Aviation Accident at Selänpää Aerodrome on July 16, 2023

L2023-02

SYNOPSIS

Pursuant to section 2 of the Safety Investigation Act (525/2011), the Safety Investigation Authority of Finland (SIAF) decided to investigate an aerobatic aircraft accident that occurred at Selänpää aerodrome on July 16, 2023.

The purpose of a safety investigation is to promote general safety, the prevention of accidents and incidents, and the prevention of losses resulting from accidents. A safety investigation is not conducted in order to allocate legal liability.

Airline transport pilot Mika Kosonen was appointed the investigation team leader. The appointed team members were airline transport pilot and flight instructor Kimmo Lius, licensed aircraft mechanic Mikko Raatikainen, airline transport pilot (retired) Kristian Rintala, and flight instructor and safety manager Jukka Intke. The investigator-in-charge was Chief Air Safety Investigator Janne Kotiranta.

The German Federal Bureau of Aircraft Accident Investigation (BFU) and the National Transportation Safety Board (NTSB) of the United States appointed accredited representatives for the investigation. The European Union Aviation Safety Agency (EASA) appointed a technical advisor.

The safety investigation examines the course of events, their causes and consequences, search and rescue actions, and actions taken by the authorities. The investigation specifically examines whether safety had adequately been taken into consideration in the activity leading up to the accident and in the planning, manufacture, construction and use of the equipment and structures that caused the accident or incident or at which the accident or incident was directed. The investigation also examines whether the management, supervision and inspection activity had been appropriately arranged and managed. Where necessary the investigation is also expected to examine possible shortcomings in the provisions and orders regarding safety and the authorities' activities.

The investigation report includes an account of the course of the incident, the factors leading to the incident, and the consequences of the incident as well as safety recommendations addressed to the appropriate authorities and other actors regarding measures that are necessary in order to promote general safety, prevent further accidents and incidents, prevent loss, and improve the effectiveness of actions conducted by search and rescue and other authorities.

An opportunity is given to those involved in the accident and to the authorities responsible for supervision in the field of the accident to comment on the draft investigation report. These comments have been taken into consideration during the preparation of the final report. A summary of the comments is at the end of the report. Pursuant to the Safety Investigation Act, no comments given by private individuals are published.

The investigation report was translated into English by TK Translations.

The investigation report and its summary were published on the SIAF's internet page at *www.turvallisuustutkinta.fi* on June 11, 2024.

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1 FACTUAL INFORMATION

1.1 History of Flight

On Sunday, July 16, 2023, at 1359 h[1], an Extra EA300/S airplane, bearing registration OH-ESS, was involved in an accident at Selänpää aerodrome. The pilot failed to effect timely recovery from a flat spin that was part of an aerobatic display routine, and as a result the airplane struck trees and forested terrain to the east of the intersection of runways 04/22 and 12/30. It was damaged beyond repair and the pilot sustained fatal injuries.

The routine was part of the program of a public aviation day organized by Kouvola Flying Association. Before the accident flight, the pilot performed a practised two-ship sequence with another pilot flying the same airplane type. This was followed by the solo routine that led to the accident.

After the accident, spectators crossed the active runway, on which another aerobatic airplane was preparing for takeoff, to help the pilot. The event organizer terminated the display.

1.2 Survival Aspects

The first report of the accident was made to the emergency response center (ERC) at 1359 h, and the ERC initiated a prescribed procedure for a serious aviation accident. The response included four rescue units, two water tenders, an on-duty fire officer, an on-duty fire chief, a paramedic field supervisor unit, two paramedic units, an emergency physician, and an ambulance helicopter with a doctor on board. Police units and a social and crisis emergency services team were also alerted.

The paramedic and rescue units found the pilot beyond medical help. The rescue units, which included a water tender equipped with a foam cannon, carried out fire prevention actions and cordoned off the accident site.

Table 1. Alerted rescue units.

Call sign	Alerted at	On accident site at	Station	Role
RKY601	14.00.44	14.22.21	Kuusankoski	Rescue unit
RKY503	14.00.44	14.25.00	Kouvola	Water tender
RKY641	14.00.44	14.13.00	Selänpää	Rescue unit (VFB)
RKY32	14.01.36	14.23.04	Kouvola	On-duty fire officer
RKY501	14.01.36	Canceled	Kouvola	Rescue unit
RKY631	14.01.36	Canceled	Jaala	Rescue unit (VFB)
RKY643	14.01.36	14.15.00	Selänpää	Water tender
RKY20	14.02.00	14.28.00	Kotka	On-duty fire chief

[1] All times are Finnish daylight savings time (UTC + 3 h).

Table 2. Alerted paramedic units.

Call sign	Alerted at	On accident site at	Station	Role
EKY21	14.01.29	14.25.19	Kouvola	Medical supervisor / Field supervisor unit
EKY222	14.01.29	14.19.32	Kouvola	Paramedic unit
EKY2212	14.01.36	Canceled	Kuusankoski	Paramedic unit
EKY20	14.01.29	Canceled	Kouvola	Emergency physician
EFH10	14.03.19	Canceled	Vantaa	Ambulance helicopter with doctor on board

Table 3. Alerted police units.

Call sign	Alerted at	On accident site at	Station	Role
PKY113	14.03.37	14.25.00	Kouvola	Police vehicle
PKY119	14.38.51	15.31.10	Kouvola	Police vehicle

Table 4. Alerted social and crisis emergency services units.

Call sign	Alerted at	On accident site at	Station	Role
SKY231	14.01.23	Canceled	Kouvola	On-duty social and crisis emergency services team

1.3 Wreckage and Impact Information

The pilot sustained fatal injuries at impact. The aircraft was damaged beyond repair. A small amount of fuel and oil leaked into the ground.

2 BACKGROUND INFORMATION

2.1 Environment, Equipment and Systems

2.1.1 Aerodrome

Selänpää aerodrome (EFSE) is in Valkeala, 22 km north of the town of Kouvola. The uncontrolled aerodrome[2] is maintained by Kouvola Flying Association. It has four runways. Runway 04/22 is 850 m long and has gravel and grass surface, while runway 12/30 is paved and 1,000 m long. Aerodrome elevation is 417 ft[3] above mean sea level. The aerodrome is a venue for extensive gliding and powered flying activity.

Figure 1. Selänpää aerodrome with runways indicated by arrows. (Aerial view ©National Land Survey of Finland 09/2023, annotations by SIAF)

[2] No air traffic control services are available at an uncontrolled aerodrome.

[3] 1 ft = 0.3048 m, so 417 ft equals approximately 127 m.

2.1.2 Aircraft

The accident aircraft was a single-seat type-certified Extra EA300/S aerobatic airplane manufactured by Extra Flugzeugproduktions und Vertriebs GmbH. The empty weight and maximum takeoff weight of the type are 670 and 920 kg, respectively. The maximum allowable airspeed is 220 kt, and the airplane is qualified for load factors[4] of +10/-10 G. The accident airplane was built in Germany in 1992.

