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REPORT
ACCIDENT

Collision between a tug and a glider, on an aerodrome circuit, during an air display

Aircraft	PA25 tug registered F-GHSH Slingsby T31b glider identified BGA 4926
Date and time	5 May 2012 at about 16 h 50[(1)]
Operator	Aeroplane: club Glider: private
Place	Buno-Bonnevaux aerodrome (Essonne, France)
Type of flight	General Aviation
Persons on board	Aeroplane: 1 pilot Glider: 1 pilot and 1 passenger
Consequences and damage	Pilots and passenger killed, aeroplane and glider destroyed

[(1)]Unless otherwise specified, the times in this report are local

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.

1 - HISTORY OF FLIGHT

At about 16 h 45, the pilot of the PA25 took off from runway 28 at Buno Bonnevaux aerodrome while towing a glider. Following the release, he began a continuous descent towards the aerodrome in order to land back there. At about 16 h 50, flying over the southern threshold of runway 10, at a height of about 100 metres above some woods, the aeroplane collided with another glider. The latter had taken off from runway 28, with the assistance of a winch, a few minutes earlier.

2 - ADDITIONAL INFORMATION

2.1 Context of the Event

Since 28 April 2012, the French Glider Championships had been organised at the aerodrome. On 4 and 5 May, an air display had also been organised. Owners of vintage gliders had flown their aircraft to present them to the widest possible public.

On May 5, at the beginning of the afternoon, noting that the weather was not favourable, the director of the competition had cancelled the events under way and ended the competition.

At the time of the event, some gliders were flying over the area where the collision occurred. Pilots familiar with the aerodrome explained that this was an area known to generate updrafts.

2.2 Aircraft Information

2.2.1 The PA 25 Pawnee tug registered F-GHSH

The PA 25 was produced between 1959 and 1982 by the Piper Aircraft Company.

It is a single-seat, single-engine piston airplane with a steel tube and canvas fuselage, unpressurized, with a low wing and conventional landing gear. It was developed to meet the specific requirements of agricultural spraying.

It is also used to perform flights towing banners or gliders.

The PA 25 WAS equipped with onboard radio and a FLARM®[(2)] type onboard traffic detection system.

[(2)]FLARM® is an international trademark registered with the National Institute for Standardization and Industrial Property. This system is intended to alert the pilot on the proximity of other aircraft. It is said to be "*cooperative*" since its operations depend on information developed and transmitted by another system of the same type.

2.2.2 The Slingsby glider T31b identified as BGA 4926

The Slingsby T31 is a collector's glider. It's a two-seater without a canopy and has a wingspan of about 13 meters. The first prototype flew in 1949. It was designed for training Royal Air Force cadets.

Its theoretical glide ratio is about 17. By comparison, current gliders have a glide ratio of between 30 and 70.

The glider was not equipped with onboard radio. The pilot, however, had a portable radio, indispensable for the launch procedure with the winch.

The glider was not equipped with an onboard traffic detection system, this not being required by the regulations.

2.3 Buno Bonnevaux Aerodrome

Buno Bonnevaux is an uncontrolled aerodrome, with restricted use reserved to gliders and service aircraft. It has two perpendicular runways oriented 10-28 and 01-19. None of these QFU's is preferential. A specialised aeroplane and glider circuit is defined for each QFU. The Association Aéronautique du Val d'Essonne (AAVE) is the only club using this aerodrome. To make the best use of the crossing runways, a local agreement allows for simultaneous use of both QFU's:

when runway 10-28 is in use for the takeoff of tug aircraft as well as for the takeoff and landing of gliders, runway 01 is used mainly for landing tug aircraft, the length of this runway is sufficient for aeroplanes to land and stop without interfering with the runway 10-28 centreline.

