BEA

Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

ANNUAL REPORT

2019

RÉPUBLIQUE
FRANÇAISE

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Safety together

TABLE OF CONTENTS

A MESSAGE FROM THE DIRECTOR

The year 2019 will undoubtedly be remembered as a "paradoxical" year for civil aviation safety worldwide.

On the one hand, although it is not the best year in history in terms of the number of fatal accidents or victims, we will nevertheless look back on 2019 as being one of the best three years seen since the end of the second world war, with 20 fatal accidents in commercial air transport resulting in 283 victims.

On the other hand, we will remember it as the year in which the Ethiopian Airlines Boeing 737 MAX crashed leading to the loss of 157 lives, followed, a few months later, by another B737 MAX accident, resulting in 189 victims. These two accidents led to one of the longest suspension of flights of a transport aircraft - and arguably the most significant - that the international aviation community has ever known.

It should be noted that, although not having a "statutory" reason to participate in the safety investigation carried out by the Ethiopian authority (the aeroplane being of neither French design nor operated by a French operator), the BEA was quickly called upon to carry out the read-out and analysis of the recorders in its laboratory, and then to dispatch several investigator teams to support the work in Ethiopia. In the particular context of this investigation, the participation of a partner who could provide both neutrality and a high level of expertise was considered useful by the stakeholders.

For the BEA, 2019 was also marked by the success of the search operations in Greenland and the recovery of the engine parts of an Airbus A380 which suffered a serious failure in September 2017: these parts were buried under four meters of ice, in a particularly hostile environment, on the ice sheet. These operations required significant material resources, and above all the perseverance and tenacity of a number of teams from various organizations in different countries. The funding of these search operations was shared between the various stakeholders. The BEA's share represented an amount equal to approximately 10% of its annual operating budget, and sizeable savings had to be made on many budget items. Ultimately, the analysis of the recovered parts revealed unexpected failure mechanisms which fully justify in retrospect, all the efforts made. It should be possible to publish the final investigation report in the months to come.

As I have already mentioned in the previous publications of the annual report, I consider that significant efforts should be put into investigations in the field of general aviation, the main focus being fatal accidents, or those that could have been, regardless of the type of aircraft involved (whether certified or not): the BEA has applied this investigation policy for several years and will continue to apply it, encouraged by the general aviation accident statistics for 2019 which show that the year is the best of the decade 2010 –2019, taking all activities together (planes, helicopters, ultralights) both in terms of the number of fatal accidents and in terms of victims.

This policy has a twofold objective: to free up resources by reducing the investigative work into the least serious occurrences, in order to reallocate them to the most relevant occurrences in terms of safety. One of the consequences of this policy has had measurable effects: the number of reports published over the year has risen to a record level of 163. It is more than the number of investigations opened, and has allowed the BEA to reduce the number of ongoing investigations.

I wanted to highlight some key aspects of the life of the BEA and its staff this year, through a small supplement: the reader, who, beyond the BEA's annual results, would like to learn a little more about some of its concrete and operational activities, can refer to the end of this document to share in some, sometimes quite extraordinary experiences.

I will not end this message without pointing out that this annual report was produced under very specific conditions, due to the confinement measures implemented in March 2020 as part of the fight against the COVID-19 pandemic. From the beginning of these measures, the BEA has organized itself around generalized telework, relying on the setting up of teleconferences and on the long-standing organization of a computer system which allows staff to have remote access connections, in particular for the needs of conventional telework and those of on-site investigation acts. This organization makes it possible to maintain an activity which, admittedly in degraded mode, is still relatively effective: the publication of numerous investigation reports and this report during this confinement period being proof of this.

I would like to warmly thank all the BEA staff for their commitment and dedication, both in normal circumstances and in this crisis situation.

Rémi Jouty, BEA Director

1. OVERVIEW OF ACCIDENTS, INVESTIGATIONS INITIATED IN 2019 BY THE BEA

Accident to the Robin DR400 registered F-GBIA on 16 June 2019 at Saint-Cyr-l'Ecole (Yvelines)
Investigation in progress

1.1. GENERAL CONTEXT

The obligations of the Member States of the European Union in terms of Civil Aviation safety investigations are defined in European regulation No 996/2010.

The general principle according to which any serious civil aviation accident or incident will be subject to a safety investigation in the Member State of Occurrence is maintained, and this requirement now applies to all manned and unmanned aircraft (drones), except those listed in Annex I of regulation (EU) No. 2018/1139 (the aircraft listed in this Annex are mainly non-certificated aircraft: microlights, aeroplanes of historic interest, etc.). Exemptions are however provided for: "…the responsible safety investigation authority may decide, taking into account the expected lessons to be drawn for the improvement of aviation safety, not to initiate a safety investigation when an accident or serious incident concerns an unmanned aircraft for which a certificate or declaration is not required pursuant to Article 56(1) and (5) of Regulation (EU) 2018/1139, or concerns a manned aircraft with a maximum take-off mass less than or equal to 2 250 kg, and where no person has been fatally or seriously injured."

Furthermore, Annex 13 of the International Civil Aviation Organization (ICAO) specifies that, when a safety investigation is conducted by a State (usually the State of Occurrence), the State of the Operator, the State of Registry and the State of Manufacture of the aircraft involved participate in this investigation, by naming an accredited representative (ACCREP).

In France, the BEA is the authority responsible for safety investigations. Its procedures, in place since 1 January 2015, stipulate that, in addition to the investigations it has an obligation to conduct in accordance with European regulations, it also investigates the following events:

- ◊ reported incidents, which are of particular interest for safety;
- ◊ fatal accidents involving aircraft listed in Annex I of regulation (EU) No. 2018/1139.

In addition, the BEA continues to conduct investigations into accidents involving aircraft weighing less than 2,250 kg, including those where no person was fatally or seriously injured, despite the possibility of the aforementioned exemption.

Finally, the BEA investigates drone accidents which have caused injuries (this occurred once in 2019).

1.2. ACCIDENT DATA AND INVESTIGATIONS OPENED

This section sets out the data with respect to occurrences in 2019 concerning the BEA and with respect to investigations opened after these occurrences, i.e.:

- ◊ accidents occurring in France;
- ◊ investigations opened by the BEA or delegated to the BEA;
- ◊ investigations opened by foreign authorities with notification of the BEA (whether or not the BEA decided to appoint an accredited representative);
- ◊ occurrences for which a BEA team was sent to the site (either in France or abroad).

1.2.1. NUMBER OF ACCIDENTS

The data in the table below comes from two sources:

- ◊ investigations conducted by the BEA;
- ◊ information provided by Field Investigators with respect to "Annex I" aircraft accidents that are not the subject of a BEA investigation.

Accident to the Rolladen Schneider LS8-18 registered F-CIBD on 13 April 2019 at Avize (Marne)
Report published in April 2020

Accidents in France in 2019				
	Number of accidents		Number of injured people	
	Total	of which fatal	fatal	serious
COMMERCIAL AIR TRANSPORT				
Aeroplanes	2	0	0	2
Helicopters	1*	1	1	0
Balloons	5	1	1	3
Commercial Air Transport Total	**8***	**2**	**2**	**5**
AERIAL WORK / SPECIALISED ACTIVITY				
Aeroplanes	3*	0	0	0
Helicopters	2	1	1	0
Microlights	1*	1	1	0
Gliders	1	0	0	0
Aerial work/Specialised activity Total**	**7***	**2**	**2**	**0**
GENERAL AVIATION***				
Aeroplanes	73	4	7	7
Helicopters	13	0	0	1
Gliders (including powered gliders)	24*	4	5	5
Balloons	2	0	0	3
Microlights (including microlight helicopters)	103	18	23	22
General Aviation Total***	**215***	**26**	**35**	**44**
STATE AIRCRAFT				
Helicopters	1	0	0	0
State Aircraft Total	**1**	**0**	**0**	**0**
TOTAL	**231**	**30**	**39**	**49**

(*) *The number of accidents recorded may differ from the number of damaged aircraft or aircraft involved in accidents.*

(**) *Accidents occurring during the aerial activities listed under GM1 SPO.GEN.005 associated with Regulation (EU) No 965/2012 are counted under the "aerial work/specialised activity" heading even if the flights involved do not formally meet the requirements of PART SPO of this Regulation.*

(***) *Local commercial microlight flights are included in the "general aviation" category.*

More information about accidents involving several aircraft

The above table includes three accidents involving several aircraft, namely:

- The loss of control of a paraglider pilot under the effect of wake turbulence behind an Airbus EC135 helicopter on a medevac flight (SMUH); this fatal accident is counted under the helicopter / commercial air transport heading. It is important to take note that free flight activities themselves (e.g. paragliding, hang gliding) are not part of civil aviation.
- The loss of control of an Ikarus C42 microlight during take-off while towing an ASK21 glider for a training flight. Both aircraft were damaged; the pilot of the microlight towing the glider was fatally injured. This accident is counted under the microlight / aerial work heading.
- The collision of a Jodel D114 aircraft with vegetation during a go-around at an altiport, while a second Jodel aircraft was taking off towards the D114.

More information about accidents during specialised activities

The above table includes seven accidents in the scope of activities considered as specialised. In addition to the loss of control of the microlight tug already mentioned, the following was also noted:

- The loss of control of an Airbus AS350 helicopter while lowering a slung load. The pilot was fatally injured during this accident.
- Accidents with material consequences which occurred during a line surveillance flight by helicopter, after parachute drop flights by aeroplane, or as part of competitions (plane aerobatics, gliding).

More information about commercial air transport accidents

The above table includes two aeroplane accidents which occurred in the scope of commercial air transport and led to serious injury to ground staff:

- One member of ground staff was struck by a rotating De Havilland DHC6 propeller on the apron.
- One member of ground staff was hit by a tow bar during a Boeing B777 pushback.

More information about balloon accidents

The BEA recorded seven balloon accidents in 2019: five during commercial flights and two during recreational flights.

These accidents generally occur during landing. The occupants are injured during the hard landing or if the basket tips over. Ejections have also occurred during this phase: a pilot of a commercial flight was fatally injured in this way in 2019.

Collisions with power cables are also a major risk identified for balloon operations. However, only one occurrence was recorded in 2019, during a commercial flight, with only material consequences this time.

In the face of recurrent balloon accidents and the observation that applying current regulations is not sufficient to significantly reduce the risks identified, the BEA, in a report published in 2019, once again brought attention to the fact that balloon flights can be perceived by uninformed passengers as an intrinsically low-risk activity, however experience has shown that balloon safety levels are actually well below the commercial air transport safety levels to which the general public have become accustomed.

More information about general aviation accidents

Readers should refer to chapter 3 of this report, which gives details of the types of accident specific to general aviation.

1.2.2 INVESTIGATIONS OPENED BY THE BEA IN 2019

Investigations opened by the BEA in 2019						
Type of event	**Commercial Air Transport**	**General Aviation**	**Aerial Work**	**Other or State flights**	**Total**	***(Reminder of total in 2018)***
Accidents	8	107	7	2	**124**	*(139)*
Serious incidents	4	4	2	0	**10**	*(5)*
Incidents	2	1	0	0	**3**	*(5)*
TOTAL	**14**	**112**	**9**	**2**	**137**	*(149)*
(Reminder of total in 2018)	*(6)*	*(132)*	*(10)*	*(1)*	*(149)*	

The number of investigations opened by the BEA indicated above is substantially lower than the number of accidents, mainly because non-fatal accidents involving "Annex I" aircraft are only investigated in certain specific cases.

More information about variation compared with the previous year

The number of investigations opened by the BEA in 2019 is slightly less than the previous year. This variation is mainly due to the difference in the number of accidents involving aircraft certified for non-commercial aviation, which was particularly high in 2018.

More information about an investigation delegated to the BEA by a foreign authority

An investigation into an accident which occurred abroad has been delegated to the BEA: this investigation concerns an accident over Dominica involving a TB20 registered in France, during a flight between Martinique and Guadeloupe, the pilot was fatally injured.

More information about investigations into incidents and serious incidents

The BEA opened 13 investigations into serious incidents and incidents. The following are particularly notable:

- One serious incident, with the loss of control of a drone being used for aerial photography during a gathering of people: two members of the public were slightly injured by the aircraft, highlighting the risk of third parties on the ground being injured by a drone, for the first time in France. For information: in 2016, the BEA conducted its first two investigations into the risk of an in-flight collision between drones and commercial air transport aircraft.
- Six investigations into incidents and serious incidents occurring during commercial flights by plane in 2019. Details of these occurrences can be found in part 3 of this report.