The EA300/S has a fabric-covered tubular steel fuselage with composite covers, fairings and engine cowling panels. The main landing gear units are attached to the lower fuselage forward of the cockpit, and a tailwheel is mounted under the empennage. The single-seat cockpit is fitted with instrumentation for visual flight rules operation. The one-piece composite wing is attached to the lower fuselage at the main spar. The full-span ailerons are of composite construction, and no flaps are fitted. The stabilizers, rudder and elevator are made of composite material. The ailerons and elevator are actuated via pushrods, while the rudder is cable-operated. A trim tab fitted to the elevator is operated mechanically via a cable system.

The accident airplane was powered by a six-cylinder Lycoming AEIO-540-L1B5 piston engine driving a four-blade propeller. The maximum rated power of the engine is 300 hp.

The total fuel capacity of the accident airplane was 160 l in two 60 l wing tanks and in a 40 l fuselage tank located between the engine and cockpit. The wing tanks must be empty during aerobatic maneuvering. The engine used AVGAS 100LL aviation gasoline. A smoke oil system[5] was installed in the airplane.

2.1.3 Display Routine

The accident flight was not preplanned. The pilot intended to impress the crowd by performing high-risk maneuvers and therefore violated the minimum aerobatic heights quoted on his public display authorization. The routine included, among other maneuvers, loops, rolls, inverted flight and a flat spin.

Approximately 40 s prior to ground impact the pilot initiated a climbing 270° turn. Halfway through the turn the airplane began to descend, and in the final phase of the turn the altitude was approximately 300 ft above aerodrome level. On completion of the turn the pilot pulled up into a pure vertical climb. By this time the elevator had remained in the nose-up position for 13 s, which had bled the airplane's kinetic energy. During the climb, the pilot performed two 360° aileron rolls[6] to the right. These rolls were not "clean" in that the airplane's nose oscillated in a circular motion about the longitudinal axis. In the end of the second roll, airspeed decayed to near zero. The pilot then put the airplane into a left-hand flat spin at an altitude of 1,200 to 1,300 ft. The airplane made approximately four and a half rotations about

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4 Load factor, or G-force, is a multiple of gravitational acceleration.

5 A smoke oil system generates smoke for visual effects during aerobatics.

6 Roll means rotation of the aircraft about its longitudinal axis.

the vertical axis[7] while the nose continued to pitch[8] up and down. It is possible that nose position alternated between above and significantly below the level of the horizon. The duration of each full 360° rotation was about 2.5 to 3 s. The pilot began recovery after approximately four rotations at about 600 ft above surface level by applying the rudder in the opposite direction of rotation, i.e., to the right, and by neutralizing the elevator and ailerons. A moment later, he applied right aileron while the elevator remained in neutral and the rudder remained deflected to the right. These actions were initiated 5 s prior to ground impact. The airplane continued to rotate about the vertical axis approximately 120° to 150° after the initiation of recovery. Once the rotation stopped, it continued to roll approximately 10° to 20° to the left into the direction of the rotation, and simultaneously the nose dropped. Just before ground impact, the airplane banked in the opposite direction, i.e., to the right. It struck the ground in almost vertical nose-down attitude right wing first, with the elevator in fully nose-up position and the rudder deflected slightly to the right. The pilot reduced power to idle about 1 s before impact.

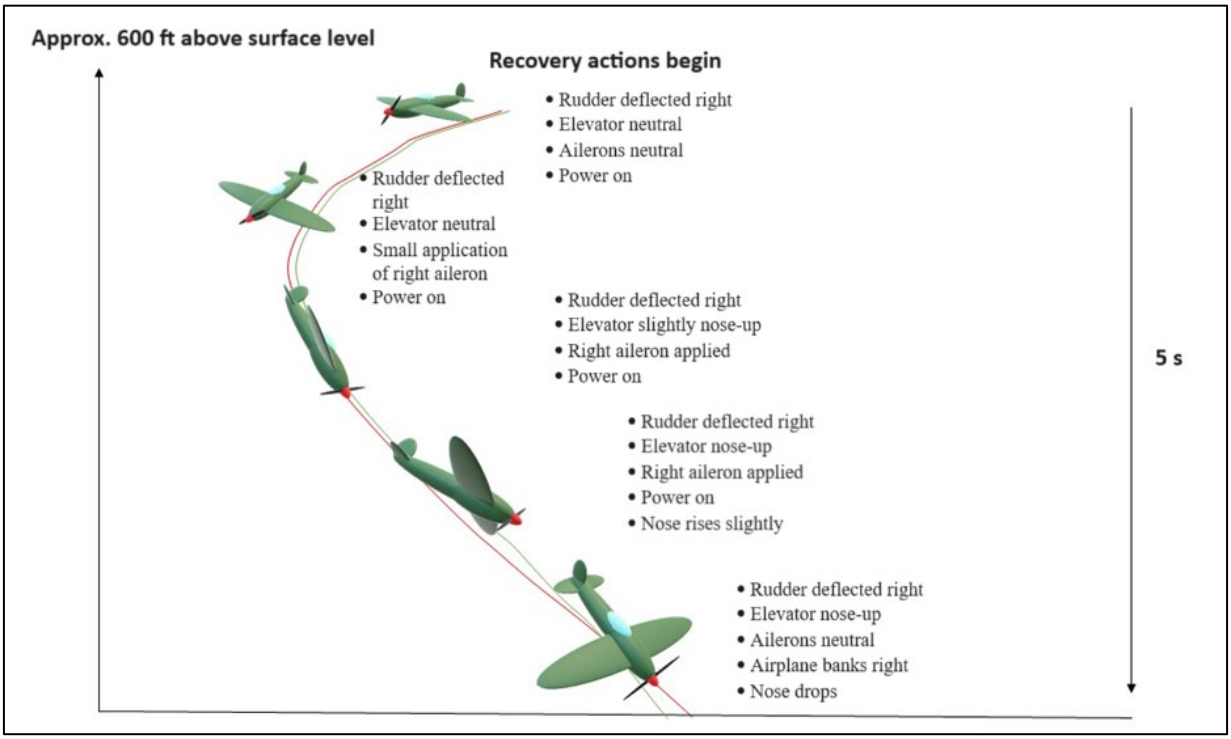

Figure 2. Sequence of attempted spin recovery. (Figure: SIAF)

2.1.4 Flat Spin in Aerobatic Display Routine

Flat spin is an autorotative motion of the airplane that occurs when the control stick and rudder are deflected simultaneously to the left or right at the lowest possible airspeed and back pressure is maintained on the stick. When the airplane enters the spin, opposite aileron

[7] Rotation of the aircraft about its vertical axis is called yaw.