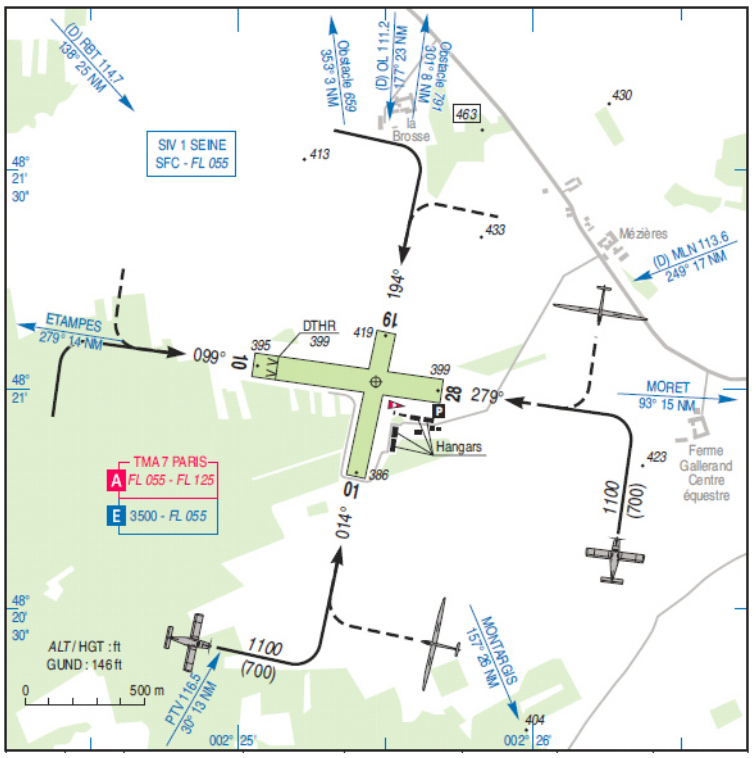


Figure 1: extract from the VAC chart

In this configuration, few gliders land on runway 01. Aerodrome circuit 10-28 reserved for gliders is mainly located to the north of the aerodrome. Some witnesses described this use with the expression as: ''*Gliders to the north and tugs to the south*''. This practice makes it possible to limit the risks of collision between gliders and tugs while optimising the frequency of rotation of the tugs.

From 2 to 5 May, a winch to launch gliders had been installed at the aerodrome. A specialised team was operating it. It had been installed in the extension of runway 28, at a distance of about 200 metres beyond the opposing threshold in order to increase the length of the running cable[3]. It was equipped with two launch cables used alternately. The average theoretical release height was between 400 and 500 metres.

Note: the temporary setting up of winching activity had resulted in the publication of a NOTAM, without any additional specific instructions being issued on the use of the aerodrome.

[3]The length of the running cable is one of the parameters that determine the release height of a glider launched with winch assistance. The longer the cable length, the higher the release height.

2.4 Regulatory aspects relating to winching

In 1987 the French glider federation (Fédération Française de Vol à Voile - FFVV) and the French civil aviation authority (Direction Générale de l'Aviation Civile - DGAC) developed and published a practical guide for launching gliders by winch (Livret du lancement des planeurs au treuil), which is the reference. This document covers the activity and the associated training, but does not cover coexistence between winches and tugs

In 2009, the DGAC asked a working group on gliders to analyse various regulatory aspects and techniques relating to the installation and use of winches used for launching gliders. The working group's report, which appeared in February 2010, proposed changes in the regulations regarding infrastructure.

2.5 Flight Preparation

The aeroclub did not have an Operations Manual, this not being required by the regulations. Its internal rules did not deal with flights. The procedures in force at the aerodrome are usually re-stated during the daily briefing.

As a result of the competition, two separate briefings were held on the morning of the event. The first, made by the director of the competition, was aimed at the competitors. The second, made by the aeroclub's head pilot, related to flights of tug aircraft used both for the competition and club activity. The chef pilot specifically informed the pilots of tugs that overflying the aerodrome was banned due to the presence of the winch, and that takeoffs would be undertaken from runway 28 and landings on runway 01.

According to witnesses, the pilot of F-GHSH was not participating in championship activities and did not attend the morning briefing. The accident flight was his first flight of the day.

2.6 Meteorological Conditions

At the time of the accident the meteorological conditions were compatible with visual flight rules, witnesses mentioning a grey sky, good visibility and a light wind. The conditions were, however, not very favourable to gliding due to the weak aerological updrafts.