More information about different investigation categories managed by the BEA

The BEA adapts its investigative resources and the type of report issued based on the perceived level of risk, the envisaged lessons to be learnt and the target public. On this basis, the BEA has established a classification system for investigations and associated reports, with the following three categories:

Category 1 investigation: "Major" investigation into an accident to an aircraft operated under an air operator's certificate with a maximum certified take-off weight of more than:

- 5.7 t for an aeroplane, or
- 3.18 t for a helicopter,

during which:

- at least one person onboard is fatally injured, or
- an emergency evacuation is required and the aircraft is destroyed, or
- the aircraft is reported missing.

This category is for investigations requiring several areas of organisational and/or systemic analysis and which lead to the writing of a report, using the full structure proposed by ICAO Annex 13. These investigations generally give rise to safety recommendations.

Category 2 investigation: This category is for investigations where the areas of in-depth examination and analysis are limited, giving rise to a "simplified report": the structure of these reports may differ from the template provided in ICAO Annex 13 in order to adapt to the circumstances of the occurrence and the priorities of the investigation. These investigations apply for all types of operations. They primarily aim to provide operational feedback, but can also lead to the issue of safety recommendations.

Category 3 investigation: Investigation "by correspondence". During these investigations, information is mainly obtained by testimonies from the parties directly involved. This information is not generally validated by the BEA, and there is no development of an analysis, conclusions or lessons. With this investigation category, the BEA wants above all, to ensure that personal experience is shared throughout the community in question. This investigation category is generally reserved for light aircraft and types of occurrences which do not lead to serious bodily injury, based on past experience.

In theory, investigations opened by the BEA in 2019 can be broken down as follows:

- ◊ category 1: no investigation;
- ◊ category 2: 96 investigations;
- ◊ category 3: 41 investigations.

However, this breakdown could change based on the information obtained during investigations, many of which are still in progress in relation to the accidents and incidents which occurred towards the end of 2019 (investigations can indeed change category while in progress).

1.2.3. INVESTIGATIONS OPENED BY A FOREIGN BODY FOR WHICH THE BEA HAS BEEN OFFICIALLY NOTIFIED

Foreign investigations opened in 2019 for which the BEA has been officially notified							
Type of event	**Commercial Air Transport**	**General Aviation**	**Aerial Work**	**State aircraft**	**Unknown**	**Total**	***(Reminder of total in 2018)***
Accidents	42	38	15	7	14	**116**	*(126)*
Serious incidents	120	6	3	0	7	**136**	*(165)*
Incidents	19	0	0	0	0	**19**	*(29)*
TOTAL	**181**	**44**	**18**	**7**	**21**	**271**	*(320)*
(Reminder of total in 2018)	*(213)*	*(58)*	*(19)*	*(2)*	*(28)*	*(320)*	

After a 15% increase in the number of notifications in 2018, this number has in 2019, returned to a similar level to 2016 and 2017.

Variations recorded in previous years particularly concerned “incidents“ and “serious incidents“. These variations can be linked to subjective classification criteria, which vary substantially over time, and changes in the investigation policy of some foreign bodies in terms of incidents.

Considering the stakes inherent in the international aspects of the BEA’s activities, in 2018, the BEA started to coordinate with its main industrial partners in order to target and better adjust its level of involvement in foreign investigations. The resulting mode of operation is likely to change, however an initial overview can be drawn up, based on the notifications received in 2019. On this basis, out of the 271 occurrences notified to the BEA:

- ◊ 171 involved the appointment of an accredited representative (ACCREP), who is expected, if it has not already been confirmed, to actively participate based on the needs of the investigation authority;
- ◊ 23 involved the appointment of an ACCREP in order to follow the work, without any specific requests expected from the investigation authority;
- ◊ 77 led to a response to the notifying body indicating that the BEA did not intend to appoint an ACCREP. This mainly includes occurrences with no safety priorities identified for the French manufacturers involved.

Four of the 171 accredited representations in the first group are considered as major accidents in the context of the international activities of the BEA, i.e.:

- The accident to the Boeing B737 Max operated by Ethiopian Airlines, which occurred on 10 March 2019, after take-off from Addis-Abeba, and led to the death of the 149 passengers and 8 crew members; the Ethiopian authorities in charge of the investigation requested the assistance of the BEA.
- The accident to the Sukhoi RRJ95 operated by Aeroflot, which occurred on 5 May 2019 when landing at Moscow-Sheremetyevo airport, and led to 41 fatalities; the BEA was contacted in order to examine several items of equipment designed or manufactured in France.
- The forced landing of the Airbus A321 operated by Ural Airlines, which occurred on 15 August 2019 after take-off from Moscow-Zhukovsky International Airport: a bird strike led to a reduction in thrust for two CFM56 engines during take-off.
- The collision with water involving an Airbus EC225 helicopter, which occurred on 31 October 2019, operated by the South Korean fire service shortly after take-off, at night, from the Dokdo island: the seven occupants died in the accident.

The BEA is involved in these latter two occurrences as a representative of the State of design of the aircraft and the engines.

Serious incident to the Airbus A220 registered HB-JCC operated by Swiss on 15 October 2019 while en route [Investigation delegated to the NTSB / United States]

1.2.4. GO-TEAMS

In the case of a particularly serious accident (in France or abroad), the BEA sends a team of investigators to the site without delay. The size and composition of this "Go-Team" are defined on a case-by-case basis.

In 2019, 53 Go-Teams were dispatched, including nine abroad.

Go-Teams abroad

The nine Go-Teams sent abroad concerned the following occurrences:

- ◊ two ground collisions involving Bell 505 helicopters fitted with Safran engines, in Georgia and Kenya respectively;
- ◊ collision with surface of water involving an Airbus EC225 helicopter, in South Korea;
- ◊ accident to a Boeing B737 Max operated by Ethiopian Airlines, in Ethiopia;
- ◊ forced landing of an Airbus A321 operated by Ural Airlines, in Russia;
- ◊ fire during passenger boarding on an Airbus A330 operated by Air China, in China;
- ◊ collision with ground followed by fire involving an Airbus AS350B3, in Norway;
- ◊ collision with surface of water involving an Airbus EC130-T2, in the Philippines;
- ◊ collision with terrain of a SOCATA TB20 near Marigot (Dominica), for which the investigation was delegated to the BEA.

Go-Teams on French territory

The 42 Go-Teams sent out on French territory included the following occurrences:

- ◊ collision with terrain involving a Cessna 172, on Reunion island, with four people onboard;
- ◊ collision with ground involving a class 6 LCA LH 212 microlight, at Ancona (Italy), during a training flight (the DGAC issued a recommendation bulletin on this occurrence (see paragraph 3.2.3)).

1.2.5. FIELD INVESTIGATORS

The BEA frequently uses the services of Field Investigators, who are DGAC staff posted in the different Inter-Regional divisions, or in the DSAC Delegations, and in overseas services.

These field investigators are trained by the BEA and have been approved by the BEA director in accordance with the provisions of the Code of Transport.

On request by the BEA and under its authority, they carry out the initial investigation actions (often on site) immediately after the accident and exclusively on French territory. They are mainly called on for general aviation occurrences, but sometimes they are also called on for commercial air transport occurrences, particularly in overseas territories.

According to the occurrence, BEA investigators will join them on-site, or not. In all cases, the rest of the investigation is carried out by BEA investigators.

Around 150 Field Investigators are currently available. A tripartite service contract between the BEA, the DSAC and the DGAC Secretary General specifies the terms of their training, approval and use by the BEA.

Sixty-eight operations by Field Investigators were recorded by the BEA in 2019.

2. INVESTIGATIONS CLOSED, REPORTS PUBLISHED IN 2019

Accident to the Cessna - 172RG registered F-GEJD on 13 June 2019 at Saillagouse (Pyrénées-Orientales)

Report published in April 2020

2.1 INVESTIGATIONS CLOSED AND INVESTIGATION REPORTS PUBLISHED

European regulation No 996/2010 specifies that each safety investigation must be concluded with a report in a format suitable for the type of occurrence. The BEA has defined three investigation categories (cf. paragraph 1.2.2), with a suitable report format allocated to each category.

Number of investigations closed / reports published by the BEA in 2019				
	Category 1	Category 2	Category 3	Total
	with safety recommendations			
Commercial air transport	**2**	**10**	**1**	**13**
	2	*1*	*0*	*3*
Aerial work / Specialised activity	**0**	**6**	**5**	**11**
	0	*0*	*0*	*0*
General aviation	**3**	**79**	**54**	**136**
	3	*2*	*0*	*5*
State Operation	**1**	**2**	**0**	**3**
	1	*0*	*0*	*1*
Total	**6**	**97***	**60**	**163***
	6	*3*	*0*	*9*

(*) *A joint report was written on the investigations into the incidents to the A318 registered F-GUGB, which occurred during a commercial air transport flight on 28 March 2017, and to the A321 registered F-GTAT, which occurred during a ferry flight on 30 March 2017. This report is filed under the "commercial air transport" category.*

All BEA reports are published in French, but some of them are also published in other languages, mainly English. In 2019, the BEA thus translated 19 final reports.

The following table lists the six ICAO reports published in 2019. Safety recommendations were issued for all of these reports. A total of 28 safety recommendations were issued in relation to these ICAO reports: 12 relate to commercial air transport, 9 to light aircraft and 7 to an accident which occurred during a fire fighting flight.

Occurrences that led to the publication of an ICAO report in 2019					
Registration	**Type of aircraft**	**Place**	**Date of occurrence**	**Type of occurrence**	**Number of recommendations**
F-GLZU	Airbus A340-300	Bogota airport (Colombia)	11 March 2017	Abnormally long take-off	7
F-GPIT	Extra 300-200	Saint-Héand (Loire)	25 February 2016	Loss of control in flight in adverse meteorological conditions for VFR – collision with terrain	2
F-OIAO	Airbus AS350 B3	Voh (New Caledonia)	04 October 2015	Snagging of Bambi Bucket in vegetation, causing helicopter to tip forward and then collide with ground, during firefighting flight	7
F-HEHM	Piper PA28	Treille (Aude)	01 July 2015	Collision with terrain in adverse meteorological conditions	4
9Y-TTC	ATR 72-200	Near Piarco airport (Trinidad and Tobago)	04 May 2014	Strong vibrations in flight with right electronic propeller control warning	5
F-GEAL	Pitts S2 B	Meaux aerodrome (Seine-et-Marne)	08 December 2013	In-flight separation of the propeller, damage to the tail fin, after an aerobatic flight, forced landing at aerodrome	3

2.2 COMMENTS ON BEA ACTIVITIES AND PERFORMANCE IN 2019

Firstly, 164 investigations were closed in 2019:

- ◊ This number is greater than the number of investigations opened (137): the stock of investigations in progress has therefore decreased by 27.
- ◊ This number is well above the number of investigations closed in 2018 (107).

Regulation (EU) No 996/2010 specifies that an investigation report should be published rapidly and, if possible, within twelve months of the date of the occurrence. For the BEA, a duration of twelve months for each investigation is thus a general objective and a monitoring indicator. This indicator is defined as the percentage of investigations closed within one year among the investigations opened the previous year.

In 2019, the global result of this indicator is 56%. This is equivalent to the 2017 figure, after a significant decrease in 2018.

It can be seen that if a distinction is made between investigation categories (as defined in paragraph 1.2.2. above), the indicator varies substantially, as shown in the following table: over and beyond the volume of factual items of information to be obtained and the time spent collecting and then analysing this information, the need to conduct complementary and potentially time-consuming work, and the duration of validation and consultation processes, vary widely depending on these investigation categories. In addition, issuing recommendations is – except in the case of urgent recommendations - a demanding process with various validation phases, which also extend the duration of investigations.

Breakdown of indicator for 2019				
Investigation categories	**Category 1**	**Category 2**	**Category 3**	**Total**
Investigations opened in 2018	1	99	50	**150**
Closed in less than one year	0	43	41	**84**
Indicator 2019	**0%**	**43%**	**82%**	**56%**

The following table narrows down this data for each category by indicating the year of the investigations closed in 2019.