[8] Pitching means rotation of the aircraft about its lateral axis.

is applied, and power is added to raise the nose level with the horizon assisted by gyroscopic forces. Easing back pressure on the stick combined with gyroscopic forces helps the airplane to rotate about the vertical axis. The nose is kept level or almost level by coordinating elevator inputs and engine power and by making use of gyroscopic forces created by the engine. Attempts will be made to keep the wings level by coordinated use of the rudder and ailerons while the wings remain stalled. Gyroscopic forces created by the engine and propeller slipstream against the rudder contribute to the rotating movement. One 360° rotation during a fully developed "clean" flat spin causes an altitude loss of approximately 200 to 230 ft, depending on the rate of rotation. Slow rotation rates increase altitude loss appreciably.[9]

According to the EA300/S pilot's operating handbook, the airplane will recover within approximately 1/2 turn, and after six turns of spinning the altitude loss including recovery is approximately 2,000 ft.[10]

2.1.5 Wreckage and Impact Information

The airplane impacted the ground in a steep nose-down attitude, banked to the right. It was destroyed, and there was no fire. The four corners of the airplane were identified at the accident site.

The impact caused deformation of the fuselage. The steel-tube structure showed bending and fractures over its entire length, and the empennage was partially separated. No significant deformation was noted in the cockpit area, although the footwell was partially crushed in due to the distortion of the fuselage in line with the instrument panel. The panel remained in place, but was bent, and some instruments had dislodged. The seat harness remained attached and was intact. The airplane was not fitted with flight recorders.

The right main landing gear was fractured and separated from the fuselage attachments, while the left main landing gear remained attached to the airframe.

The fuselage fuel tank was breached around the filler port and contained fuel.

The engine mount was fractured at several points. The cylinder block and cylinders exhibited inward crushing and fractures, most of the damage being on the right-hand side. The inlet manifold and the fuel injection servo had broken free from the underside of the engine. The propeller blades had fractured and separated, but the propeller hub remained attached, and the engine could be rotated from the hub.

The flight control systems remained attached to the fuselage and continuity was established. The top end of the control stick had separated. The elevator and the aileron control rods could be operated by manipulating the control stick. The rudder pedals were torn off from their

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9 De Lapparent 1996, p. 22–30.

10 Pilot's Operating Handbook, p. 4–12.

attachments. The actuators of the electrical pedal adjustment system were partially separated, and the slide tubes had the same length. The rudder control cables were intact and attached.

The engine controls remained attached. The throttle control lever was in a position consistent with a partial power setting, and the mixture and propeller controls were fully forward. The forward part of the throttle quadrant exhibited fractures, and the mixture control was bent. The throttle and mixture control cables remained attached to the cockpit controls but showed significant bending over their full length within the forward portion of the fuselage. The throttle and mixture control levers were broken free from the fuel servo. The propeller control mechanism was intact and in place, and the propeller governor was undamaged.

The right wing was separated at the wing-to-fuselage junction and broken into several parts. The left wing was attached to the fuselage, and its outermost portion had separated. The wing remained attached to the fuselage at its center section, and the main spar attachments were undamaged, while the auxiliary spar attachments were bent and partially fractured at impact. No sign of pre-impact wing damage or displacement was noted.

The ailerons remained attached to their hinges in their respective wing and showed fractures at several points. The aileron control rods remained in place but were broken.

The rudder and the elevator were damaged but in place, and they could be moved by manipulating the controls. The elevator trim tab remained attached and connected to the actuating rod, which was bent.

2.1.6 Further Examination

Further examination of the airframe and structural joints revealed no signs of pre-impact damage. The distortion, deformation and fractures found in the wings and other components of the airplane had resulted from the ground impact.

The horizontal stabilizer remained attached to the fuselage and was essentially intact. The elevator was attached to the stabilizer and operated normally, and the elevator control system components were in place and could be operated by manipulating the control stick. The elevator trim tab was in nose-up position. However, damage sustained by the aft portion of the fuselage had resulted in distortion of the tab control mechanism, which in turn had changed tab angle. No sign of elevator control restriction or pre-impact damage was found.

The vertical stabilizer and the rudder were attached and in place. The tip of the rudder was crushed, but this did not restrict the free movement of the rudder. The rudder control cables remained connected to the rudder and attached to the fuselage and were found attached to the rudder pedals, which were partially detached. The components of the electrical pedal adjustment system remained in place, the system was in mid-travel, and the slide tubes had the same length. No sign of pre-impact rudder control system anomalies was found.

The ailerons and their control system exhibited multiple fractures. The end fittings of the control rods remained connected to the lower end of the control stick. The control rod of the

left aileron was bent but remained attached to the aileron, and the aileron could be deflected by manipulating the control stick. The control rod of the right aileron exhibited multiple fractures that had resulted from ground impact, but its end fittings were in place. The fractures had resulted from the ground impact. No sign of rudder control system anomalies was found.

Engine examination looked at factors that could have affected engine operation and control. The engine could be rotated by hand-turning the propeller. Damage noted in the cylinder block and cylinders had resulted from ground impact, while the accessory section showed no signs of pre-impact damage. The ignition system had remained intact, and the engine had operated correctly until the impact.

The engine fuel system contained fuel. The fuel injection servo and the lower part of the intake manifold had broken off at impact, and this had probably resulted in ingress of dirt into the servo unit. The throttle and mixture control cables were attached to the servo unit but had fracture-separated next to the cable end bearing. A fracture mode analysis and the position of the controls indicated that full rich had been selected and the throttle had been at or near idle.

The propeller blades had broken into several sections, two blades next to the propeller hub, and two at about 20 cm from the hub. The separated sections were located at the accident site or in its immediate vicinity. Blade tips exhibited minor impact damage from tree strikes. The blades were at high pitch consistent with propeller control and governor settings. Blade damage, pitch angle and the location of the blade sections suggested that the engine had been at idle or low power at impact, and the propeller had been selected to high pitch.

The condition of the airspeed indicator and altimeter was examined. Damage to the fuselage and wings had also ruptured the tubing connected to these instruments. The pitot tube[11] had detached from its attachment in the left wing. No blockage or pre-impact damage was found in the pitot-static system, and the airspeed indicator showed zero. The 10,000-foot pointer in the altimeter was between 0 and 9 on the instrument dial, the 1,000-foot was near 5, and the 100-foot pointer was at 2. Altimeter setting was 1,001 hPa. The pointers moved when reference pressure was readjusted and responded to changes in ambient pressure, and no anomalies were noted in instrument operation or mechanism, although the mechanism had been disturbed at impact.

The findings of further examination were compared with photographs and video footage of the accident flight, and no inconsistencies were found.

It was concluded that the aircraft had sustained no pre-impact damage or malfunctions, and no indication of pre-impact separation of components was found. The altimeter was apparently set to indicate altitude above aerodrome level.

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[11] The pitot tube measures the total pressure of fluid flowing past the aircraft. The difference between total pressure and static pressure is called dynamic pressure, and it is shown as airspeed on the airspeed indicator.