2.7 Description of Three Flights by the Slingsby T31b Glider

According to the winch data log, the pilot made three flights during the afternoon with this glider. The pilot had over 3,000 flying hours experience. He knew the aerodrome. He was accompanied by a different passenger each time.

2.7.1 Flight n°1 between 15H10 and 15H20

The pilot was accompanied by a pilot instructor. This flight was intended as a re-check of winch-assisted glider launch. According to the instructor's testimony, the pilot released the winch cable at a height of between 300 and 350 metres from the ground. He then turned north to perform a ''*tail wind right hand*'' manoeuvre followed by standard terrain following and a landing on runway 28. The flight was shortened to allow time for enthusiasts to discover this aircraft during the afternoon.

2.7.2 Flight n°2 between 15H55 and 16H15

The passenger, an experienced pilot, was not from the club and was flying for the first time on this aircraft. He explained that after the release of the cable they steered towards the runway extended centreline, in order to try to ''*catch updrafts*'' over the clearing in a woods. Not having succeeded in gaining height, they decided to turn back towards the aerodrome via the south in order to land there. The passenger stated that he thought that when they were crossing the threshold of runway 10, they were low in relation to the aerodrome circuit. He realised that the glider had a high ''clean descent rate''[(4)]. Their initial objective was to land on the opposite QFU (on 10) but the runway was busy as a second winch was being prepared. However, due to their low height, they could no longer reach the 28 final. They decided to land on 01 by flying an L manoeuvre.

[(4)] Clean descent rate: Descent rate in calm air.

2.7.3 Accident flight

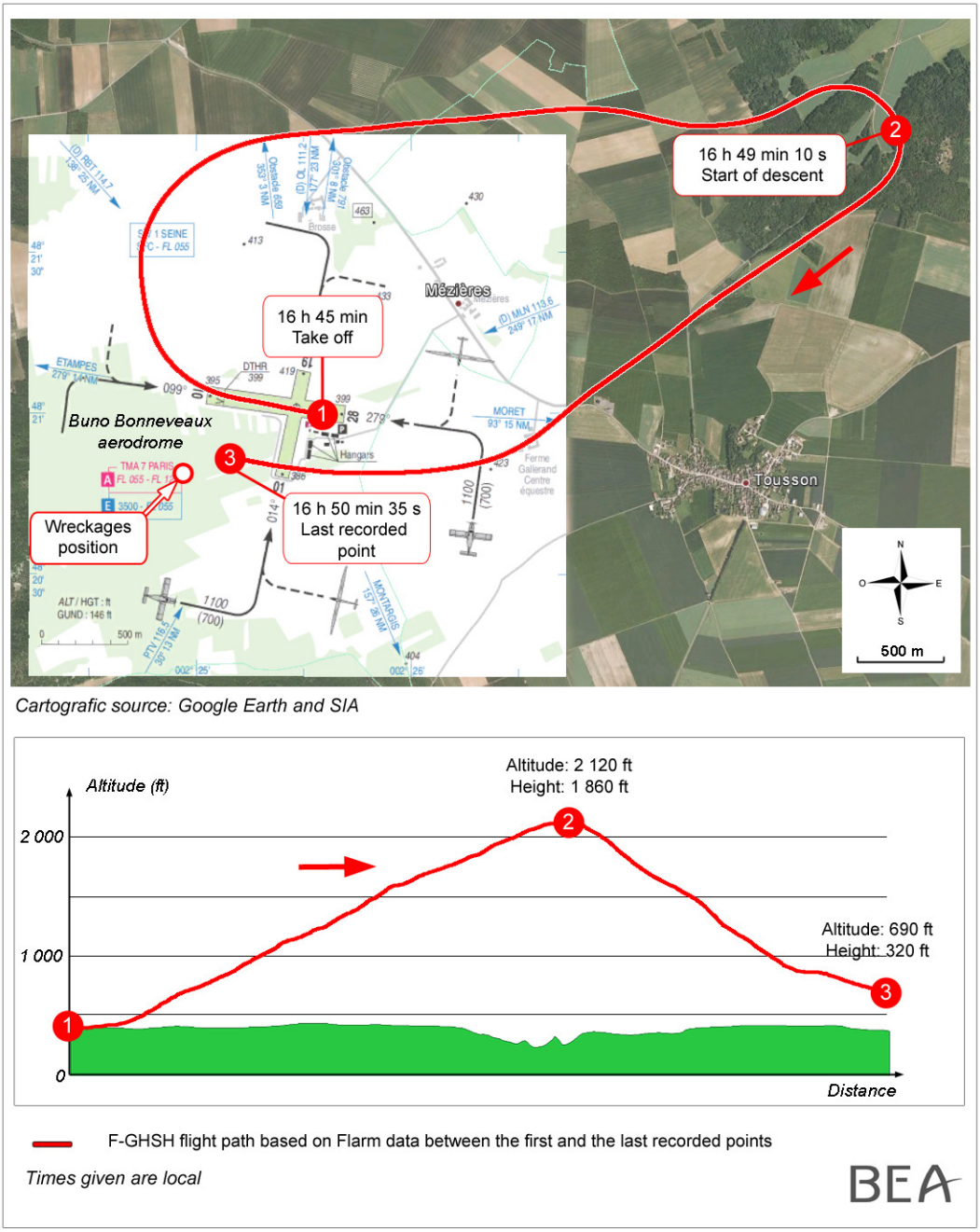
The investigation was not able to determine the exact flight path of the accident flight or the intentions of the glider occupants. Testimony indicated, however, that this flight took place under conditions similar to those of flight n° 2. The pilot and the passenger knew the aerodrome. It is likely that at the time of the collision, they were trying to reach runway 01 to land. They apparently tried an avoidance manœuvre during the last few seconds before the collision.