Year in which the investigations were opened for all reports published by the BEA in 2019					
Investigation categories		**Category 1**	**Category 2**	**Category 3**	**Total**
Year of occurrence	2019	0	6	24	**30**
	2018	0	55	18	**73**
	2017	1	24	8	**33**
	Previous	5	13	10	**28**
Total		**6**	**98**	**60**	**164**

A total of 125 investigations were opened more than one year ago on 31 December 2019. The following table gives details for each investigation category.

Number of BEA investigations opened more than one year ago on 31 December 2019				
Investigation categories	**Category 1**	**Category 2**	**Category 3**	**Total**
Commercial air transport	4	21	2	**27**
Aerial work / Specialised activity	0	5	1	**6**
General aviation	2	72	18	**92**
Total	**6**	**98**	**21**	**125**

The stock of investigations from more than one year ago is at exactly the same level as in 2017 (125), despite increasing to 148 in 2018.

3. GENERAL CONSIDERATIONS ON AIR SAFETY IN FRANCE IN 2019

Accident to the Cessna 207 registered F-OSIA on 25 January 2019 in Cayenne (French Guiana)
Investigation in progress

3.1. COMMERCIAL AIR TRANSPORT

3.1.1 GENERAL

Firstly, no French operator of commercial air transport planes was involved in an accident in 2019, either on French territory or abroad.

The only two accidents which occurred in France in 2019 involved foreign operators. These accidents are mentioned in paragraph 1.2.1 above. They specifically involved ground operations. Accidents giving rise to ground staff injuries occur regularly. They generally bear witness to a lack of harmonisation between the procedures applied by air operators and stopover assistance service providers.

An investigation was opened for six of the commercial air transport incidents notified to the BEA and four were classified as «serious incidents», of particular note are:

- ◊ The loss of altitude of a Boeing B737-800 operated by Air Algérie during a go-around ordered by the traffic controller on short final at Paris Orly due to the risk of a runway incursion. According to the initial information obtained, the crew had difficulty managing this sudden situation. In 2013, the BEA published a safety study on "Aeroplane state awareness during go-around". This study referred to a number of dramatic accidents which had occurred during this manoeuvre, considered as a normal procedure, although rarely used by pilots in actual conditions.
- ◊ A loss of separation between two aeroplanes triggering a TCAS resolution advisory, following a go-around by a Boeing B717 operated by Volotea, due to a Bombardier CRJ-700 operated by Hop ! taking off at the same time on the same runway.
- ◊ An approach flown above the ILS glideslope despite an attempt to return to the glideslope by an Airbus A318 operated by Air France at Toulon: in this case, the autopilot captured a secondary beam, which increased the angle of attack, which the crew failed to detect until the activation of the angle of attack protection system.

Turbulence causes injures, which are sometimes serious, to passengers and crew members around the world each year. On 13 February 2019, a Boeing B737-800 operated by Transavia flew through some strong clear air turbulence en route at FL370. This turbulence caused slight injuries to some passengers who did not have their seat belts fastened, as well as to some members of cabin crew. According to the investigation[(1)], some meteorological information available before the flight (TEMSI and dedicated EFB application) reported strong turbulence in this sector and at this flight level. This information was not taken into account by the crew for various reasons. In the absence of a pre-alert, the information provided by the crew of another aeroplane and passed on by air traffic control did not allow the cabin crew enough time to check that all passengers had fastened their seat belts before the aircraft entered the strong turbulence.

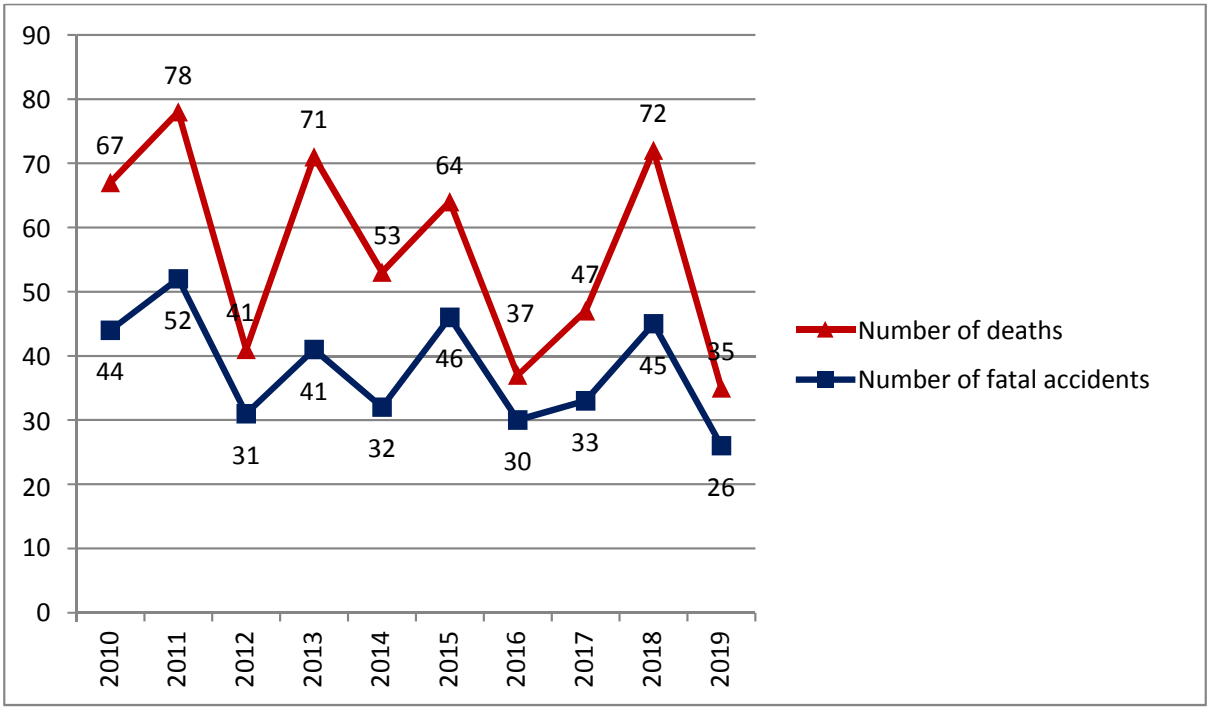
[(1)] https://www.bea.aero/uploads/tx_elydbrapports/BEA2019-0056.en.pdf

A BEA investigation was conducted into an incident which occurred in 2019: this involved the combustion of a lithium battery in a wheel chair in the cargo hold of a Boeing B737-900 operated by El Al at the start of taxiing at Paris - Charles de Gaulle. The aim of the investigation was to understand why this equipment was in the hold despite existing procedures, specific to this type of material. This occurrence indirectly highlighted the risks associated with the multiplication of batteries with lithium, which is generally not easy to detect and trace. Studies are currently in progress to check whether it is possible to detect such equipment in hold luggage. This detection system would complement initiatives which have already been taken, particularly in the form of instructions issued to passengers or procedures for managing thermal run-away in the cabin.

3.2. GENERAL AVIATION

3.2.1. OVERVIEW FOR ALL TYPES OF GENERAL AVIATION ACTIVITIES

The overview for 2019 for all types of general aviation activities can be considered as fairly positive, in terms of the number of fatal accidents and deaths, as shown on the following graph. It is, however, important to take note that the conclusion refers to small numbers, which vary significantly each year, which makes it difficult to determine a reliable trend that can be interpreted in terms of safety levels.



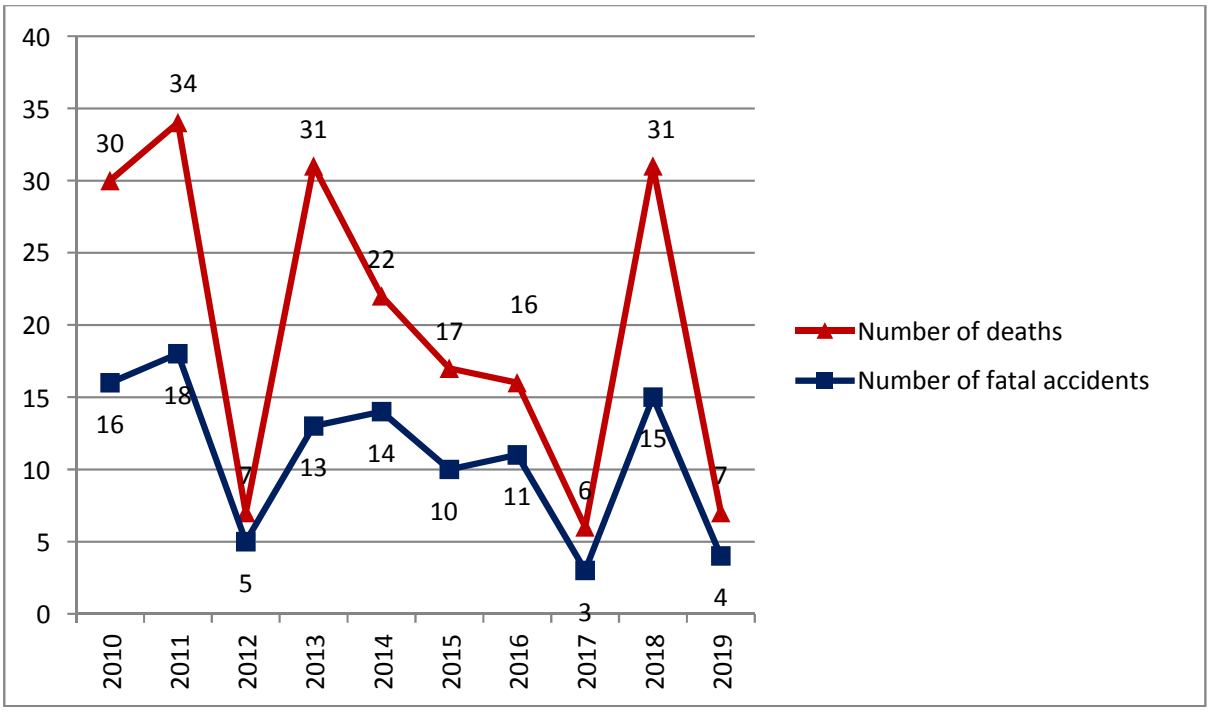
Variation in fatal accidents for general aviation (all activities) over the 2010-2019 period

The reduction in the number of fatal accidents in general aviation in 2019 compared with 2018 mainly concerns helicopters (no fatal accident), aeroplanes (-73%) and, to a lesser extent, microlights (-14%). No fatal accident was recorded for non-commercial balloon operations, just like the previous year. The number of fatal accidents for gliders remained stable compared with 2018.

The figures given below are numbers of accidents and not accident rates. They should therefore not be interpreted as a comparison of the safety levels of aeroplanes and microlights (any comparison of safety levels should particularly take into account fleet size, number of flights or flight hours for each activity).

3.2.2. OVERVIEW FOR GENERAL AVIATION - AEROPLANES

After a peak year in 2018, with 15 deaths, 2019 was one of the best years of the past decade in terms of fatal aeroplane accidents in general aviation, with four cases recorded (prior to 2019, 2017 held the record for the decade with three deaths, and 2012 with five deaths).