2.2 Conditions

2.2.1 Weather

Since Selänpää aerodrome does not have a weather observation station, meteorological data was obtained from Utti aerodrome located 20 km south-southeast of Selänpää. At 1350 h, the sky was almost clear. Temperature was 24 °C and dew point was 9 °C. Wind was from 210° at 10 kt, variable between 170° and 230°. Atmospheric pressure was 1,014 hPa.

2.3 Recordings

2.3.1 Airborne Recorders and Radar Data

The airplane was not fitted with flight recorders, and no radar data was available for the investigators.

2.3.2 Photographs and Video Recordings

Photographs and video footage obtained from spectators were used during the investigation. These recordings were captured both with mobile devices and with 4K resolution equipment. They were used to determine the flight path of the airplane during the display routine, and they also yielded details of the moments preceding the accident.

2.4 Organizational and Management Information

2.4.1 Pilot

The 51-year-old pilot held a valid private pilot license with an SEP(A) rating revalidated to expire on September 30, 2023. His LAPL aeromedical certificate was valid until August 14, 2023. He held an unlimited public display authorization (PDA) valid until June 30, 2025. The minimum aerobatic heights quoted on his PDA were 400 ft for aerobatic maneuvers and 200 ft for flypasts. The pilot's skill level had been upgraded by two tiers one month prior to the accident, and the minimum aerobatic height was lowered from 700 to 400 ft. The pilot had applied for the upgrade in order to be allowed to perform flat spins in flying displays.

Table 5. Pilot's flying experience: total and during last 24 hours, 30 days and 90 days.

Flight experience	Last 24 h	Last 30 days	Last 90 days	**Approximate total**
On all aircraft types	55 min	3.5 h	15 h	435 h
On Extra EA300	55 min	3.5 h	15 h	57 h

2.4.2 Kouvola Flying Association

The event was a public aviation day arranged by Kouvola Flying Association, which has over ten years of experience in organizing aviation events. Aviation day programs have included demonstration flights and, in several years, aerobatic displays.

The association, which operates from Selänpää aerodrome, was founded on July 4, 1960.[12] It provides training for a glider pilot license and familiarization flights, and for these purposes its fleet includes several gliders.

2.4.3 Emergency Plan

Kouvola Flying Association had submitted a public event emergency plan to Kymenlaakso Rescue Department on July 3, 2023.

Section 1 of the plan contains a description of the event. The expected attendance at the aerodrome was approximately 250 to 350 persons between 1000 and 1500 h. The largest estimated number of people simultaneously at the event was approximately 150. Spectators would be given pleasure flights in two gliders and possibly in one touring motor glider. These flights were considered familiarization flights and would be conducted in accordance with the applicable regulations of the authorities. The event organizer expected, with the experience from previous years, that between 5 and 8 aircraft would arrive at the aerodrome in addition to a DC-3.

Section 2 contains a description of the venue. The focal point of the activities would be in front of the cafeteria and aircraft hangars. Joyriders would be guided to the glider departure area. Car parks were delineated adjacent to the access road, and disabled parking spaces were demarcated closer to the airfield. Vehicle traffic in the movement area was allowed only for association members for the operation of the event.

Section 3 contains a description of the safety organization and identifies the event safety manager. Under the safety organization arrangement

- persons involved in the conduct of the event would be familiarized with their assigned duties beforehand
- persons responsible for specified duties and their contact information would be shown in a separate organisational chart
- approximately 25 persons in total would be involved in the arrangements of the event
- Kouvola Flying Association personnel would be on location and carry out their duties during the duration of the event
- the association's personnel would maintain contact with mobile phones or via aeronautical radios
- safety instructions and regulations and particular caution would be observed in all activities
- association members would wear high-visibility vests within the aerodrome area
- further assistance would be requested by calling the emergency number 112
- a first response team of Selänpää voluntary fire brigade team would be present during the the event.

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[12] KILY - Kouvolan Seudun Ilmailuyhdistys ry. [https://www.kily.fi/site/index.php]

Section 4 contains a general description of risk prevention arrangements. The organizing committee had carefully assessed the anticipated risks, helped by the fact that Kouvola Flying Association has over fifteen years of experience from organizing similar events, and most of organizing personnel had retained their positions throughout that period.

Section 5 contains a general description of risk mitigation actions. Emphasis was to be on preventive risk management. Specific areas of interest included minimum separation distances, supervision and guidance of flying activity. The barbecue pit was to be moored in accordance with the applicable instructions, and organizing personnel would be continuously present at the pit. At least one 6 kg hand-held fire extinguisher would be available in the immediate vicinity of the pit.

Section 6 contains instructions for action when an anticipated risk is realized or an accident or incident occurs. Familiarization of security personnel has included procedures for contingencies such as accidents and sudden attacks of illness, fires, disorderly conduct and removal of disruptive person or persons from the venue. Potential flying-related accidents and incidents mentioned in the plan include an aircraft impact with terrain, a mid-air collision and a collision between an aircraft and a vehicle, while remote control problems are identified as risks during radio controlled model aircraft operation. The section also contains driving instructions from Valkeala township to the aerodrome for emergency vehicles.

Section 7 states that authorities are alerted by calling the emergency number 112.

Section 8 includes a description of the means of risk identification and preparedness for various contingencies. The most serious likely risks would be related to aircraft movement in the air and on the ground. Flying activity at the aerodrome would not differ much from normal daily operations. Exceptions are movement of persons to the departure point of pleasure flights and possible aerobatic displays.

Kymenlaakso Rescue Department had assessed the emergency plan and found it adequate for the purpose. However, approximately 400 to 600 vehicles arrived at the venue according to various estimates. The aerobatic display and the visit of the DC-3 had been advertised in the local newspaper and in the media, and pleasure flights in a helicopter were also available,

Despite all this, the event was not classified as a flying display in the emergency plan. Southeastern Finland Police Department had not been notified of the event, and no flying display permission had been issued by the the Finnish Transport and Communications Agency Traficom.

2.5 Alerting Procedures

2.5.1 Ministry of Employment and Economy

The Ministry or Employment and the Economy has since 2016 coordinated a project to develop practices in licensing and supervision across organizational and administrative

boundaries.[13] The project aims to reform practices in licensing and supervision by harnessing the benefits of digitalization. This can be achieved by identifying licensing and supervision packages that meet clients' needs and integrating the service and handling processes in a client-oriented way. Another goal is to dismantle unnecessary and overlapping processes and services and make authorities' activities and processes more effective and integrated.

The project term was September 1, 2016, to December 31, 2023. The first licences were processed within the new service framework on September 1, 2020, and the service package for event licensing[14] was rolled out in the summer of 2023. The service facilitates the handling of matters related to licencing and supervision because services provided by various authorities are integrated into easily accessible packages. The service makes possible the identification of all applications, notifications and registrations that may be required for an event that is being planned, and clients can monitor the progress of the matter in the authorities involved. A client will also need to enter the information required by various authorities into the service only once.