The previous two flights were aimed at discovering the specific characteristics of this vintage glider. In both cases, the pilot did not turn towards the north immediately on cable release. He continued along the runway extended centreline in order to try to ''*catch some updrafts*''. Other gliders were flying at a higher altitude in this same area, perhaps encouraging him to steer in their direction in order to take advantage of the same updrafts.

The pilot, co-owner of the glider, knew its exact aerodynamic performance, and this was not his first flight on this aircraft. At the time of the collision the glider was about 100 metres above a wooded area. This low height in relation to the ground left him with little room for manœuvre and did not allow him, as for the previous flight, to reach the starting point of the downwind leg for runway 28. At that point a height of about 250 metres was required to conform to the standard circuit and reach the threshold of runway 28 safely.

At the time of the collision, the glider's flight path interfered with the aerodrome circuit reserved for aeroplanes such as those defined on the VAC chart.

2.8 Flight Path of the PA 25 Tug



Cartografic source: Google Earth and SIA

Figure 2: reconstitution of the flight path of the PA 25 based on data from the FLARM

The pilot of this aircraft had more than 2,500 flying hours experience. He was familiar with the aerodrome. He took off from runway 28 then reached a release area located to the east of the installations.

A few minutes later, at the top of his flight path, at a height of about 1 900 ft., he started a continuous descent at an average rate of 1,200 ft/mn.

Arriving at a height of about 700 ft. he stabilized in level flight for about four seconds then started to descend again with a rate of descent of around 500 ft/min, lining up the flight path of the aeroplane to the west to overfly the threshold of runway 01 at a height of about 300 ft.

From this point, the flight path of the aeroplane remained parallel to the centreline of runway 10/28, descending until the moment of the collision.

According to the testimony of pilots of tug aircraft based at this aerodrome, this circuit integration was accomplished with a flight path and an axis described as ''*unusual*''. Further, the height passing over the threshold of runway 01 was lower than the height of the aerodrome circuit. It is possible that the pilot wanted to adopt an integrating flight path clearly separate from that of the glider flight paths by adopting a circuit to the south of the glider circuit, at a height that was lower than the latter.

The tug's flight path could be explained by the occasional presence of the winch and the ban on directly overflying the installations. The pilot would then have wished to be in the best position to observe current activity on runway 10/28 and/or to search visually for the glider whose takeoff he would have been aware of following the winching radio message transmitted a short time before.