Variation in fatal general aviation accidents (aeroplanes only) over the 2010-2019 period

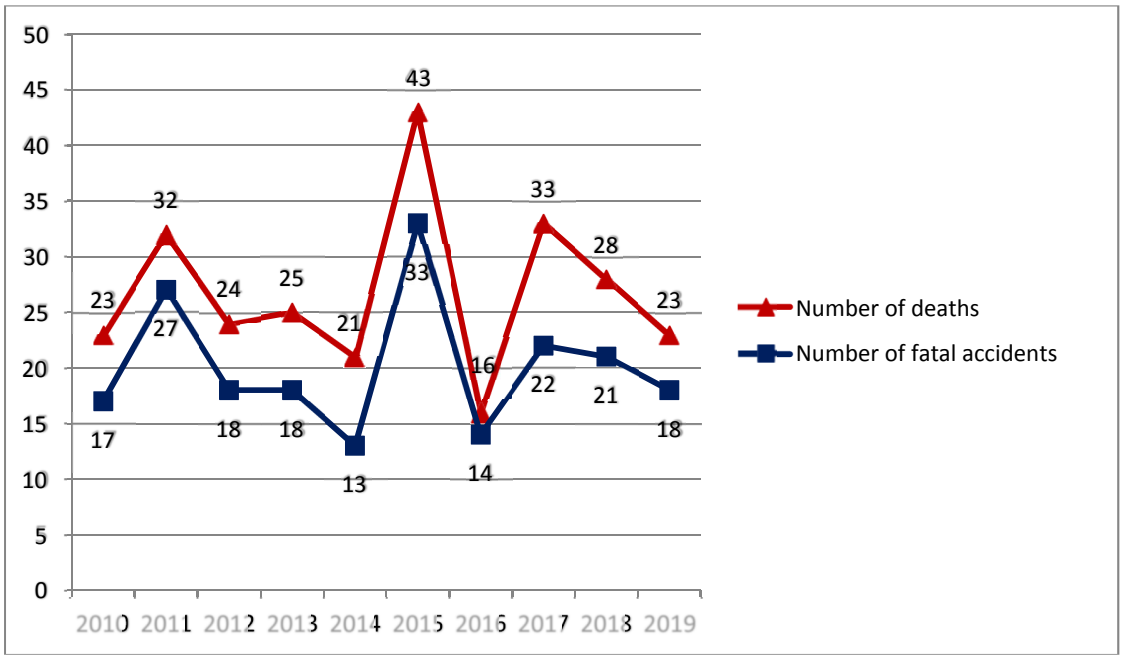
Most of the investigations into the aeroplane accidents leading to serious or fatal injuries were still in progress at the time of writing this report, therefore it is difficult to reach any general conclusions. It is, however, worth taking note that:

- ◊ At least three accidents appear to have the characteristics of a loss of control in flight. Two of these accidents involved amateur-built aeroplanes.
- ◊ At least three other accidents would appear to have been caused by an engine shutdown or a decrease in engine power. In particular, in one case, the malfunction appears to have significantly increased the take-off run distance at the aerodrome where the pilot is based. This accident raises the question of reference points on a runway used frequently by the pilot and the decision to interrupt the take-off based on these, even if there is a risk of damaging the aircraft during a runway excursion.

Furthermore, only one of these accidents involved an aeroplane operated by a club. In addition to the types of aeroplane used by clubs, which are generally more conventional, reliable and simpler to operate, the club structure probably encourages pilots to control certain at-risk human behaviour.

3.2.3. OVERVIEW FOR GENERAL AVIATION - MICROLIGHTS

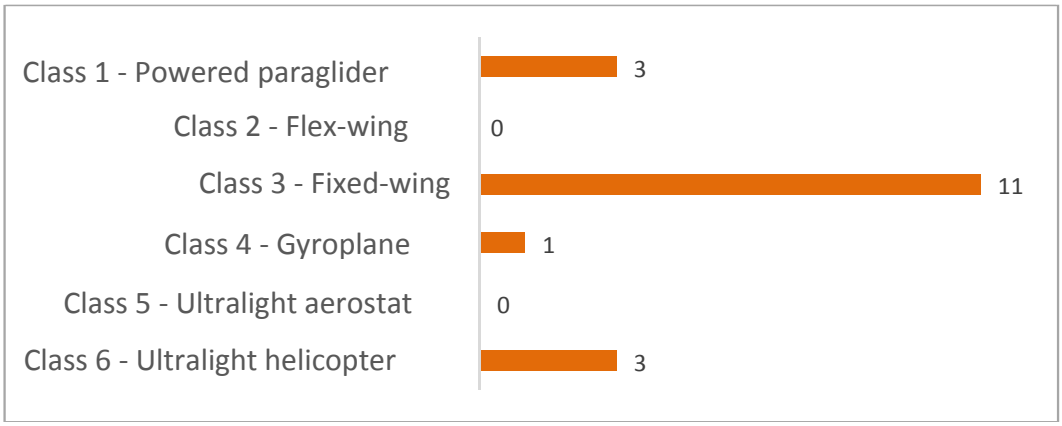
The overview is slightly positive with 18 fatal accidents in 2019 compared with the mean figure over the last decade for the microlight activity.



Variation in fatal general aviation accidents (microlights only) over the 2010-2019 period

The following graph shows the breakdown of fatal accident per class of microlight.

Note: the BEA has no activity data (number of flights, flight hours) for each of these microlight classes. It is therefore important to avoid an abusive interpretation of the safety levels of each microlight class based on this overview of fatal accidents.



Number of fatal accidents per type of microlight in 2019

As is the case for other general aviation activities, most investigations relating to these accidents are still in progress and the circumstances of these accidents have not been fully determined. However, in two cases, the BEA immediately shared the initial material elements collected and analysed with the DSAC, in order to allow for rapid communication with users:

- The first occurrence involved a class 6 LH 212 microlight. The instructor and student pilot died in September 2019 during a collision with the ground while flying aerodrome traffic patterns. A fatigue failure was detected on one blade of the tail rotor. The DSAC issued a recommendation bulletin suggesting the temporary suspension of flights on this type of microlight (ref. BR2019-ULM-002).
- The second occurrence also involved a class 6 microlight, a Héli-sport CH77 "Ranabot". The pilot died during the accident, which occurred in July 2019. As the location of the aircraft doors with respect to the main wreckage suggests that they separated in flight, the DSAC published an information bulletin reiterating the action taken by the manufacturer after a similar accident the previous year, involving the same type of microlight, for which an investigation had also been opened by the BEA[(2)].

Other fatal accidents involving microlights include:

- A collision with vegetation which may be explained by the pilot attempting to keep the ground in view when confronted with a sudden decrease in visibility after take-off, in a context of low clouds.
- Eight occurrences typical of a loss of control in flight (including one which occurred when turning around in a valley, after a navigation error[(3)].

In terms of loss of control in flight, in 2019, the BEA published the investigation report on an accident, which occurred during a local commercial passenger flight[(4)]: the appropriate use of the parachute by the pilot attenuated the consequences of the loss of control and neither occupant was injured. In this report, the BEA recommended that the DGAC require the installation of a reserve parachute, when technically feasible, on all microlights operated in this context, with a paying passenger.

(2) https://www.bea.aero/uploads/tx_elydbrapports/BEA2018-0375.pdf

(3) https://www.bea.aero/uploads/tx_elydbrapports/BEA2019-0456.en.pdf

(4) https://www.bea.aero/uploads/tx_elydbrapports/BEA2017-0382.pdf

4. SAFETY RECOMMENDATIONS

4.1. GENERAL CONTEXT

According to the ICAO, a safety recommendation is a proposal made by an investigation authority on the basis of information gathered from an investigation or a study, in order to prevent accidents or incidents.

The BEA sends most of its recommendations either to the civil aviation authority of a State or to the European Aviation Safety Agency (EASA). Some recommendations may also be sent to operators or manufacturers. They must relate to the measures to be taken to prevent occurrences with similar causes.

Follow-up of safety recommendations

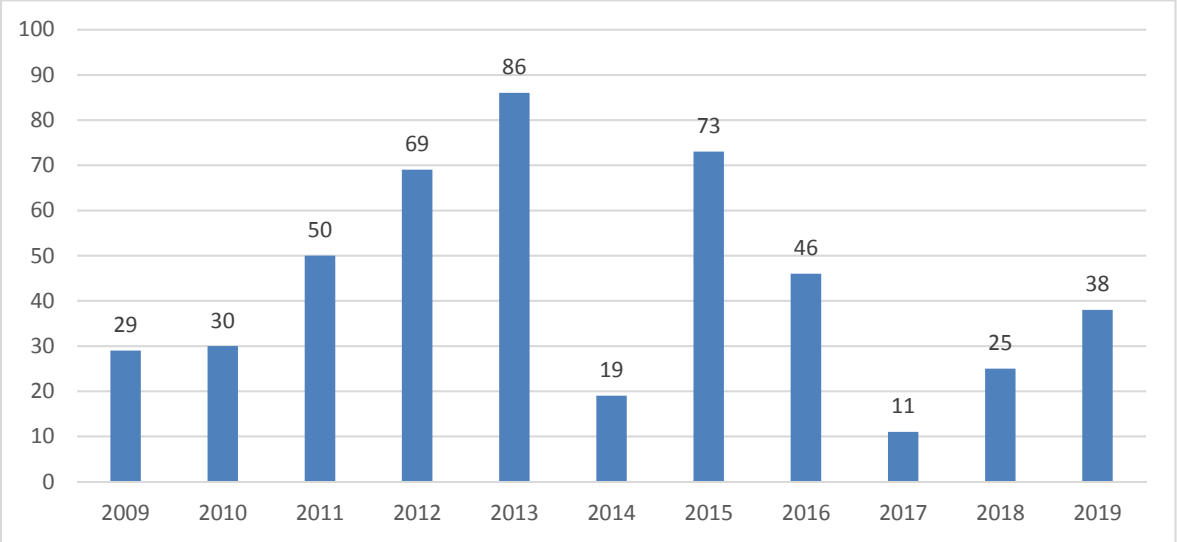
The provisions of Regulation (EU) No 996/2010 of the European Parliament and Council on investigations and the prevention of civil aviation accidents and incidents requires, for Member States, that recipients of safety recommendations acknowledge receipt and inform the issuing authority, responsible for investigations, of the measures taken, or under consideration.

This response must be addressed to the issuing authority within 90 days of receipt of the Safety Recommendation letter.

The investigation authority then has 60 days to inform the recipient of the Safety Recommendation if it considers its response as adequate or, if it disagrees with the response, to give reasons.

4.2. SAFETY RECOMMENDATIONS ISSUED

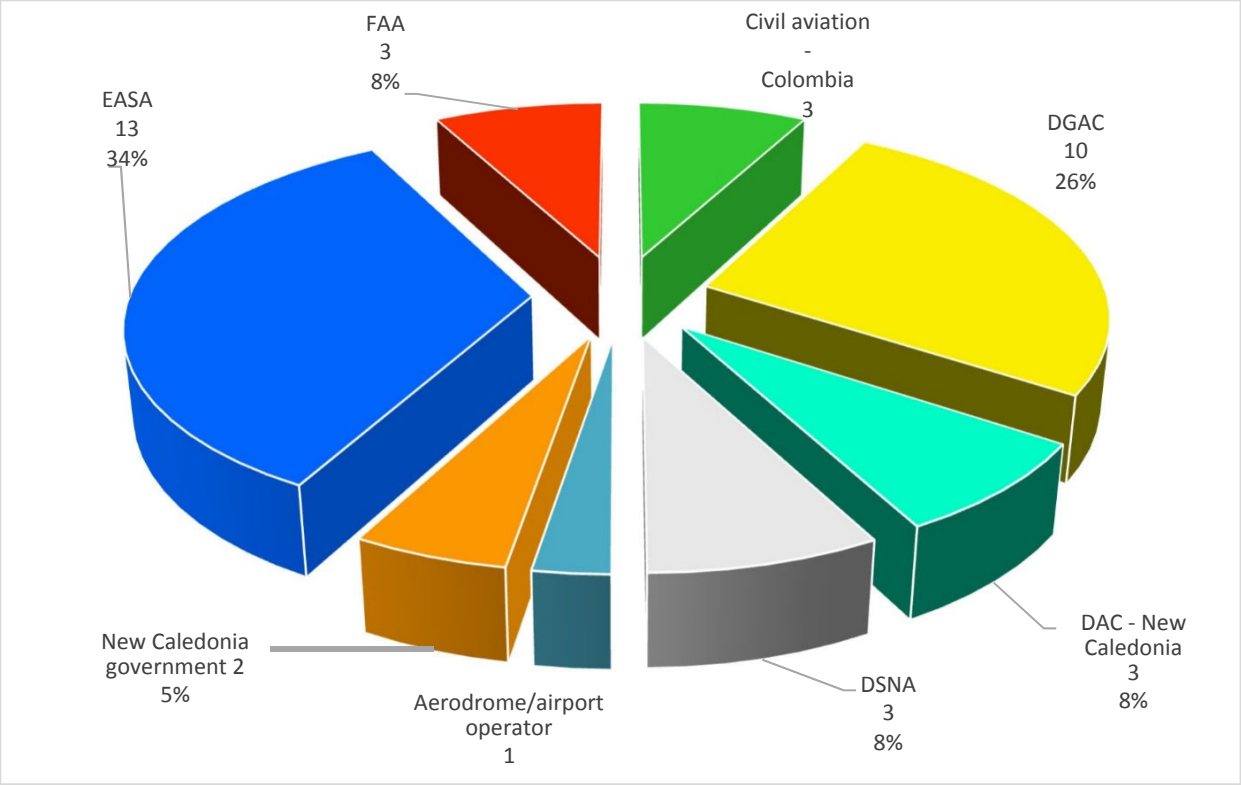
The BEA issued 38 recommendations in 2019.