2.5.2 Finnish Transport and Communications Agency

The Finnish Transport and Communication Agency Traficom decided on September 5, 2022, to launch a project for updating Aviation Regulation OPS M1-2 (for flying displays and contests), which was first issued in 1997 and has since become partially obsolete. Traficom has found that areas for updating include, among others,

- risk assessment requirements
- the duties and responsibilities of the event organizer and flying display director
- post-event reporting
- procedures for the issuance of public display authorizations
- a need to differentiate requirements for small and large flying displays.

In addition to the text of the original regulation, use will be made, among other sources, of the applicable parts of the CAP standards issued by the Civil Aviation Authority of the United Kingdom,[15] the flying display regulations of the North Atlantic Treaty Organization, and the respective requirements of other EU member states.[16] The CAP standards include instructions for risk assessment for flying displays, among other guidance.[17] Risk assessment was introduced as a new item in Traficom's project launch decision.

The Finnish Transport Safety Agency issued in 2014 a recreational aviation survey, in which risk levels associated with aerobatic flying were assessed. The survey states that "competitive flying can create a through and safe foundation for aerobatics, assuming that the pilot has a

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13 Project number TEM026:00/2017.

14 https://luvatjavalvonta.fi, https://lv.ahtp.fi/fi/

15 CAP 403: *Flying Displays and Special Events: Safety and Administrative Requirements and Guidance* and CAP 1724: *Flying Display Pilot Authorisation and Evaluation: Requirements and Guidance*.

16 TRAFICOM/325680/03.04.00.00/2022.

17 CAP 403, Appendix A, p. 125–137.

safety-conscious attitude. Even some of the most successful and experienced competition pilots have had accidents through unnecessary risk-taking, although not in competitions, because competition rules are very strict. Unnecessary risks are sometimes taken during practice flights or at an air show through over-confidence. If a pilot develops a sense of being 'all-powerful' through mastery of routine, this may be fatal. Flying involves hundreds of variables, and aerobatics is even more complicated. Indeed, flying always entails risk factors, and that risk should not be compounded through poor risk management." The assessment was initiated by the Ministry of Transport and Communications.[18]

2.5.3 Previous Investigations into Accidents during Public Events

The SIAF has previously probed the arrangements of public events and related requirements and published the following reports:

- Y2015-03 *The wheel of a monster truck ended up in the crowd at Alahärmä on 8 August 2015*
- Y2018-03 *Accidents during motorsport events in Seinäjoki on 15 June 2018 and in Pori on 22 June 2018*
- Y2020-02 *Boating accident at a public event in the Hanko harbour on 8 August 2020*

Based on these investigations, the SIAF issued safety recommendations, including the following:

- The Ministry of Interior (police and rescue service) and the Ministry of Employment and the Economy clarify the safety requirements for mass gatherings and make them available at a "single service point" and in a single, comprehensive safety plan. The requirements must be understandable and simple for event organizers.
- The Finnish Safety and Chemicals Agency (Tukes) must show initiative and present the need for the simplification and streamlining of the requirements of the authorities to the relevant ministries and authorities. In connection to this, Tukes must plan what kind of cooperation is required for the creation of an event database. The purpose of the database is to guide event organizers in entering the basic and safety planning details of the event into the database, allowing the information to be distributed to the different authorities.
- The Ministry of Interior (police and rescue services) and the Ministry of Employment and Economy ensure that event organizers have access to a set of safety training materials that are not limited to any specific administrative branch, and for example, an (online) course whose successful completion would qualify course takers to act as safety managers of mass events. Event organizers must be familiar with the applicable legislation and the principles of safety planning and management.
- Together with the other authorities supervising events, the Finnish Safety and Chemical Agency ensures that in motorsport events and other similar events involving

[18] The Finnish Transport Safety Agency Trafi 2014, p. 77.

high kinetic energy, the event organizer is always required to provide reports and plans based on calculations or applicable rules of the sport concerning the safety distances and structures implemented to protect the public and the officials.

2.6 Rescue Services and Their Preparedness

2.6.1 Kymenlaakso Wellbeing Service County

Under Section 4 of the Act on Organising Rescue Services (613/2021), wellbeing service counties are responsible for organizing rescue services in their area. Kouvola is part of Kymenlaakso county, in which these services are provided by Kymenlaakso Rescue Department.

The department maintains 24/7 readiness in five fire stations in Kotkansaari, Karhula, Hamina, Kouvola and Kuusankoski. These stations are manned by salaried personnel and are supported by 29 contract fire brigades with the total manning of approximately 850 contracted firefighters. Further support is available from three military firefighting units and four industrial fire services.

Paramedic services are provided by emergency care units that operate 24 hours day in Kymenlaakso Central Hospital in Kotka and in Ratamo facility in Kouvola. The paramedic services and emergency care units are the components of acute care service in the county.

2.7 Regulatory Framework

2.7.1 Administrative Procedure Act

According to section 8, subsection 1 of the Administrative Procedure Act (434/2003), an authority shall, within its competence, provide its customers, as necessary, with advice on dealing with administrative matters and respond to questions and enquiries concerning the use of its services. Subsection 2 states that, if a matter does not fall within the competence of an authority, it shall seek to refer the customer to the competent authority. During the prework of the act, it was concluded that an authority should refer the customer to the competent authority of another administrative branch or even to an agency that operates outside the administrative framework. This is particularly important for clients who only rarely need to contact the authorities. The purpose of the act is to offer clients a means of managing personal matters on their own initiative.[19]

2.7.2 Aviation Act

Section 72 of the Aviation Act (864/2014) governs flying displays and flying competitions. According to subsection 1, a permission from the Finnish Transport and Communications Agency Traficom is required for a flying display or flying competition when the event takes place at an airport, the program includes aerobatic flying, or there are foreign participants.

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[19] Government proposal 72/2002 request for a reply, p. 64.

Subsection 2 states that to obtain the permission to organize a flying display or flying competition, the applicant must have at its disposal an organization and staff necessary for the safe conduct of the display or competition. In addition, the equipment to be used in the event for which a permission is granted, the performers of the display or competition, the flying programs and the safety arrangements must meet the requirements of the applicable rules and regulations.

2.7.3 Aviation Regulations

Aviation Regulation OPS M1-2 contains detailed regulations for the arrangements of flying displays. Paragraph 1a in Appendix A to the regulation defines a flying display as any flying activity deliberately performed for the purpose of providing an exhibition or entertainment at an advertised event open to the public.

Paragraph 1a also defines a public display authorization (PDA) as a national document detailing the groups or categories of aircraft in which a pilot is authorized to display, together with any limitations and other specific endorsements. Paragraph 1d states that the flying display director shall not allow any pilot to participate in a flying display unless he or she holds a PDA issued by the authority or an exemption granted for a specific event. Paragraph 6a states that the display pilot shall not violate the minimum aerobatic height quoted on his or her PDA.