The pilot had a lot of experience of towing at this aerodrome, and perhaps went into his usual routine. Used to towing the gliders to the north after takeoff from runway 28, he perhaps did not realize that the recent installation of a winch on the same axis might lead pilots to turn towards the south after being winched. Wishing to optimize his flight and reduce its duration as much as possible, while taking into account the specific activity under way at that time at the aerodrome, he may have decided to ignore the aerodrome circuits on the VAC chart.

Pilots of tug aeroplanes are subjected to contradictory pressures. On the one hand, they are asked by clubs to minimize flight time and limit the length of flights. On the other hand they are required to respect the basic rules of general aviation. The information gathered in the course of the investigation showed that, in general, many of these pilots ignore the rules for integrating traffic.

Tug activity, in the context of an aeroclub, is not considered as a specific activity (commonly called aerial work). The French regulation does not take into account the specificities of this activity and does not define appropriate rules for use. Such rules could be described in the operations manual and shared by all of the members of the club.

2.9 Use of the radio

The captain onboard an aircraft with radio-communication equipment must transmit position reports, state his intentions and transmit any subsequent modifications to the AFIS organization or, if not possible, via air-to-air communication.

The 123.150 MHz frequency is attributed to Buno-Bonnevaux aerodrome, though the use of radio is not mandatory.

The last radio messages heard on the frequency by the flight director concerned the winch launches of the accident glider.

The glider not having a canopy, it is possible that the noise generated by the airflow made the use of the radio more difficult.

2.10 General Preventive Actions

2.10.1 BEA action

At the time of the investigation into the mid-air collision on 4 February 2010[5], between a Piper PA28 aeroplane and a ULM, the limits of the ''*see and avoid*'' concept had already been brought to light. The BEA issued a recommendation [FRAN 2010-036] to EASA in order to accelerate the evaluation of various existing traffic detection systems and to ensure the promotion of their implementation in the field of general aviation.

[5] http://www.bea.aero/docspa/2010/f-pq100204/pdf/f-pq100204.pdf

2.10.2 EASA actions

In January 2010, in the context of its approach to promote safety, the European General Aviation Safety Team (EGAST), in collaboration with the European Aviation Safety Agency (EASA), published a brochure entitled ''Collision Avoidance''[6] aimed at pilots in general aviation.

In 2011, EASA ordered a study: ''*Research Project EASA.2011/07 Scoping Improvements to 'See and Avoid' for General Aviation*[7] *(SISA)*''. This research project was undertaken in the context of the European Strategic Safety Initiative (ESSI). Its aim is to analyse possible improvements in the "*see and avoid*" concept.

[6] http://www.skybrary.aero/bookshelf/books/991.pdf

[7] http://easa.europa.eu/system/files/dfu/safety-and-research-research-projects-docs-general-aviation-Final-Report-EASA.2011.07.pdf

This study identified that:

- The key element in "*see and avoid*" is to look outside to detect the presence of another aircraft. The best tools to improve this practice are training and instruction.
- However, training in the "*see and avoid*" principle can be completed by onboard equipment that makes it possible to detect nearby aircraft. Several types of systems are already widely used by pilots.
- This equipment to assist in the detection of aircraft must be light, inexpensive and cooperative. A non-cooperative system would probably be too expensive.
- Implementation of a standard for this equipment by the aeronautical industry, such as by EUROCAE, should be encouraged. This standardisation would ensure interoperability between systems.

This study proposed four additional recommendations:

- To develop a technical standard for a collision warning system for general aviation. Identified standardization body here is EUROCAE.
- To develop common more procedures and requirements for operation of one or more system solutions in uncontrolled airspace. A safety leaflet could support the harmonization of system solutions and procedures. Identified organization here is EGAST.

Safety monitoring remains a difficult task, but widespread use[8] of avoidance systems could contribute to studying near misses between aircraft. EASA and national aviation authorities could thus:

[8] By collecting the numbers of warnings generated and by analysing common points, for example.

- more easily analyse in more detail commonalities of hazards and causal factors related to "*see and avoid*";
- develop specific Safety Performance Indicators (SPIs), and then also monitor how these SPIs evolve in Europe.

Training material shall be developed to cover not only the safety benefits for the users but also the limitations and human factor issues such as potential over-reliance on the equipment.

The recommendations issued with this study have not been adopted or approved by EASA.