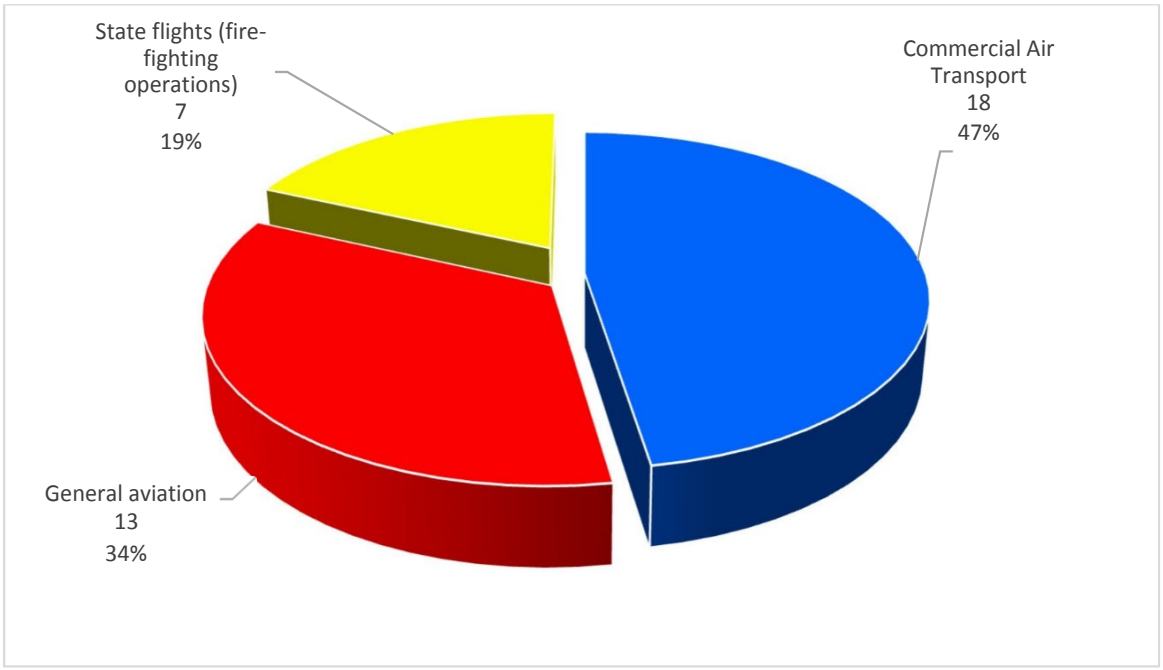
Breakdown by recipient

EASA, the FAA, the DGAC and the DSNA were the main recipients of recommendations in 2019.

Unlike the previous year, no recommendations were made directly to aeronautical manufacturers.

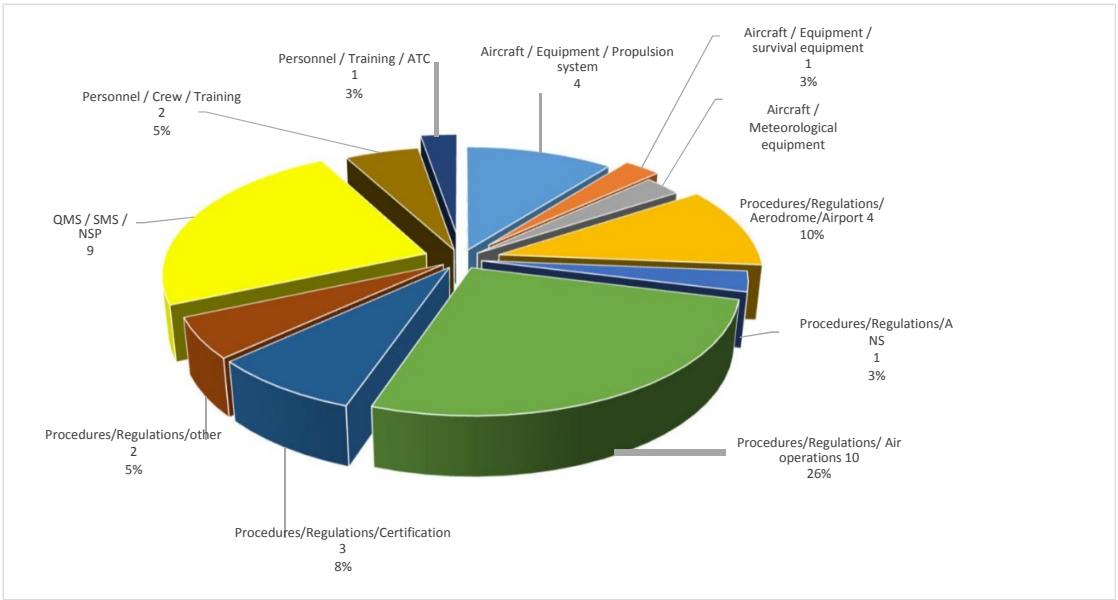


Breakdown by type of operation



Themes of recommendations

The breakdown of recommendations issued in 2019 by theme includes eleven areas in which safety actions were recommended. The breakdown is as follows:



4.3. RESPONSES TO SAFETY RECOMMENDATIONS

As regards the follow-up to the 38 recommendations issued by the BEA in 2019:

- ◊ twenty-two recommendations received a favourable response; six of these recommendations were closed by the recipient;
- ◊ two recommendations were closed by the recipient with a partially favourable response;
- ◊ six recommendations received a response from the recipient indicating that action was under way;
- ◊ eight recommendations are still awaiting a response from the recipient authority, including six issued on 4 December 2019.

4.4. PERFORMANCE INDICATOR FOR SAFETY RECOMMENDATIONS

The BEA has established a recommendation performance indicator. The indicator reflects a qualitative evaluation of the appropriateness of the action envisaged by the recipient in comparison with the action expected by the BEA.

For each recommendation issued, the BEA recommendations board (Corec) will assign a performance indicator (between 0 and 1):

- ◊ either when it decides to close the investigation;
- ◊ or when receiving the final response from the recipient.

The recommendation general performance indicator is then determined by calculating the mean value of the indicators of each recommendation evaluated.

In 2019, the BEA closed 40 recommendations and the mean value of the indicator was 0.75. The following table shows the breakdown of the appropriateness of the responses to these recommendations by recipient:

Appropriateness of responses to recommendations by recipient	
Recipients	**Level**
EASA	0.46
DGAC	1
DSAC	1
DSNA	0.50
FAA	0.81
Other	1

5. ENGINEERING DEPARTMENT ACTIVITIES

Accident to the Comco Ikarus C42 identified 03AEN and the Schleicher ASK21 registered F-CITS on 11 September 2019 at Itxassou (Pyrénées-Atlantiques)

Investigation in progress

5.1. OVERVIEW OF ENGINEERING DEPARTMENT ACTIVITY IN 2019

The volume of activity of the Engineering Department is more or less the same as in 2018, with a total of 561 examinations of all types (versus 599 the previous year).

Occurrences generating particularly high workloads or complex or highly technical work include:

- The read-out of the flight recorders of the Boeing 737 Max operated by Ethiopian Airlines (CVR and FDR) in March 2019, with notably, a damaged internal memory card.
- The end of search operations in Greenland for parts of the engine on an Airbus A380 operated by Air France and the recovery of the main part of the missing fan hub. Metallurgical examinations of this part led to significant technical progress in understanding the failure mechanism of the fan hub.
- A trip by a team to South Korea for the accident to an Airbus EC225 helicopter, which occurred at sea during a rescue operation, and the read-out of the flight recorders at the BEA. It was necessary to unweld the box and read the memory card components directly, and then recover files using techniques developed in the laboratory in the field of new NAND technology memories.
- The preparation of a complex series of examinations to understand the mechanism having led to the loss of a windscreen on an Airbus A319 operated by Sichuan Airlines in China, with the assistance of CETIM and DGA-TA.
- Audio and spectral analyses of four videos recorded using cell phones during the flight leading to the accident to an Airbus AS350 in Norway, which was used to characterise the engine and rotor speeds.
- Work carried out on 14 computers and a quick access recorder, while participating in the investigation conducted by Russia into the accident to a Sukhoi RRJ95 operated by Aeroflot on landing at Moscow.
- A trip by a team to China as part of an investigation into a cabin fire on an Airbus A330 operated by Air China and the laboratory analysis of over 30 items of onboard equipment.
- Large-scale research work into the cause of a fire onboard a Cessna 206, leading to the identification of the factors behind the fire.
- Metallurgical analyses leading to the identification of a series of fatigue fractures on the tail rotor blades, after the accident to a class 6 LCA LH 212 microlight.

5.2. WORK BY PESA (FLIGHT RECORDERS AND AVIONIC SYSTEMS SECTION)

5.2.1. FLIGHT RECORDERS

In 2019, 28 CVR recordings and 50 flight data recordings were downloaded and read out at the BEA, representing a total of 78 recordings. This total is less than the previous year (112 recordings).

Over two-thirds of these recordings concerned investigations in which the BEA participated as an accredited representative, or work carried out as part of the provision of technical assistance to third party countries.

	BEA investigation	BEA Accrep	Technical assistance	Total
CVR recordings read out at the BEA	3	13	12	**28**
FDR recordings read out at the BEA	12	27	11	**50**

5.2.2. AVIONICS SYSTEMS

In 2019, the BEA's avionics lab read out 193 computers, to which can be added work on photo and video recordings as well as on laptops and smartphones. With a total of 254 examinations (versus 231 in 2018, 189 in 2017, 152 in 2016 and 137 in 2015), the activity of the avionics laboratory is growing substantially.

	BEA investigation	BEA Accrep	Technical assistance	Total
Computers(*)	87	97	9	**193**
Laptops/Smartphones	28	5	1	**64**
Photo/video recordings	20	7	0	**27**

(*)The term "computer" groups various types of avionic and GNSS[5] equipment

[5] Global Navigation Satellite System (incorporating various systems with worldwide coverage, including the American GPS).

5.2.3. ATM RECORDINGS

In 2019, 50 occurrences led to work on Air Traffic Management (ATM) data, based on radar data or Air Traffic Control (ATC) exchanges. This type of work related essentially to investigations led by the BEA, and the level of this activity was stable with respect to the two previous years.

ATM work by type of investigation was split as follows:

	BEA investigation	BEA Accrep	Technical assistance	Total
Number of events	42	6	2	**50**

5.2.4. PESA DEVELOPMENT WORK

The laboratory has upgraded its equipment for reading flight recorders to expand its reading capabilities, and has consolidated the software developed in house in order to analyse the data on these recordings.

The development projects started in the avionics laboratory in 2018 - internal developments and the acquisition of OTS tools - were continued and led to operational tools by late 2019, which can be used to read practically all types of new NAND technology memories found when examining avionics system.

As the BEA is regularly required to take samples from, transport and store damaged systems containing lithium batteries, it requested that tests be carried out by the DGA-TA. Procedures are progressively being implemented to ensure that handling operations by assigned personnel are carried out safely.

5.3. WORK BY PSEM (STRUCTURE, EQUIPMENT AND ENGINES SECTION)

5.3.1. EXAMINATIONS CARRIED OUT

In 2019, 184 examinations were performed of which 51 in the scope of an accredited representation, which is a similar level of activity to previous years.

The examinations performed can be broken down as follows:

	BEA investigation	BEA Accrep	Technical assistance	Total
Wreckage examinations	35	11	6	**52**
Engine and propeller examinations	10	14	4	**28**
Fluid examinations	12	0	1	**13**
Equipment examinations	57	26	8	**91**

5.3.2. PSEM DEVELOPMENT WORK

A study was initiated into the icing of piston engine carburettor systems, including:

- ◊ a phase of bibliographical research and the provision of information to BEA investigators with the assistance of the DGA (this phase had almost been completed at the time of writing);
- ◊ an in-flight measurement phase on aircraft equipped with a Rotax engine (towards the end of 2019);
- ◊ a nine-day test campaign on a dedicated bench at the DGA-EP to take precise measurements of carburettor icing in a wind tunnel. This campaign is planned shortly.

