease. Retrieved 15.2.2017.

38 Navathe, P., Drane, M., Preinter, C. (2014). "*Aeromedical Decision Making: From Principles to Practice*". Aviation, Space and Environmental Medicine, Vol 85, pp. 576-580.

39 Correspondence. René Maire member of ESAM advisory board. 9.3.2017.

2 ANALYSIS

The analysis of the accident used the AcciMap[40] model. The outline of the analysis is based on an AcciMap drawn by the investigation group, included in appendix 1.

2.1 Analysis of the accident

2.1.1 Medical certifications

A PPL licence requires a class 2 medical certificate. An LAPL medical certificate is automatically included in a class 2 certificate. When it comes to the medical certification of the pilot, issued in 2015, his class 2 certificate was valid for one year and his LAPL certificate was valid for two years. Judging by interviews and medical documents it appears that the pilot did not intend to fly without a valid, required medical certificate. On the basis of documents it can be assumed that he believed that the LAPL medical certificate, together with a valid PPL licence, allowed him to operate aircraft with a maximum take-off mass of less than 2000 kg.

A medical certificate can be issued with limitations if the applicant is not regarded to present a danger to the safety of flight. For instance, following the first heart attack the pilot had the limitation that, in addition to the next aeromedical examination, he would have to produce the results of an exercise ECG and a cardiologist's evaluation. Another limitation for a class 2 certificate can include, among other things, an OSL limitation, which means that flying can continue when accompanied by a safety pilot.

Converting a PPL licence to an LAPL licence is a simple procedure following which the LAPL medical certificate applies. Nevertheless, when it comes to this accident, neither medical certification was valid because the pilot had suffered a heart attack, which he failed to report to an aeromedical examiner.

Nor did the pilot report the changes in his state of health to the AME without undue delay. He brought them up during the medical examinations when he needed to revalidate the medical certification.

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40 The AcciMap model is used to analyse factors that contributed to the accident, to find the essential conclusions and to prepare and target the key safety recommendations.

The accident is depicted at the bottom of an AcciMap as a chain of events. The recognised decision-making entities and other relevant actors are marked on the left axis. The analysis of the flow of the events goes from bottom to top. The lower part of the presentation illustrates the individual accident under analysis and from there on the analysis proceeds to the big picture and significances, for example, at the national or international level.

The analysis complies with the AcciMap presentation and provides background information on individual text boxes, including their mutual association. The analysis of the authorities' action, meant by the Safety Investigation Act, is done separately as required.

The source of the AcciMap model: J.Rasmussen and I.Svedung, 2000, Proactive Risk Management in a Dynamic Society, Swedish Rescue Services Agency, Karlstad, Sweden.

2.1.2 The first heart attack

The symptoms associated with coronary heart disease had appeared years earlier. The pilot had his first heart attack in March 2011 at the age of 59. In conjunction with the follow-up fitness assessment the licensing authority first requested that all actions pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council be completed. Nevertheless, they were not delivered to the authority by the due date. Following this, the pilot revisited the AME and the medical certification was granted in March 2012. At the time the AME did not require a stress echocardiogram test be completed.

2.1.3 The second heart attack and obstructive sleep apnoea

The pilot had his second heart attack in September 2013 at the age of 62. In early 2014 he was diagnosed with obstructive sleep apnoea (OSA). He received CPAP treatment for it. According to the results of a recent, wide clinical trial, CPAP treatment does not reduce the risk of recurrence of a cardiac event to that of a person recovering from a heart attack with no OSA.

2.1.4 The third heart attack

The pilot had his third heart attack in January 2015, in other words a little over a year from the second one. He did not report this to the AME. Even though the pilot assumed that his medical certificate was valid, his class 2 certificate was not valid. Rather, his LAPL medical certificate was technically valid. Still, an LAPL medical certification alone does not suffice for a PPL licence. Even so, the pilot should not have been flying because, following his third heart attack, no medical assessment had been made.

2.1.5 The fourth heart attack

The fourth, fatal, heart attack occurred on 24 September 2016, a little less than two years from the third one. Approximately one month prior to that the pilot had seen a doctor because he was feeling unwell, but no signs of cardiological symptoms were found in the examination.