2.10.3 AAVE actions undertaken before the accident

In 2003, following a fatal collision between two gliders from the aeroclub, the AAVE had put in place internal measures making it mandatory to install an onboard traffic detection system. This system, of the FLARM type, equipped the aeroclub's gliders and tug aircraft. Gliders belonging to private owners were not subject to this obligation.

The PA 25 tug belonged to the club and was thus equipped with FLARM. However, even though based at the aerodrome, the glider was not similarly equipped. It belonged to private owners, who did not consider it useful to install such a system. One of the co-owners stated that the red and white colours of the fuselage seemed to them to be adequate for detection. An exchange of position information was thus not possible between the two aircraft.

It should be noted that the accident glider was not the only one in this situation. In fact, at the time of the collision an Emouchet, an old single-seat glider belonging to a private owner was flying in the same sector with neither a radio nor FLARM.

2.10.4 FFVV action after the accident

On 12 May 2012, the FFVV management committee decided to make mandatory the installation of FLARM brand equipment in all aircraft declared by the affiliated associations, or recognized by the federation and those of their private owners licensed by the FFVV.

2.10.5 DGAC and AAVE actions following accident

A modification of the VAC chart has been in effect since the start of 2014:

Modification of procedures for tug aircraft:

- ❒ respect of circuits;
- ❒ radio announcement after release;
- ❒ no overflying of runways crossing when intergrating the aerodrome circuit;
- ❒ single QFU.

Modification of glider procedures:

- ❒ systematic callout in a « l*ow uptake* »[9] situation around the aerodrome circuit;
- ❒ mandatory callout on base and final legs.

[9] Manœuvre to take advantage of an updraft while at a relatively low height from the ground (about 200 metres above ground level).

3 - LESSONS LEARNED AND CONCLUSION

3.1 Influence of the use of a winch in aerodrome traffic

Installation of the winch at the end of the threshold of runway 10 modified the balance that had been established during habitual use of the runways as well as that of aerodrome circuits.

Towing with the assistance of an aeroplane makes it possible for the glider pilot to be released in a given sector, at a release height for free flight and allowing for a return to the runway with an adequate safety margin. On the other hand, the winch release point is systematically located overhead the runway.

The height then reached by the glider depends on the running length of the launch cable, on the wind and on the glider's characteristics.

The use of a winch leads to a relatively low release height and, combined with unfavourable aerological conditions, can lead the pilot to try for a ''*low updraft*'', close to the aerodrome circuit and thus to the local flight cone.

In the absence of any specific modification in the aerodrome traffic defined by the VAC chart, exiting the local flight cone makes it impossible to reach the threshold of runway 28, leading to the following alternative for the glider pilot:

- land on the opposite QFU on runway 10, which requires coordination with the winch launch sequence, which would be to the detriment of the latter's capabilities;
- land on runway 01, interfering with the aerodrome circuit reserved for aeroplanes;
- make an emergency landing in a field, common for a glider, but which makes it impossible to make another flight immediately and is thus insurmountable in the context of an air show.

In this context, the glider seeking an updraft located on the extended winch axis to the west (above the forest) is faced with a complex alternative if it is not defined in the predefined operational rules linked to the installation of a winch.

In addition, such rules could aim to provide a framework for the simultaneous use of a winch and tug aircraft, on a case by case basis, whether the use of the winch is permanent or temporary. They would be particularly relevant at aerodromes like Buno Bonnevaux with crossing runways and on which the aerodrome traffic is not controlled and radio is not mandatory.

The modifications made to the aerodrome's VAC chart, as well as the evolving booklet on glider launches by winch, mentioned above, seem to provide some answers to the questions raised by this event.

3.2 Failure of Visual Detection of the Conflict

The ''*see and avoid*'' principle must make it possible to detect and avoid other nearby aircraft. It seems particularly relevant to aerodromes where the traffic is not controlled and which have several circuits.