The study as a whole will provide the BEA with precise data in order to evaluate occurrences which were investigated where carburettor icing may have occurred.

In addition, the BEA's piston engine examination capabilities have been consolidated on its premises. The BEA can now boast a disassembly area, test capabilities for ignition systems and disassembly procedures, with access to detailed technical documentation via manufacturers and its counterparts. Engine test benches were also developed under a partnership between the BEA and the ENAC Castelnaudary centre: they are now operational at the Castelnaudary site.

6. INTERNATIONAL ACTIVITIES, COMMUNICATION & TRAINING ACTIONS, INFORMATION FOR FAMILIES

Accident to the BRM Aero Bristell NG5 registered G-CLDO on 12 May 2019 at Montmorillon (Vienne)

Investigation in progress

The BEA undertakes many activities on the European and international scene: communication activities through its participation in international conferences, the setting up of cooperation agreements with foreign investigation authorities, organising training seminars in France and abroad and participating in working groups in international organisations (in particular the European Union, ECAC and ICAO).

In addition, the BEA has a duty to provide information to victims of aviation accidents, or their families, in compliance with regulation (EU) No 996/2010.

6.1. COMMUNICATION ACTIVITIES IN PROFESSIONAL FIELD

Every year, the BEA participates in several conferences and expert meetings. This allows the BEA not only to spread safety messages based on investigations that it has led or participated in, but also to make its investigation expertise more widely known abroad. This reputation and keeping in close contact with its counterparts are essential tools for the success of its work during investigations abroad.

In 2019, the BEA participated in the following international conferences:

- **International Society of Air Safety Investigators (ISASI)**, in The Hague (Netherlands): this conference provided the opportunity to report on an occurrence in Bogota (Colombia) with an abnormally long take-off due to a slow rotation rate.
- **European Society of Air Safety Investigators (ESASI)**, in Derby (United Kingdom): during the workshop of the European branch of the ISASI, the BEA presented safety investigations improving or refreshing the knowledge of manufacturers.
- **Middle East and North Africa Society of Air Safety Investigators (MENASI)**, in Abu Dhabi (United Arab Emirates): during this conference of the Middle East and North Africa branch of the ISASI, the BEA presented its communications experience as part of a safety investigation.
- **AIR (Accident Investigator on Recorders)** meeting, in Tokyo (Japan): annual meeting of flight recorder specialists from the main safety investigation authorities.
- **AIM (Accident Investigator on Materials)** meeting, in Braunschweig (Germany): annual meeting of material investigation specialists from the main safety investigation authorities.
- **AIP (Accident Investigator on Performance)** meeting, at the BEA: annual meeting of aircraft performance investigation specialists from the main safety investigation authorities.

6.2. COLLABORATION WITH FOREIGN INVESTIGATION ORGANISATIONS

Through its experience and know-how, the BEA is recognised as one of the most important safety investigation authorities. As such, it is regularly consulted by many States for assistance in the monitoring of the implementation of the standards and practices recommended by ICAO. It was in this context that in 2019 the BEA signed five Declarations of Intent for Cooperation in investigations into civil aviation accidents, with NEPAL, QATAR, SLOVENIA, NIGERIA and ETHIOPIA respectively (this latter declaration of intent was signed in the specific context of the accident to the Boeing 737 Max operated by Ethiopian Airlines, which occurred after take-off from Addis-Abeba).

Three Declarations of Intent for Cooperation were also updated, with Japan, Russia and Morocco respectively.

Declarations of Intent for Cooperation have been signed with a total of 54 countries.

This document proposes assistance, within the bounds of reasonable limits, in case of a major investigation.

It should be noted that, with regard to Slovenia, this principle of cooperation is in keeping with the assistance procedures promoted by ENCASIA (see paragraph 6.3.2.) and mentioned in article 7 of Regulation (EU) No 996/2010.

One of the main outcomes of the Declarations of Intent signed by the BEA has been the provision of technical assistance by the PSEM and PESA sections of the Engineering Department (this technical assistance activity is described in chapter 5 above).

6.3. PARTICIPATION IN THE WORK OF INTERNATIONAL ORGANISATIONS

6.3.1. ICAO

The BEA plays an active role in several of the ICAO's groups of experts:

- ◊ Accident Investigation Group (AIG): the BEA chairs this group of experts, which is mandated to study amendments to Annex 13. The BEA also chairs an AIGP sub-group, which analyses the reasons why foreign investigation authorities do not make all final investigation reports public after accidents involving commercial air transport aeroplanes.
- ◊ Flight Recorder Specific Working Group (FLIREC-SWG): this group of experts is responsible for proposing amendments to ICAO Annex 6 and in particular, with respect to the carrying of flight recorders.

The BEA is also an active participant in a GADSS-AG Working Group, the aim of which is to update the actions to be taken as part of the GADSS (Global Aeronautical Distress Safety System) concept, particularly taking account the lessons learnt from the AF 447 accident (over the Atlantic in 2009) and the MH 370 accident (which disappeared over the Indian Ocean in 2014).

The 40th ICAO Assembly session was held in 2019 at Montréal. This Assembly brings together all of the 193 Member States, and meets every three years. The role of this Assembly is, in particular, to review ICAO work, propose political recommendations and adopt resolutions. In this context, the BEA led the drafting of a working document on how the Regional Accident and Incident Investigation Organizations (RAIO) function, inspired by the ENCASIA approach.

Finally, in the context of the work by the ICAO's RASG-EUR (Regional Aviation Safety Group – Europe), the BEA is actively involved in IE-REST (ICAO Europe Regional Experts Safety Team) which brings together 52 European states. The work aims, in particular, to develop methods and introduce shared tools for occurrence reporting and data analysis. IE-REST also offers an opportunity to strengthen ties, particularly with authorities in Eastern European countries (Russia, Georgia, Ukraine, etc.).

6.3.2. EUROPEAN UNION

Regulation (EU) No 996/2010 created the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA) to coordinate the work of and feedback from the EU's various investigation authorities. The BEA's Director has been the chairman of ENCASIA since 2017.

In the context of ENCASIA's work, the BEA is a key player in the various permanent working groups and chairs a group on the identification, formalisation and sharing of European best practices in investigations and the drafting of reports. The BEA is also very involved in the working group devoted to peer reviews between European investigation authorities: one - even two - BEA investigators participate each year in the review of several authorities. In addition, the BEA has actively participated in the promotion of mutual support between all European investigation authorities. The main aim is to guarantee that all air transport accidents, throughout Europe, are subject to a suitable investigation and that lessons are learnt and shared to avoid any repeat occurrences. This ENCASIA mutual support system (EMSS) provides one example of BEA's extensive involvement in a medium to long-term project.

6.3.3. ECAC (EUROPEAN CIVIL AVIATION CONFERENCE)

The BEA's Director is the vice-chair of the Group of Experts of Accident Investigation (ACC) bringing together the 44 Member States of the European Civil Aviation Conference (ECAC), a forum for exchanging feedback. The ACC holds meetings every six months and in 2019, these provided an opportunity for the BEA to give an update on the investigations opened in 2018 to its European counterparts.

6.3.4. EUROCAE (EUROPEAN ORGANISATION FOR CIVIL AVIATION EQUIPMENT)

EUROCAE is a European organisation that publishes reference documents on specifications for onboard systems. EUROCAE works in close coordination with the RTCA, its American counterpart, in many fields. EUROCAE and RTCA documents are written by representatives of the aeronautical community. The BEA has chaired various EUROCAE working groups over the last 20 years, and in particular WG-98, a joint EUROCAE-RTCA group. In December 2018, this working group published documents which, in particular, define the specifications for new generation Emergency Locator Transmitters (ELT), which are activated in flight when an emergency situation is automatically detected by the aircraft systems. These specifications are based on recommendations issued by the BEA as part of the investigation into the accident to flight AF 447. These documents are now referenced by ICAO standards and all international regulations (FAA, EASA, etc.). They are an essential component of effective regulatory changes to improve aviation safety.

A sub-group of the WG-98, which the BEA actively contributes to, is currently developing the specifications for the Return Link Service for ELTs. This functionality will, in particular, inform people in distress that the ELT signal has been picked up and that the emergency services are on their way. This sub-group plans to publish RLS specifications in 2020.

6.4. TRAINING ORGANISED BY THE BEA

In 2019, the BEA organised two training courses in Basic Investigation Techniques. These courses, which lasted two weeks, took place at the Le Bourget site. They are mainly intended to provide initial training for investigators recently recruited by the BEA and for Field Investigators (DGAC staff approved by the BEA and intervening at its request to obtain and protect evidence in the first few hours or days after a general aviation accident). They are also open, subject to available places, to the air transport gendarmerie (GTA), investigators from French-speaking countries and individuals from French aeronautical associations.

The BEA also led a training course on the investigation methods and techniques used in relation to occurrences involving commercial air transport aircraft. The main goal is for trainees to grasp the issues at stake both in terms of relations and debates within the investigation team and with the various bodies involved in these investigations, and in terms of investigation and communication techniques. This "phase 3" training course took place on the BEA's premises over a two-week period. This course meets the need for the advanced training of BEA investigators after initial training and a few years of experience to allow them to progress in their investigator career. This course is held in English and is open to our partners and counterparts. The British, German, Italian, South African, Polish, Argentine, Pakistani and Iranian investigation authorities, the operator Hop! and the manufacturers, ATR and Airbus, participated in 2019.

6.5. INFORMATION FOR FAMILIES

In 2019, two meetings at the BEA site and three telephone meetings were organised for the families of victims to present the safety investigations, their progress and their conclusions.

These meetings concerned a total of three general aviation accidents that occurred in France in 2016, 2017 and 2019.

The BEA also participated in an information meeting for families of the French victims of the accident to the Boeing 737 Max operated by Ethiopian Airlines after take-off from Addis-Abeba, at the invitation of national coordinators appointed by the interministerial delegation for victim support.

6.6. PUBLIC COMMUNICATIONS

In 2019, the BEA continued its digital communication strategy, starting with the development of its Twitter @BEA_Aero thread.

The BEA's Twitter thread has around 10,000 followers and informs the public of:

- the opening of BEA safety investigations (on a weekly basis);
- the departure of any BEA go-teams and their arrival on site;
- key events, during major investigations;
- the publication of investigation reports;
- the issuing of safety recommendations.

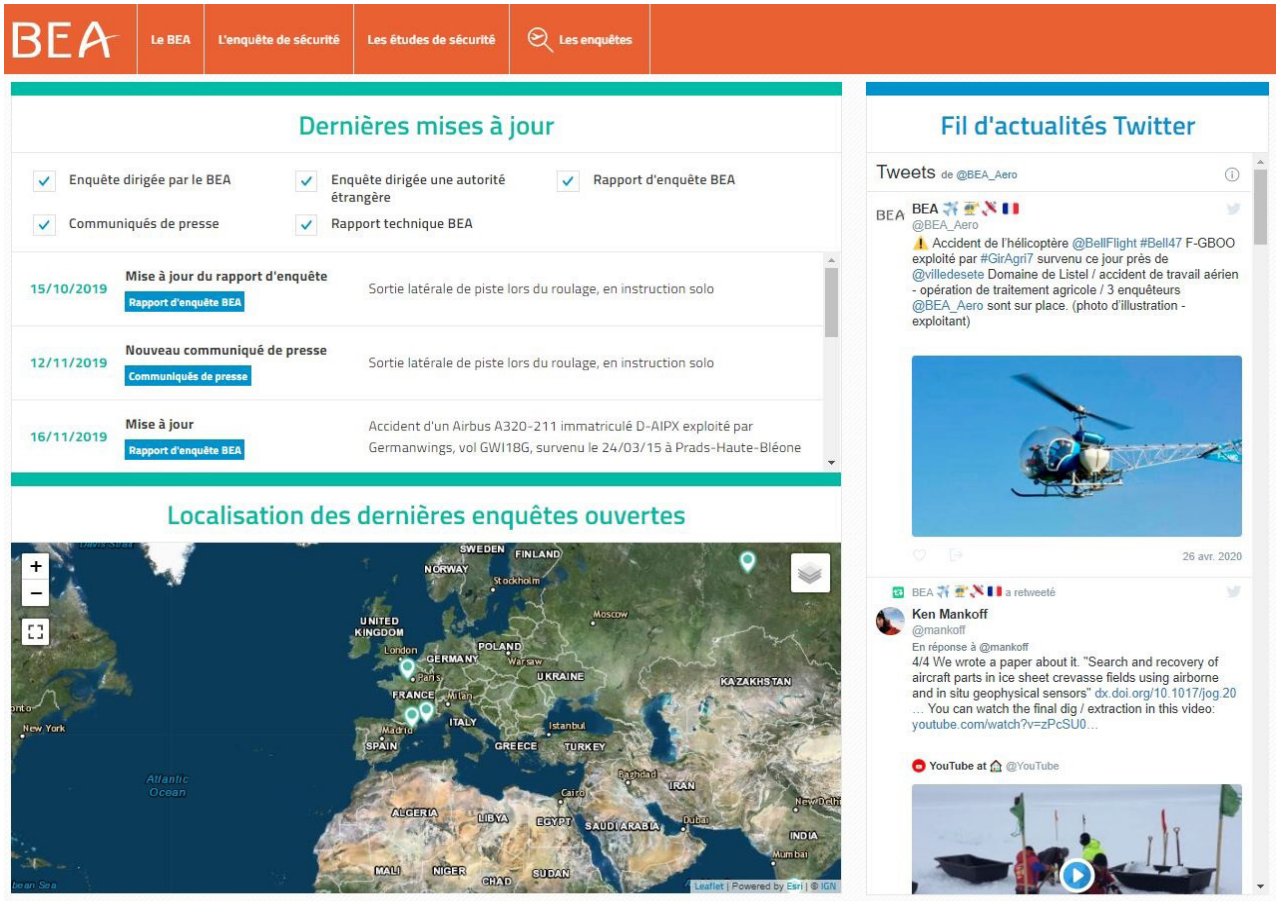
For some safety investigations, if the BEA holds accredited representative status, it will coordinate with the authority responsible for the investigation for communication purposes.