The pilot was already feeling unwell earlier in the day before the accident flight. During the accident flight the pilot's functioning suddenly became impaired because he was feeling ill. For this reason he decided to end the flight earlier than planned. The CCTV image taken at the aerodrome verifies the deterioration of his functioning. Also the interviews and the flight path analysis support this view.

2.2 Coronary heart disease

The heart attacks of 2011, 2013 and 2015 occurred in the area supplied by the left coronary artery. Transport Canada's handbook pays particular attention to disease in the left coronary artery.

Coronary heart disease is a chronic disease. Treatments, such as revascularisation, can improve its prognosis. There is a follow-up period for granting medical certification after a

heart attack as well as additional testing as per regulations. On the basis of these, the fitness to fly can be restored in full or with limitations, depending on if the future risk level of incapacitation is considered to be low enough. The risk of a recurring heart attack grows after each heart attack. The evaluation tests presented in regulations improve the odds of predicting the risk of a future infarct. A stress echocardiogram is one of the tests mentioned and, for its part, improves the chances of diagnosing asymptomatic oxygen deprivation in the heart muscle after a heart attack.

2.3 Overall risk assessment

Here, overall risk assessment means an evaluation, which takes into account different illnesses as well as the clinical deterioration of a disease, such as recurring heart attacks. On the basis of these the examiner will comprehensively assess the subject's present and future fitness.

Documents do not reveal to which level the examiner assessed the pilot's overall risk for the period of validity of the medical certification, which was granted in 2015. The assessment became more challenging after the second heart attack. At that time the risk factors that had to be considered were, among other things, those caused by age, recurring heart attack and sleep apnoea. The risk of the pilot losing his functioning ability was higher after the second heart attack. The increased risk did not manifest itself in more limitations. Aeromedical guidance material only partly supports the overall risk assessment, especially after the recurring acute myocardial infarction. For example, the Australian licensing authority has provided regulations on risk assessment and risk management. The purpose of their guidelines is to make it easier for the AME to make an overall risk assessment.

2.4 Significance of the duty of notification

Doctors are not required to notify any changes in the state of a private or commercial licence holder's health to the licensing authority. At the hospital, after the first two heart attacks, the pilot was reminded to visit the AME. Following the third infarct the pilot's medical records contained no mention of a reminder to visit an AME before continuing to fly. A duty of notification could reduce the number of illness-related incapacitations and, so, improve flight safety.

2.5 The pilot's health care

The pilot's comprehensive health care was distracted by the fact that the public health care system did not seem to have a clear picture of the aeromedical examiner's role. In practice, the AME mainly participates in the pilot's medical *assessment,* rather than treatment. The reason for this is that people only tend to visit AMEs in conjunction with recurring medical examinations associated with certification. It is worth noting that the doctor treating the pilot's illnesses received the information from the pilot's own account.

2.6 Analysis of the rescue operation

The dispatched units arrived at the site within approximately ten minutes from the alarm. Emergency medical care was immediately given to the pilot. Judging by the ERC's risk assessment and the information relayed to the rescue units the units may have misinterpreted the situation as being a more serious air accident than just taxiing into a ditch. The dispatched units were sufficient, even somewhat large, in terms of number and quality with respect to the magnitude of the situation. On the other hand, the sufficient number of units arriving at the site would have made it possible to properly manage an even more serious accident. This being the case, the ERC's decision to dispatch a response to an "air accident, medium size" was correct.

3 CONCLUSIONS

3.1 Findings

1. The patient suffered his first heart attack in March 2011, at the age of 59. Balloon angioplasty was performed in three different places on the narrowed left coronary artery; they were then stented.

2. In a follow-up examination in May 2011 at the hospital the pilot was reminded to visit an aeromedical examiner before continuing to fly.

3. The pilot applied for medical certification. As additional accounts the licensing authority demanded, among other things, that the results of a stress echocardiogram, a 24-hour ECG monitoring, and the cardiologist's evaluation be delivered to them by October 2011. The results of the stress echocardiogram were not delivered by October 2011.

4. In March 2012 the licensing authority issued the medical certificate with the condition that, in addition to the aeromedical examination, the pilot would have to produce the results of an exercise ECG and a cardiologist's evaluation. No stress echocardiogram was done in conjunction with the 2012 medical assessment.