Visual detection of other aircraft is not, however, only dependent on the quality of pilots' external vigilance. This can be disturbed by factors such as:

- approaches at constant heading, characteristic of conflicting flight paths, and low contrast between an aircraft and its environment, can deceive the peripheral vision, which remains mainly sensitive to highly visible objects;
- the ergonomics of the cockpit and the specific attributes of the human eye can mask some parts of the space;
- the size of the other aircraft can appear to be small just before the collision and make detection difficult. Its sudden increase in size, however, creates a significant surprise effect;
- the avoidance manœuvre is never instantaneous.

Various studies[10] have shown the limits of the ''*see and avoid*'' rule. Uncertified onboard traffic detection systems like the FLARM have been developed and have been adopted by a number of aircraft in Europe. In parallel the SISA study conducted by EASA showed that the risk of collision did not only involve gliders. For the period from 2006 to 2011, 82 mid-air collisions occurred in Europe. They caused 82 fatalities and 16 serious injuries. The majority involved aircraft with a maximum takeoff weight below 2,250 kg. The accident at Buno Bonnevaux demonstrates the potential interest in extending this type of system to all aircraft in general aviation.

[10] http://www.bea.aero/etudes/abordages/abordages.pdf

3.3 Context of the end of the competition

The accident occurred on the last day of a competition that lasted more than a week. Activity during this time was intense, without any notable incidents. It is thus possible that all of the participants may have suffered lowered attention, associated with probable fatigue.

This competition finished with an air display, which involved demonstrating glider activities, with the presentation of a launch with a winch and of vintage gliders. The various persons involved were thus led to undertake first flights in a convivial context that tended to lead to a relaxation of attention. This might well have diminished risk awareness and safety margins.

3.4 Causes

The collision was due to the failure of both pilots to detect the other aircraft visually, in uncontrolled airspace where collision-avoidance depends entirely on external vigilance. It appears that neither of the two was aware of the possible presence of another aircraft nearby.

The following contributing factors were identified:

- the absence of air-to-air communication by the pilots of both aircraft, although the two aircraft were flying on unpublished flight paths at a low height;
- the glider's manoeuvres near the aerodrome, at a height lower than the height to integrate the circuit;
- the specific configuration of this aerodrome with crossing runways used simultaneously;

- ❒ the unusual operations at this aerodrome due to the temporary installation of the winch, its influence on the aerodrome traffic and on the activity of tug aircraft;
- ❒ the absence of any rules relating to the simultaneous use of the winch and of tug aircraft;
- ❒ a possible decrease in attention of all of the participants at the end of the afternoon after a week of intense activity linked to the championship.

4 - SAFETY RECOMMENDATION

Note: In accordance with Article 17.3 of European Regulation (EU) 996/2010 of the European Parliament and Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation shall in no case create a presumption of blame or liability for an accident, a serious incident or an incident. The addressee of a safety recommendation shall inform the safety investigation authority which issued the recommendation of the actions taken or under consideration, under the conditions described in Article 18 of the aforementioned Regulation.

Onboard traffic detection system

The SISA study ordered by EASA showed that 82 midair collisions occurred in Europe between 2006 and 2011. These accidents caused 82 deaths and 16 serious injuries. The majority of accidents involved aircraft with a maximum takeoff weight below 2,250 kg.

The investigation showed once more the operational limits of the ''*see and avoid*'' concept as well as the requirement to develop an onboard traffic detection system for all aircraft in general aviation. EASA encourages their installation, without however making certification mandatory. Systems, such as FLARM, have been developed and subsequently adopted by a large number of European pilots.

Nevertheless, operational reliability of such equipment cannot be guaranteed for all flight conditions. Various technological solutions are identified in the SISA study. EASA encourages industrial manufacturers to carry out research and studies to develop alternative solutions.

However, to be effective, these systems must be interoperable. Interoperability of a system depends on the choice of a common exchange format (communication protocol). Consequently, the exchange formats for the various onboard traffic detection systems should be standardised.

Consequently the BEA recommends that:

- ❍ **EASA encourage the development, use and generalisation of interoperable onboard traffic detection systems. This can be achieved through standardisation of the broadcast and exchange formats between the various systems. [Recommendation 2015-057]**

Any mention of the study entitled: ''Research Project EASA.2011/07 Scoping Improvements to 'See And Avoid' for General Aviation (SISA)'' must be accompanied by the following note:

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