2019 offered the opportunity to use Twitter in the scope of a commercial air transport accident with strong media attention, for the first time. As previously indicated, the BEA was responsible, at the request of the Ethiopian authorities, for repairing and downloading data from the FDR and the CVR of the Boeing 737 Max operated by Ethiopian Airlines and involved in the accident of 10 March 2019: the BEA used Twitter to provide information on the progress of the technical operations in its laboratory on behalf of the Ethiopian authorities. This approach meant that it could be proactive in replying to media requests around the world.

Besides the use of Twitter, the BEA published its first video module dedicated to its experts, on its YouTube channel. This video focuses on wreckage specialists and describes how operations are organised in the field and on site as part of an investigation, in an accessible and educational manner. Other modules, which are expected to ultimately cover all of the stages of a safety investigation, are currently in the planning phase.

Since 2019, all of the BEA's digital channels (Twitter, YouTube, Linkedin) can be accessed from its website at all times.

Finally, the BEA is currently developing version 4 of its bea.aero website, which should propose simplified access to content and investigations reports sometime in 2020, as well as hosting the Twitter thread on the home page.



Planned new homepage www.bea.aero (2020)

7. HUMAN RESOURCES & FINANCES

Accident to the Pro Mecc Sparviero 100R identified 57AYE, on 07 October 2019 at Jumeauville (Yvelines)
Investigation in progress

7.1. PERSONNEL

7.1.1. STAFF ON 31 DECEMBER 2019

As of 31 December 2019, the BEA had 96 members of staff divided as follows:

BEA staff	Civil servants	Contractual employees	Workers	Total
Flight crew	-	2	-	**2**
Engineers	42	8	-	**50**
Senior technicians	15	-	-	**15**
Technicians	-	1	9	**10**
Administrative staff	14	4	1	**19**
Total staff	**71**	**15**	**10**	**96**

Note: 2 apprentices and 151 field investigators must be added to the above staff figures. Fields investigators are trained by the BEA, and take action at its request, subject to its control and authority, generally as part of general aviation investigations. Most field investigators hold positions in DGAC departments, or to be more precise DSAC Inter Regional departments. They are covered by a service contract concluded between the BEA and these departments.

7.1.2. PERSONNEL TRAINING

The BEA spends a significant part of its budget on professional training in order to guarantee a high level of skills for its personnel in various areas, vital for its activity.

In 2019, the budget devoted to professional training was €157,828. This represents 6.2% of the annual operating budget and close to 5.5% of the overall annual budget. The reduction in training expenses is significant compared with the previous year (the budget was approximately €216,000 in 2018) and is due, notably, to the financing of search operations in Greenland to find parts of the engine on the Airbus A380 operated by Air France, registered F-HPJE, on flight AF 066 Paris-Los Angeles on 30 September 2017.

This budget did, however, finance 428 training actions for 89 staff members. These training actions represented a total of 949 days, which gives an average of 10.66 days of training per staff member.

On a basis of 208 working days each year, the training courses represent 4.56 person-years and were in the following areas: language training (mainly English), technical training courses with specialised organisations related to investigations, manufacturers' training courses and flight training.

The initiative launched in 2016 to enable staff who are type rated on passenger planes to periodically undertake commercial air transport flights as a First Officer was continued in 2019. Three agreements were in force between the BEA and airline companies. Three investigators continued to acquire major experience in flying commercial air transport flights, which is necessary for carrying out some complex investigations in this specific area.

7.2. BUDGET

7.2.1. ALLOCATIONS

The BEA budget was set in the initial finance law at €2.85 million in commitment authorisations (CA) and payment appropriations (PA).

This budget received an allocation representing a total of €17,369 in CA and PA. This allocation was from the sale of vehicles and various moveable assets, and an additional allocation of €50,000 in CA and PA.

The total consumption of the BEA was €2.91 million in CA and €2.88 million in PA.

7.2.2. EXPENDITURE FOR THE PERIOD

Services	Operation		Investment	
	CA (€)	PA (€)	CA (€)	PA (€)
Logistics	684,283	753,742	320,301	323,973
Travel	630,373	630,373		
Communication	61,155	33,289		
Training	157,828	147,383		
Engineering	694,207	728,877	69,720	12,251
Information Technology	272,320	234,471		
Investigation support	16,599	11,622		
Total (€)	**2,516,765**	**2,539,757**	**390,021**	**336,224**

8. FOCUS

Tomographic x-ray tube in the BEA's engineering laboratory

8.1 CERTIFICATION AND CONTINUING AIRWORTHINESS PROBLEMS

Two of the category 1 investigation reports published in 2019 cover topics relating to certification and continuing airworthiness.

Incident to the ATR 72-212A registered 9Y-TTC operated by Caribbean Airlines on 4 May 2014

At the start of the descent to Piarco airport (Trinidad & Tobago), strong vibrations were felt and a Propeller Electronic Control (PEC) warning concerning the right propeller was activated.

A total of seven occurrences associated with strong vibrations were recorded on this type of aircraft between 2007 and 2014. In most cases, the failure of a trunnion pin of one of the blades and damage to the propeller blade actuator forward plate were observed.

The investigation could not fully explain the process behind the observed damage. However, during in-flight testing after this incident, different factors likely to contribute to such damage were identified. In particular, significant loads caused by the trunnion pin striking the ear of the plate on forward plate cyclic loading were detected. These phenomena occur when the aeroplane's speed is close to the maximum operating speed (VMO) with the power levers set to flight idle.

The certification methods and criteria prevailing when the UTAS 568F-1 propellers were certified (1994-1995) did not provide for testing in this specific configuration. In addition, up to 2014, when initial in-flight testing was carried out after the incidents, the holder of the propeller type certificate and the main certification authority did not identify the need to carry out tests again. However, since being put into service, over a hundred or more technical modifications had been made. All of these modifications had been validated by a theoretical analysis of the impact on the behaviour of the propeller.

Four safety recommendations were sent to EASA during this investigation. These recommendations concern:

- ◊ Continuing the analysis of the cyclic load phenomenon revealed at flight idle and at a speed slightly above VMO.
- ◊ Continuing research in order to understand the sequence of damage and pending the outcome of this research, introducing flight operation restrictions for the aeroplanes concerned.
- ◊ Installing vibration level indicators for each propeller-engine assembly in cockpits.
- ◊ Modifying certification criteria, to include a study of the actual vibration behaviour of each propeller in flight idle with speeds around VMO.

On the date of writing of this report, EASA was considering what follow-up to take based on these safety recommendations.

Serious incident to the Airbus A340-313E registered F-GLZU operated by Air France on 11 March 2017

When taking off on runway 13R at Bogota airport, the captain who was pilot flying (PF) started the rotation when the CAS reached the rotation speed (VR). The aeroplane was 2,760 m from the threshold of runway 13R. The rate of rotation of the plane was low. The three crew members indicated that they heard the "PITCH PITCH" audio warning. The main landing gear left the ground when the aircraft was 140 m from the opposite runway threshold.

The aircraft passed the opposite runway threshold at a height of 6 ft, according to the Radio Altimeter (RA). The plane passed the end of the clearway (CWY) at a height of 20 ft RA. Its speed was V2 + 9 kt. The plane cleared the ILS antennae (the first obstacle on the flight path) by 12 ft.

According to the investigation, the serious incident was caused by the insufficient nose-up inputs made by the PF, which extended the take-off distance by 424 m compared with the certified theoretical take-off distance plus regulatory safety margins in the operating conditions that day. This significantly increased the risk of a runway overrun or a collision with obstacles.

In the conditions of the serious incident, the initial nose-up input then held at the typical value recommended by the FCTM (2/3 of the backward deflection) was not sufficient to reach the rotation rate of 3°/s which is the rotation rate retained in the certified performance model, also mentioned in the FCTM.

The investigation revealed a significant and systematic difference between the take-off performances reached during A340-300 operations by Air France and Lufthansa, and certified performances. Prior to this occurrence, Airbus A340-300 operators had not identified the difference between the rate of rotation obtained in operations and that considered in the performance calculations due to the lack of crew reports and take-off performance monitoring during flight analyses.

During the investigation, the operators, Air France and Lufthansa, the manufacturer, Airbus and the certification authority, EASA, adopted safety measures and notified these measures to the BEA.

On the basis of the safety investigation, and taking into consideration the safety measures taken in the meantime, the BEA sent seven safety recommendations to EASA. Five of these recommendations concerned certification and continuing airworthiness. They relate to:

- ◊ Re-examining the validity of the initial certification hypotheses of the A340-300 take-off performance.
- ◊ Taking the necessary measures to re-establish consistency between the take-off performance in operations and that established during certification on the Airbus A340-300.
- ◊ Examining whether other CS-25 type aircraft are affected by this type of difference in performance and taking the corrective measures that may be necessary.
- ◊ Taking into account the indicators required to monitor take-off performance and, at least, long take-offs, in flight analysis programmes.
- ◊ Collecting and analysing the results of this monitoring to establish a report on the actual situation in operation.

8.2 AIR TRAFFIC CONTROL ASSISTANCE FOR VFR PILOTS IN DIFFICULTY

On 18 April 2019, the pilot of the TB20 registered F-GDNF took off under a VFR flight plan from Fort-de-France to Pointe-à-Pitre, on a professional flight. When level with Dominica, at an altitude of 4,500 ft and in contact with the Guadeloupe air traffic control unit, the pilot encountered adverse meteorological conditions consisting of convective clouds with a base at approximately 600 m and rain showers in which the ceiling may have descended to 400 m. While the pilot changed the direction of the flight path to head inland over Dominica, where the highest terrain reaches 1,447 m, he requested clearance to descend to 3,500 ft and then lower due to cloud cover. The controller cleared the descent and asked the pilot to call back if he needed to contact the control unit for the Douglas airport in Dominica. The controller lost radio and radar contact six minutes later. The plane collided with the terrain at an altitude of approximately 900 m. The investigation was delegated to the BEA by the Dominican authorities and is in progress on the date of writing of this document.

The loss of external visual references during VFR flights has led to many accidents which the BEA has regularly investigated by attempting to determine why or what pressure pushes a pilot to start or continue a flight despite an apparently dangerous situation. Once again, in 2019, the BEA published reports which recall the impact of the factor frequently referred to as "get-home-itis", such as the fatal accidents involving the Beechcraft 95B55 registered N155PR on 17 February 2018[6] and the Aquila AT01 registered D-ERLM on 8 May 2018[7]. These reports reiterate once again the importance of ensuring and maintaining pilot awareness.