5. The patient suffered his second heart attack in September 2013, at the age of 62. The narrowed left coronary artery was treated with balloon angioplasty and stenting in one place.

6. During the hospitalisation the pilot was reminded to visit an aeromedical examiner before continuing to fly

7. In early 2014 the pilot was diagnosed with severe obstructive sleep apnoea. In response to this Continuous Positive Airway Pressure (CPAP) treatment was initiated.

8. The AME granted the medical certification in October 2014 and finalised the examination in January 2015. No stress echocardiogram was done in conjunction with the assessment.

9. The licensing authority did not have the 24-hour Holter monitor test result or the cardiologist's statement.

10. The patient suffered his third heart attack in late January 2015, at the age of 63. During the hospitalisation no mention of the pilot's flying hobby was made in his medical records.

11. Following the heart attacks the pilot made no contact with his own AME or the licensing authority.

12. The pilot saw a doctor in September 2015. At that time it came up in the conversation that his 'flyer driving licence' was still valid. He was mistaken about the privileges included in an LAPL medical certificate.

13. On Saturday 24 September 2016, the day of the accident, the pilot flew the aircraft from Eura aerodrome in Kauttua to Tuulikki-Vampula aerodrome in Huittinen. The pilot had to hand-start the engine by swinging the propeller. During the start process the pilot took a 15 minute break because he was out of breath.

14. The pilot took off for a second flight. During the flight the pilot reported that he would land earlier than planned because he did not feel well.

15. The pilot found it difficult to control the aircraft during the approach and landing. While taxiing, the aircraft ended up in a ditch next to the taxiway.

16. Almost immediately after deplaning the pilot collapsed to the ground. He was pronounced dead at 13.36.

17. There were two passengers on the flight, one of whom had a sudden attack and had to be hospitalised.

18. Restoring medical certification after a heart attack requires a follow-up period, additional testing in accordance with the regulations, consultation with the licensing authority and a specific limitation.

19. On the basis of the Regulation and the guidance material, there is no difference in classes 1, 2 and 3 when being considered 6 months after recovery from a heart attack for a medical certificate

20. Documents do not reveal to which level the pilot's overall risk was assessed in the 2015 aeromedical examination where he was certified.

21. The AMC Part-MED only partly supports decision-making associated with overall risk assessment or for placing limitations as a means of risk management.

22. With the exception of AMEs, Finnish doctors are not required to notify any diagnosed permanent change in the state of a pilot's health that jeopardises flight safety.

23. The rescue and the EMS units dispatched to the site were able to properly manage the accident

3.2 Probable causes

The cause of the accident was the pilot's heart attack during the flight. The pilot suffered from multi-vessel coronary heart disease and within the five years he had had three heart attacks.

The pilot was unaware of the privileges of a medical certification and the validities of the licence.

While the public health care system was aware of the pilot's flying hobby, national legislation does not lay down any duty of notification associated with medical certification to doctors treating licence holders.

The pilot's higher overall risk of a recurring heart attack, as regards flight safety, was not recognised. The European guidance material only partly provides for decision-making associated with overall risk assessment. For the time being, aeromedical processes for assessing the level of acceptable risk, especially following recurring heart attacks, are insufficient.

4 SAFETY RECOMMENDATIONS

4.1 Providing an international process for a risk assessment after heart attack

The International Civil Aviation Organization (ICAO) spearheads the development of updated decision-making mechanisms for aviation medicine. Many sudden incapacitations result from cardiovascular diseases, both in general aviation and in commercial aviation. The prognosis of a heart attack is nowadays much more optimistic. The better prognosis is caused by new, modern cardiological treatments such as stenting in the acute phase of heart attack as well as the new, extremely effective cholesterol-lowering medications. For this reason, aeromedical examiners receive pilots coming for medical assessment that have had more than one heart attack. Fresh epidemiological findings provide information on the prognoses of treatments and new medications. This makes it possible to place pilots in risk categories as regards the risk of a possible recurring heart attack.