Paragraph 3c states that a PDA may only be issued after the applicant has demonstrated to the authority or a public display authorization evaluator that his or her skills meet the requirements of the skill level and minimum aerobatic height that are quoted in the application and are prerequisites to the safe conduct of the display sequence. An evaluation flight shall always be flown in the same aircraft category or type or in an individual aircraft for which the authorization is requested. Under paragraph 3d, the authority or evaluator must be satisfied that the demonstrating pilot has the skills and ability to handle the aircraft in a safe manner during the execution of the intended display sequence before a PDA for a fixed-wing or rotary-wing aircraft can be granted. Particular attention shall be paid to the applicant's ability to

1) adhere to the display line
2) adhere to the selected height
3) maintain approved slot times and duration
4) handle changes in prevailing conditions, such as the effects of on-crowd crosswind
5) handle emergencies in a safe manner.

Paragraph 24 sets forth requirements for the scope of the emergency plan, including the preparation of safety arrangements and safety actions in cooperation with the local police department, medical and first aid service, and emergency response service in the event of an aviation accident.

Appendix A-2 to the regulation lists the permitted aerobatic maneuvers for skill levels, which are

1) standard/sportsman
2) intermediate
3) advanced
4) unlimited.

Under paragraph 5d of the appendix, flat spins are authorized in the unlimited category.

2.7.4 Rescue Act

Section 16 of the Rescue Act (379/2011) contains provisions for an emergency plan for a public event. According to subsection 1, the organizer of a public event or other event that, on account of the large number of participants or for some other special reason, involves a substantial risk to the safety of persons or fire safety shall draw up an emergency plan for the event. Subsection 2 states that the dangers and risks concerning the event shall be detailed and assessed in the emergency plan for a public event. The safety arrangements for the event and instructions issued to the personnel responsible for the carrying out of the event and the public taking part in the event on how to prevent accidents and what action to take in accidents and dangerous situations shall be defined on the basis of them.

2.7.5 Government Decree on Fire and Rescue Services

Section 3 of the Government Decree on Fire and Rescue Services (407/2011) contains provisions for an emergency plan for a public event. According to section 1 subsection 1, an emergency plan referred to in section 16 of the Rescue Act shall be drawn up for a public event or an event in which the number of participants is estimated to exceed at least 200 persons simultaneously. Subsection 4 also states that an emergency plan shall be drawn up when the nature of the event involves a substantial risk to the safety of persons.

2.7.6 Assembly Act

Section 14 subsection 1 of the Assembly Act (530/1999) states that the arranger shall notify the police of the arrangement of a public event in writing at least five days before the beginning of the event. The police may accept also a notification made later if the arrangement of the event will not disrupt public order and if the late notification will not unreasonably hamper the performance of the statutory duties of the police. According to subsection 2, no notification needs to be made on a public event which, owing to the low number of participants or the nature or place of the event, does not require measures for the maintenance of order or security nor for the prevention of inconvenience to the bystanders or damage to the environment, nor special traffic arrangements. Section 2 subsection 3 defines a public event as amusements, contests, performances and other comparable events that are open to the public, but not considered to be public meetings. According to the rationale of the

prework of the act, flying displays and sports events that are open to public fall within the definition of a public event.[20]

2.7.7 Consumer Safety Act

Section 7 of the Consumer Safety Act (920/2011) contains provisions for a safety document. Subsection 1 explains when a safety document is required. Subsection 14 states that service providers shall draw up a safety document for events involving a significant risk that could, should it materialize, endanger someone's safety due to the large number of persons participating in the service, or for some other specific reason. According to subsection 2, where provided for elsewhere under law that a rescue, preparedness or other such plan shall be drawn up for the same same service, it shall not be necessary to draw up a safety document required under subsection 1. Instead, information corresponding to the information that would otherwise be included in the safety document may be compiled and included in a plan required under another act.

[20] Government proposal 145/1998 request for a reply, p. 20.

3 ANALYSIS

A SIAF-developed format of the AcciMap approach[21] was used to support the analysis of the occurrence. The following text is arranged in accordance with an AcciMap diagram created during the investigation and shown below. The occurrence is depicted as a chain of events along the bottom of the diagram. Contributing factors at various levels can be examined by moving up and down the diagram.

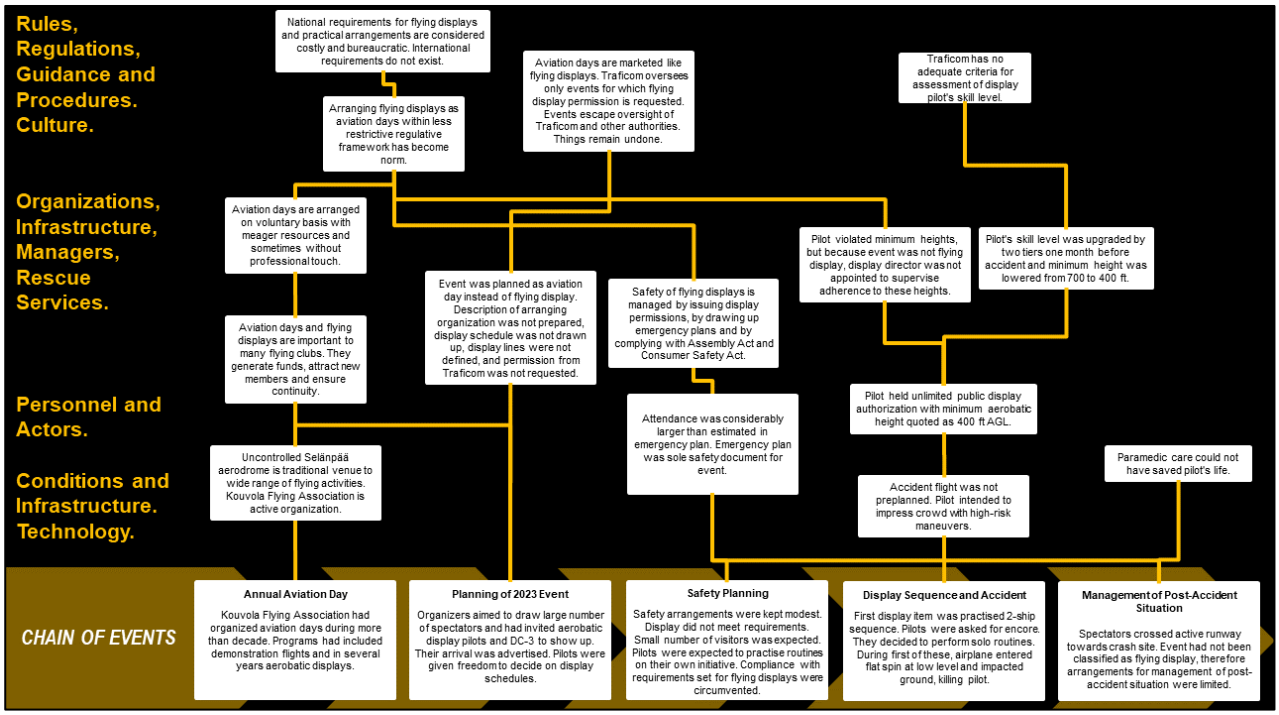

Figure 3. AcciMap diagram, investigation L2023-02. (Figure: SIAF)

3.1 Analysis of Occurrence

3.1.1 Annual Aviation Day

Kouvola Flying Association has organized annual aviation days during more than a decade. Aviation day programs have included demonstration flights and, in several years, aerobatic displays. The uncontrolled aerodrome at Selänpää has traditionally been the venue to a wide range of flying activities and it has been in active use by the association.