In parallel, just like the accident in Dominica, the BEA has recorded several occurrences during which the pilots were in contact with an ATC unit. The reports on two of these accidents were published in 2019. In addition to the «get-home-itis» factor, the BEA dealt with the relations between VFR pilots facing adverse meteorological conditions and the air traffic controllers in contact with these pilots.

Lessons learnt from the investigation into the accident to the Piper PA28 registered F-HEHM on 1 July 2015 at Treille (Aude)[8].

The report analysed that, in a situation characterized by the pilot's strong desire to reach his planned destination and a high workload, an outside aid can help a pilot relinquish his initial intentions and lead him to anticipate a modification in his flight path or envisage turning around.

[6] https://www.bea.aero/uploads/tx_elydbrapports/BEA2018-084.pdf

[7] https://www.bea.aero/uploads/tx_elydbrapports/BEA2018-0276.en.pdf

[8] https://www.bea.aero/uploads/tx_elydbrapports/BEA2015-0345.en_.pdf

The report also highlighted the fact that two other VFR pilots had turned around slightly before the accident, in the same region, due to the adverse conditions on the same flight path. This information was notified to the controller on duty, but was not transmitted during the controller handover, and was not transmitted to the pilot of F-HEHM.

The investigation concluded that the controller had probably stayed in a model of supplying information on pilot request. This might be explained by the control service not having assimilated the regulatory change specifying that the supplying of information necessary for VFR safety is no longer subject to pilot request.

Four safety recommendations were therefore issued as part of this investigation. Two were sent to the DSNA. These recommendations relate to:

- ◊ Control centres effectively taking into account and transmitting to other aircraft concerned and to other ATS units concerned, the non-routine observations received from pilots and in particular, from VFR pilots who encounter weather conditions making it impossible to continue their flight on the planned route.
- ◊ The transmission during controller handovers, of pilot reports or meteorological conditions likely to affect the continuation of a VFR flight.

The other two recommendations were sent to the DGAC and relate to:

- ◊ The effective provision of the flight information service by the control units when the weather conditions make operation under the visual flight rules impracticable.
- ◊ A raising awareness campaign directed at general aviation pilots in order to encourage the transmission of non-routine air reports when the meteorological conditions or any other event make it impossible to continue their flight on the planned route under visual flight rules.

Lessons learnt from the investigation into the accident to the Extra 300-200 registered F-GPIT on 25 February 2016 at Saint-Héand (Loire)[(9)].

According to the report, when the pilot of F-GPIT lost visual references, due to cloud, with the aeroplane with which he was carrying out a ferry flight in formation, the pilot found himself isolated without navigation equipment in his aeroplane which was basically equipped. In this critical situation, the pilot was no longer able to manage the flight alone, without external assistance.

According to the investigation, air traffic control was slow to realise that there was an emergency situation although the F-GPIT pilot had been manoeuvring for around 30 minutes in adverse or incompatible conditions for a VFR flight.

(9) https://www.bea.aero/uploads/tx_elydbrapports/BEA2016-0106.en.pdf

The following factors may have contributed to the ATC's slow awareness of F-GPIT's situation:

- The pilot not declaring an emergency.
- The pilot's evasive messages regarding the description of the weather conditions encountered in flight.
- There being no section devoted to detecting a VFR flight in difficulty due to weather conditions in the training covering a VFR flight that is lost or in difficulty due to weather conditions.
- The excessive credit given to the voice as a criteria for detecting an emergency situation over other criteria.

During this investigation, the BEA looked for comparable occurrences in investigations carried out between 2010 and 2017, i.e. VFR pilots facing a degradation in meteorological conditions while in contact with an ATC unit. Twenty-five occurrences of this type were recorded, of which 21 were fatal. The examination of these occurrences revealed the following details:

- In 23 cases, the pilots did not formally request assistance;
- In 15 cases, the controller in contact with the pilot did not detect the emergency situation. This could be due, in particular, to the fact that little time was available in which to detect the marginal situation, some accidents occuring rapidly after the initial exchanges on the frequency; or few exchanges occurred on the frequency between the pilot and the controller.
- In 19 cases, controllers had signs that could potentially mean that the flight was not going as planned (erratic flight path, requests for meteorological information sometimes repeated, ambiguous or explicit messages by the pilots in relation to their adverse conditions).

Two safety recommendations were issued after this investigation:

- The first was sent to the DSAC and concerned carrying out an awareness-raising action with respect to general aviation pilots about the importance of not waiting to declare an emergency situation to the ATC unit when manoeuvring in marginal conditions, in a just culture context.
- The second recommendation was sent to the DSNA and concerned incorporating in the training covering unusual situations, the aspects permitting the detection of situations where pilots flying under VFR could require assistance. The text of the recommendation suggested that these training courses would particularly include the study of real incidents or accidents.

8.3 RECOVERY OF ENGINE PARTS FROM AN AIRBUS A380 IN GREENLAND

Search for aircraft parts which had fallen onto the Greenland ice sheet

2019 was dominated by the final phase of the search operations in Greenland in order to try and find one or more fragments of the fan hub of engine No 4 installed on the Air France Airbus A380, registered F-HPJE: this engine had suffered an uncontained failure on 30 September 2017 when flight AF066 was en route between Paris and Los Angeles. The aeroplane finally diverted to Goose Bay airport in Canada without any other incident.

An initial report published in May 2019[10], described the first two search phases. Following these campaigns and despite the efforts made, fragments had still not been found.

After months of post-processing the radar data acquired in 2018, ONERA (The French Aerospace Lab) finally identified a high-probability target and two less prominent targets in - or very close to - the initial search area.

After initial campaigns, the GPSs (Ground Penetrating Radars) were judged unreliable for detecting buried titanium parts. Alternative detection systems were studied and a new electromagnetic detection system, SNOWTEM, was developed by the HGG group(11) run by Aarhus university, with the aim to organise a search campaign on the ground in 2019. This detector was tested in Europe and was found promising.

Testing the operation of the electromagnetic system, SnowTEM, on a glacier at Zermatt (Switzerland) in January 2019

[10] https://www.bea.aero/uploads/tx_elyextendttnews/F-HPJE_TECHNICAL_REPORT_05.pdf

[11] HyrdoGeologic Group

Extraction of part of the fan hub found 4 m under the surface of the Greenland ice sheet in June 2019 - Photo by Austin Lines

Encouraged by the prominent targets identified on the ice sheet and the availability of these new detectors, a ground search campaign was launched in May 2019. The effective start of the campaign was substantially delayed due to adverse meteorological conditions. Despite these delays, and the reduced duration of the mission caused by the late start, a strong detection result was obtained at the end of the campaign at the most promising location indicated by ONERA. The detection result was located right in the middle of a field of crevasses, one metre from a crevasse, requiring specific equipment to extract the fragment.

An Icelandic glacier rescue team was called in to help. This team of specialists in glacial terrains evacuated 40 m3 of snow and ice before confirming that it was indeed part of the fan hub.

The part was carefully extracted and transported to Narsarsuaq airport. The part was handed over to the BEA and examined on the premises of the engine manufacturer, Engine Alliance, in order to determine the cause of the damage.

A second report on the search process will be published. This report will describe the details of the operations completed during phase III and the extraction and will focus on all lessons learnt during these unprecedented search campaigns.

8.4. GROUND SEARCHES FOR PARTS OF THE AIRBUS A220 ENGINE

On 25 July 2019, the left engine of the Airbus A220 operated by Swiss, suffered a failure (this engine was manufactured by the American firm, Pratt & Whitney). After taking off from Geneva airport, as the plane was reaching its cruise altitude, the first low pressure compressor stage of the engine failed, and several internal components were ejected. Considering that it was important to find the fragments lost in flight in order to determine the causes of the occurrence, the BEA and its American counterpart, the NTSB, which was mandated with the investigation, ran ballistic calculations to determine a search zone. A call for witnesses made mid-August 2019 via social media had not resulted in any parts being found. At the request of the NTSB, the BEA organised searches on the ground in a mainly forest area covering approximately 470 ha. Around 150 individuals responded to a call for volunteers in order to contribute to the search. The search was organised in partnership with the IGN (French forestry and cartography institute), who provided the help of forestry inventory field staff. The search ultimately included approximately:

- 85 members of IGN staff, 40 members of BEA staff and 70 volunteers, on 6 November ;
- 10 members of BEA staff and 15 volunteers, on 7 November;
- 20 members of BEA staff and 20 volunteers, on 8 November.

During these three days, 260 ha were covered despite adverse meteorological conditions. Although three pieces of engine debris were picked up in the area, the main part being looked for was not found. This operation was a first in France as part of a safety investigation. The local authorities were a great help on site. This operation also provided the BEA with an opportunity to observe how its staff work well together, regardless of their positions.

There were two similar occurrences in September and October. The damaged compressor stage was found in the engine nacelle for the occurrence in September. The NTSB and Pratt & Whitney were able to start examinations in order to understand why the component failed. The American and Canadian authorities issued Airworthiness Directives to avoid a similar occurrence in the future.

Ground searches on 6 - 8 November 2019 in the municipalities of Perrigny-sur-Armançon & Rougemont

8.5 INTRODUCTORY HELIHOISTING SESSIONS WITH THE GENDARMERIE NATIONALE SERVICES

Risk management when working at the site of an accident is mainly based on preliminary preparations before heading out on the mission and feedback.

As part of general preparations, BEA investigators are trained in house in the hazards they could face in the field and methods to identify and protect themselves from the associated risks.

A new training course was added to existing modules this year. Around thirty investigators benefited from the expertise of the mountain gendarmes (PGHM) and the French military air force (FAG) in order to ensure their awareness of helihoisting techniques. This module involved becoming familiar with the equipment (harness, winch, helicopter), procedures and the associated safety measures.

This training course is part of a cooperation programme between the Gendarmerie Nationale and the BEA and aims to ensure that BEA investigators travel to accident sites which are difficult to access in a more effective and safer manner.

In this same context, the BEA, accompanied by the air transport investigation section (SRTA), was invited to participate in a half day of exchanges in November at Chamonix, during the annual seminar on PGHM feedback. The agenda included risk management methods, respective missions and finally, feedback on joint missions over the past five years. Debates proved informative and worthwhile for all.

8.6 BEA STAFF TRAVEL

The travel budget represents approximately 25% of the total operating budget of the BEA each year. This budget represented €630,373 in 2019 (of which €625,868 for missions and €4,505 in miscellaneous costs).

A significant amount of this budget concerns travel in the scope of investigations, both for go-teams and for the examinations required throughout the investigations.

The missions are organised and monitored by the BEA travel team. This team must not only prepare the trips, but also manage the many ups and downs of the missions, particularly as part of a go-team: for example, at departure, it is very difficult to forecast the duration of the mission and any modifications to the route, as well as to manage bookings in countries where the hotel infrastructure does not always meet international standards.

In 2019, the travel assistants issued 1,333 mission orders (vs. 1,278 in 2018) and 4,473 expense statements (vs. 4,773 in 2018).

The following table shows the cost of missions per type of trip, in €.

Cost by type of mission	Mainland France		French overseas regions		Europe		Rest of the world	
	2018	**2019**	*2018*	**2019**	*2018*	**2019**	*2018*	**2019**
Go-teams	*23,686*	19,474	*26,267*	36,057	*2,513*	11,921	*71,696*	64,913
Investigation examinations	*83,589*	74,930	*13,949*	-	*74,441*	46,401	*151,596*	76,674
Training and examinations	*71,342*	112,127	-	15,873	*18,959*	12,570	*11,748*	8,706
Seminars and international conferences	*5,045*	3,805	-	-	*31,132*	26,837	*63,459*	36,693
Various meetings	*40,474*	38,891	-	-	*581*	5,143	-	4,622
Flight training	*17,924*	11,092	-	-	*2,786*	949	*8,288*	-
Other	*14,317*	18,048	-	-	-	143	-	-
Total by type of mission	***256,377***	**278,367**	***40,216***	**51,930**	***130,414***	**103,964**	***306,787***	**191 607**

Cardboard model of the Le Bourget head office created in 2019 by Upuaza Tōryō, a Japanese aviation fan, who kindly gifted his artwork to the BEA.
This model is currently on display on our premises.

BEA

French Civil Aviation Safety
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