The Safety Investigation Authority recommends that

The International Civil Aviation Organization (ICAO) review the existing guidance material contained in the Manual of Civil Aviation Medicine to include a risk assessment model to facilitate aero-medical decision-making in the evaluation of pilots at risk from recurrent heart attacks. [2017-S34]

4.2 Aeromedical examiners' competency based recurrent training

Some AMEs carry out a low number of aeromedical assessments and the vast majority of their medical activity is spent in performing other medical tasks. Especially their proficiency in performing an aeromedical risk assessment may not be at the intended level.

The Safety Investigation Authority recommends that

The European Aviation Safety Agency (EASA) improve AME risk assessment competency through safety promotion, competency based recurrent training and specific training on the national procedures for referral and consultation as well as for the use of limitations. [2017-S35]

4.3 Doctors' national duty of notification

In Finland doctors are always required to notify a licence holder's impaired state of health to the police if the driver is determined to be unfit to drive for at least six months. Regarding pilots, doctors working in general healthcare do not have any comparable duty of notification to the Finnish licensing authority.

In Norway the duty of notification has been in effect since 1982 and it applies to all health care professionals. According to Norwegian experiences it has been beneficial to flight safety. Such regulations also clarify the role of the doctor treating the person and improve the exchange of information among the health care authorities and those assessing medical certification.

The Safety Investigation Authority recommends that

The Finnish Ministry of Transport and Communications standardise the duty of notification between aviation and road transport, associated with a person's state of health, as part of advancing the safety of flight. [2017-S36]

4.4 Safety of general aviation and sport aviation

The pilot was lacking the basic knowledge of the significance of reporting medical issues and the privileges associated with the pilot's licence. It is possible to advance the safety of general aviation and sport aviation by improving communications and training materials to the flight community.

The Safety Investigation Authority recommends that

The Finnish Transport Safety Agency see to it that the practitioners of general and sport aviation receive clarifying information pertaining to the privileges associated with the pilot's licence and the significance of the requirement to report medical issues. [2017-S37]

Helsinki 21 June 2017

Ismo Aaltonen Kalle Brusi Antti Virtanen

Alpo Vuorio

REFERENCES

The following documents (or their copies) used as material in the investigation are archived at Safety Investigation Authority, Finland

1. The decision to launch the investigation.
2. Photos from the accident site.
3. E-mail correspondence with the European Society of Aerospace Medicine (ESAM), Civil Aviation Authority - Norway, and the Finnish Transport Safety Agency (Trafi).
4. Recordings and transcripts made of interviews.
5. Epicrises related to the pilot's medical treatment.

SUMMARY OF THE COMMENTS TO THE DRAFT FINAL REPORT

The draft final report was sent to comments to the International Civil Aviation Organization (ICAO), the European Aviation Safety Agency (EASA), the Finnish Transport Safety Agency (Trafi), the Ministry of Transport and Communications and the Emergency Response Centre Administration.

ICAO submitted no significant comments to the content of the draft final report. Moreover, they emphasised that the present version of the ICAO's Manual of Civil Aviation Medicine includes the aeromedical follow-up process for assessing recovery from heart attack. Updates for assessing the follow-up for recurring heart attacks may be warranted.

EASA submitted no significant comments to the content of the draft final report. It seems that the recommendation directed at them could be integrated into the ongoing development project for improving aero-medical examiners' competency. This project could include additional AME training in risk management.

The Finnish Transport Safety Agency's comments call attention to the fact that the AME had not included any information of the 24-hour ECG monitoring test performed in January 2015, or the cardiologist's consultations. Furthermore, The Finnish Transport Safety Agency calls attention to the fact that the pilot repeatedly failed to report any changes in his state of health. The Finnish Transport Safety Agency reminds that stress echocardiogram tests are not widely available in Finland.

In addition, it was stated that when the AMC Part-MED entered into force, aero-medical examiners will normally issue medical certifications on their own. When needed, pursuant to the demands of regulations or at their own discretion, they will either consult, or completely refer the decision to, the Finnish Transport Safety Agency's Traffic Medicine Unit. When the AME issued the medical certification following the examination after the second heart attack he did not consult the licensing authority.

The Ministry of Transport and Communications commented the recommendation directed at them so that the already ongoing legislative project would harmonise the practices for medical notification in rail and air traffic and in navigation, and that the goal would be to achieve corresponding safety improvements as in the duty of notification in road traffic.

The Emergency Response Centre Administration had no comments to the draft final report.