Aviation days and flying displays are an important part in the activities of many flying clubs. They help to generate funds, attract new people to the aviation community, thereby ensuring continuity. Aviation days are arranged on a voluntary basis with meager resources and sometimes without a professional touch.

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21 Rasmussen, J. & Svedung, I. (2000) *Proactive Risk Management in a Dynamic Society*. Karlstad, Sweden. Swedish Rescue Services Agency.

It appears that inclusion of a flying display in an aviation day program had become a norm. This means that flying displays are arranged within a less restrictive regulative framework on the one hand, but on the other hand arrangements do not meet safety requirements. It can be assumed that aviation day organizers adhere to an established routine and do not pause to re-evaluate the nature of the event or consider undertaking a new safety assessment.

3.1.2 Planning of 2023 Event

Because the organizers' aim was to draw a large number of spectators to the aerodrome, they had invited aerobatic display pilots and a DC-3 to show up, among other attractions. The display pilots were given the freedom to decide on display schedules. A flying display is defined as any flying activity deliberately performed for the purpose of providing an exhibition or entertainment at an advertised event open to the public. The event had been advertised in the local newspaper and therefore it fell within the definition of a flying display.

However, a flying display permission that would have been required under the Aviation Act had not been requested from the Finnish Transport and Communications Agency Traficom, and the event was marketed as an aviation day. Among other regulatory issues, a description of the arranging organization had not been prepared, and no display schedule had been drawn up as required by Aviation Regulation OPS M1-2.

Attendance in any free flying display depends very much on weather. On a rainy day, many display items will be canceled, and potential spectators may prefer to stay home, whereas in clear, sunny weather the number of spectators may exceed the anticipated amount by a significant margin.

The organizer had estimated that the largest number of people simultaneously at the event would have been 150 persons, and this had been quoted in the emergency plan, but the actual attendance turned out to be much larger. The emergency plan was the sole safety document prepared for the event. In addition to requesting a flying display permission from Traficom, the organizer should have notified the police as required by the Assembly Act, under which a notification needs to made when the number of participants is not low, or when the nature or place of the event requires measures for the maintenance of order or security or for the prevention of inconvenience to the bystanders or damage to the environment, or special traffic arrangements. The number of vehicles at the aerodrome was between 400 and 600 according to various estimates. It is therefore obvious that special traffic arrangements would have been required, even though these were not described in the emergency plan. Neither did the plan include the provisions for a safety document required in the Consumer Safety Act.

3.1.3 Safety Planning

The extent of the safety arrangements did not meet the applicable requirements, and the event organizer had indicated that only a small number of visitors was expected. Traficom oversees only events for which a flying display permission is requested. The agency is not necessarily aware of other public events and will therefore be unable to give the organizer guidance in the regulatory aspects of the activity and other such matters.

The safety of flying displays is managed by issuing flying display permissions, by drawing up emergency plans and by complying with requirements set forth in the Assembly Act and Consumer Safety Act. In addition, the Administrative Procedure Act requires that an authority shall provide advice and respond to questions and enquiries concerning the use of its services. An authority shall also seek to refer the customer to the competent authority.

The event organizer had complied with some of the applicable requirements by drawing up an emergency plan and submitting it to the rescue authority. However, a rescue authority will not necessarily recognize the need to refer an event organizer to request a flying display permission from Traficom. Therefore, the agency did not receive a notification of the aviation day and was not able to advise the customer in a matter that fell under its jurisdiction.

The bottom line of the authorities' obligation to provide advice is that customers would be able to manage their matters by establishing contacts with appropriate competent authorities.

3.1.4 Display Sequence and Accident

The first display item was a two-ship sequence that the pilots had practised beforehand. After completion of the sequence, the pilots were asked for an encore, and they decided to perform solo routines. The first of these was the accident flight, during which the airplane entered a flat spin at a low height and impacted the ground, killing the pilot.

The routine was not fully preplanned. The pilot intended to impress the crowd by performing high-risk maneuvers. It has been suggested that the increased importance of social media creates additional pressures on display pilots and introduces psychological factors during the conduct of display routines. Social media has affected interactions between display pilots and spectators and given rise to a need for social recognition. This need may incent pilots to show their skills by performing risky maneuvers. This psychological factor may instil competitive attitudes, which in turn may lead to exhaustion and risk-taking in an attempt to distinguish from other performers.[22]

The pilot held an unlimited PDA on which the minimum aerobatic height was quoted as 400 ft. Despite this restriction, the pilot violated the minimum height during the routine. Because the event was not organized as a flying display, no flying display director, who could have intervened with these violations, had been appointed.

Traficom had upgraded the pilot's skill level by two tiers one month previously and had simultaneously lowered the minimum aerobatic height from 700 to 400 ft after the pilot had wished to include flat spins in his display routine.

The maneuver that preceded the entry into the flat spin was commenced at an excessively low and therefore unsafe height. Recovery was initiated too low, which resulted in the ground

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[22] Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). *Motivational, emotional, and behavioral correlates of fear of missing out. Computers in Human Behavior,* 29, p. 1841–1848.

impact. Although the pilot held a PDA, it is obvious that he did not demonstrate the skills and ability to handle the aircraft during his routine without violating the minimum aerobatic height quoted on his PDA.

Traficom has not established adequate acceptance criteria for the assessment of the skill level of a display pilot. Targets in this area would include height at the entry into a flat spin and timely initiation of recovery in such a manner that the minimum aerobatic height quoted in the PDA would be honored.

3.1.5 Management of Post-Accident Situation

Spectators crossed the active runway towards the crash site to help to the accident pilot. A helicopter that was used to give pleasure flights took off to locate the wreckage and crossed the active runway. Another airplane was on the runway preparing for takeoff. Fuel that had leaked out from the accident airplane caused a fire hazard.

The accident elevated the risk level from the spectators' standpoint. Display site safety should have been ensured in the first place by providing a properly equipped and trained emergency response service at the aerodrome. This service would have prevented the access of unauthorized persons to the accident site. However, the attempt of spectators to help the pilot is understandable due to the deficiencies in rescue arrangements. Regulations set forth requirements for the preparation of the safety arrangements and actions in cooperation with the local police department, medical and first aid service, and emergency response service in the event of an aviation accident. These arrangements had not been implemented for the accident event.

Due to the fact that paramedic care could not have saved the pilot's life, deficiencies in first aid and rescue services played no role in the outcome.

4 CONCLUSIONS

Conclusions encompass the causes of an accident or a serious incident. Cause means the different factors leading to an occurrence as well as relevant direct and indirect circumstances.

1. The event was by definition a flying display, but it was organized without the required permission.

   Conclusion: *More stringent safety requirements are needed for a flying display, which may lead to cost increases.*

2. Kouvola Flying Association had submitted an emergency plan to an authority. The authority did not recognize the need to refer the association to the Finnish Transport and Communication Agency Traficom, police or possibly to Finnish Safety and Chemical Agency Tukes.

   Conclusion: *An authority is not always aware of licensing requirements for an air display or other such event or of safety requirements issued by another authority.*

3. The pilot violated the minimum aerobatic height quoted in his public display authorization and he also entered a flat spin that led to the accident at insufficient height.

   Conclusion: *The pilot did not have the skills and ability to handle the aircraft safely during the intended routine, and therefore he did not meet the requirements set forth in his public display authorization.*

4. The pilot's skill level was upgraded by two tiers one month prior to the accident, and at the same time the minimum aerobatic height was lowered from 700 to 400 ft.

   Conclusion: *The Finnish Transport and Communication Agency Traficom had upgraded the pilot's skill level direct from intermediate to unlimited without verifying that the pilot demonstrated the required skills and ability. The pilot lacked sufficient skills and knowledge, and this went unnoticed during the public display authorization procedure.*

5 SAFETY RECOMMENDATIONS

5.1 Licensing and Supervision Service

The licensing and supervision service of the Ministry of Employment and Economy is not well known to event organizers and authorities that issue permissions and other such documents.

The Safety Investigation Authority of Finland recommends that

the Ministry of Employment and Economy ensures that event organizers and authorities become aware of the licencing and supervision service. [2024-S31]

5.2 Issuance of Public Display Authorization

The Finnish Transport and Communication Agency Traficom had upgraded the pilot's skill level direct from intermediate to unlimited. The pilot lacked sufficient skills and knowledge, and this went unnoticed during the public display authorization procedure.

The Safety Investigation Authority of Finland recommends that

the Finnish Transport and Communication Agency Traficom reassesses the procedures for the issuance of a public display authorization to ensure that display pilots possess adequate theoretical knowledge, skills and safety awareness. [2024-S32]

5.3 Safety Actions Taken

5.3.1 Finnish Transport and Communications Agency

The Finnish Transport and Communication Agency Traficom issued on April 25, 2024, an updated version of Aviation Regulation OPS M1-2. The focus areas of the revisions included risk assessment requirements, the duties and responsibilities of the event organizer and flying display director, procedures related to the issuance of public display authorizations and the need to differentiate requirements for small and large flying displays.

REFERENCES

Written Material

De Lapparent, Xavier (1996) The Aerobatic Four Minute Freestyle. Magic Voltige Publication. Varennes-Jarcy, France.

The Finnish Transport Safety Agency, Recreational Aviation Survey. Trafi publication series 15/2014.

Safety Investigation Authority of Finland (2016) The wheel of a monster truck ended up in the crowd at Alahärmä on 8 August 2015. Investigation report Y2015-03.

Safety Investigation Authority of Finland (2018) Accidents during motorsport events in Seinäjoki on 15 January 2018 and in Pori on 22 June 2018. Investigation report Y2018-03.

Safety Investigation Authority of Finland (2021) Boating accident at a public event in the Hanko harbour on 8 August 2020. Investigation report Y2020-02.

Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. Computers in Human Behavior, 29.

Rasmussen, J. & Svedung, I. (2000) Proactive Risk Management in a Dynamic Society. Karlstad, Sweden. Swedish Rescue Services Agency.

Official Sources

Government proposal 145/1998 request for a reply, Government proposal to Parliament for Assembly Act and associated Acts.

Government proposal 72/2002 request for a reply, Government proposal to Parliament for Administrative Procedure Act and revision of Administrative Judicial Procedure Act.

TEM026:00/2017, Ministry of Employment and Economy, licensing and supervision project.

TRAFICOM/325680/03.04.00.00/2022, project launch decision for updating Aviation Regulation OPS M1-2.

Investigation Material

1) Photographs, measurements and other material produced during on-site investigation
2) Police reports, photographs and investigation reports
3) Meteorological information
4) Interviews
5) Eyewitnesses' video footage and photographs
6) Newspaper clippings of the event
7) Extra 300S Pilot's Operating Handbook
8) Pilot's licence and aeromedical certificate
9) Pilot's logbook
10) OH-ESS journey log
11) OH-ESS airworthiness documents
12) Emergency response center authority alert log and incident report

SUMMARY OF COMMENTS TO DRAFT FINAL REPORT

The draft final report was submitted for comments to the Finnish Transport and Communications Agency Traficom, the European Union Aviation Safety Agency, the Ministry of Employment and Economy, the German Federal Bureau of Aircraft Accident Investigation, the National Transportation Safety Board of the United States, Kymenlaakso Rescue Department, and the interested parties. Pursuant to the Safety Investigation Act, no comments given by private individuals are published.

The Finnish Transport and Communications Agency Traficom states that the pilot had the skills and ability to handle the aircraft. The upgrade of the pilot's skill level was based on the assessment of his level of theoretical knowledge and attitudes in an interview and on an evaluation flight. The pilot's recency was also verified, and his competency was established. As a result, he was issued an unlimited skill level public display authorization with the prescribed minima. Traficom also explains that absolute minimum heights cannot be established due to the fact that the entry height and the height at which recovery is initiated vary depending on situation and are affected by the performance and other characteristics of an individual airplane, preceding maneuvers, and resulting residual energy state.

Traficom endorses the safety recommendation of paragraph 5.2.

The Ministry of Employment and Economy states that the Consumer Safety Act (920/2011) is of secondary nature and supplements other legislation, as explained in Section 4 of the act. The act takes into consideration factors affecting the safety of the consumer goods and services insofar as other legislation does not ensure at least the same level of safety.

The ministry has launched the preparation of a project (TEM115:00/2023) to revise and update general product safety of consumer services and to implement the General Product Safety Regulation (2023/988) of the European Commission.

The ministry considers the safety recommendation of paragraph 5.1 for increased awareness of the licencing and supervision service important. In the future, the ministry will strive to increase the awareness of the service among event organizers and authorities by increasing communications on the service framework in those areas that are related to event organizing. Particular attention will be given to supporting municipal authorities during the fielding of the service. The Ministry of Employment and Economy and the Ministry of the Interior have entered a mutual agreement for the nationwide implementation of the licensing and supervision service over the coming years. To this end, they have established a planning group around the core of specialist from the authorities that are responsible for event security and the licensing and supervision service. Personnel of the police, rescue service and the Finnish Safety and Chemicals Agency Tukes are also represented.

Kouvola Flying Association states that vehicles and persons that crossed the runway did not cause a safety hazard because the runway was not occupied by any departing airplane.

Neither did the actions of persons at the accident site constitute a safety hazard to the persons involved or to outsiders.