BEA

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

ANNUAL REPORT

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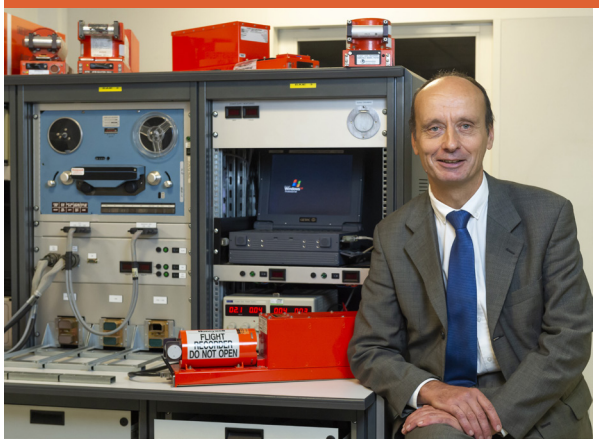
A message from the Director



2017 was identified by analysts as being the safest year ever in terms of air transport safety. We of course hoped that 2018 would be even better, but unfortunately this was not the case. Even so, the statistics that several international bodies are preparing for publication are not disappointing as they are going to show that 2018 was, nevertheless, the third best year in history, thus confirming the very high safety level in the commercial air transport sector. There were three major accidents involving twin-engine jet aircraft and three involving twin-turboprops, and slightly more than 500 victims.

While the BEA was involved in several investigations carried out by foreign authorities as accredited representative, in accordance with the provisions of Annex 13 to the Convention on International Civil Aviation, there was no fatal accident in commercial air transport in France.

I am often asked about the BEA's activity in the absence of major accidents. The answer to this question is simple: safety is not solely improved by investigations into large-scale events, but also by investigations into events which have very little media coverage. In this respect, a large part of the BEA's resources were used in 2018 to search for engine parts from the Airbus A380 on flight AF66 between Paris and Los Angeles on 30 September 2017, following the separation of the engine No 4 fan from the aeroplane over Greenland: in the end, the aeroplane was able to divert without any other incident to Goose Bay airport in Canada. The safety investigation into this event quickly revealed the necessity of recovering the key parts in order to clarify the failure mechanisms. The search for these parts, in a particularly hostile environment (at an altitude of around 1800 metres on the Greenland ice cap and around 100 kilometres from the coast) quickly posed numerous technical and financial problems: the search is still in progress and a major new phase will be initiated in the spring of 2019. The BEA cannot guarantee that the operation will be a success but the safety stakes were considered sufficiently great to justify it.

With respect to general aviation safety in France, the statistics are, unfortunately, not so good. While the figures are relatively stable for the ULM activity, there was a significant increase in the number of fatal accidents and victims for the aeroplane activity, with a return to figures which had not been seen since 2012. It is of course too early to analyse whether this increase is from systemic causes or whether it just corresponds to a statistical fluctuation. For my part, I will maintain the general aviation investigation policy introduced a few years ago which aims to use BEA resources for investigations into the most serious events (fatal accidents to certified or non-certified aircraft) and to limit them with respect to events the least rich in safety lessons. This policy has a tendency to slightly increase the BEA's workload and the number of investigations opened quite notably increased in 2018. This increase can, in part, explain a certain erosion in the BEA's performance (greater number of investigations in progress, longer average investigation time). I remain vigilant with respect to changes in the result of performance indicators and I will ensure that any possible fall is remediated. However, I will also be attentive to ensuring a high quality level in the investigations produced and I consider, from this point of view, that the BEA can be just as proud of their results in 2018 as in previous years.

I will not finish this message without mentioning the growth of the BEA's international activity: it is first and foremost the result of the BEA's solid reputation which it has built on the international level, in line with the developments of the French and European aviation industry. The number of requests from foreign safety investigation authorities has accelerated in a spectacular way the last few years. It became necessary to define priorities: the BEA's industrial partners were consulted in order to adjust our level of involvement according to criteria related to the potential for safety lessons of the notified events. This action which optimizes the BEA's international presence under the constraint of unchanged human and budget resources is an important aspect of the 2018-2022 strategic plan which was presented in last year's annual report.

The BEA largely relies on the expertise, the strong motivation and commitment of those who work for it: the technical staff, investigators, field investigators and administrative staff - let me take this opportunity to thank them for their significant contribution to aviation safety!

Rémi Jouty, BEA Director

1 - Overview of accidents, investigations initiated in 2018, by the BEA

1.1. General context

In accordance with regulation (EU) No 996/2010, any civil aviation accident or serious incident is the subject of a safety investigation in the Member State of Occurrence. This requirement applies to all aircraft, except those listed in Annex I of regulation (EU) No 1139/2018 (the aircraft listed in this Annex are mainly non-certificated aircraft: microlights, aeroplanes of historic interest, etc.). The regulation also provides that States may investigate other events, including incidents that do not fit into the category of serious incidents.

> Annex 13 to the Convention on International Civil Aviation, also 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, provide 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 to aircraft listed in Annex I of regulation (EU) No 1139/2018.

1.2. Data for accidents and investigations involving the BEA

The data presented below concerns accidents that occurred in France, investigations opened by the BEA in 2018, investigations opened by foreign investigation bodies in 2018 in which the BEA is participating - or participated - by nominating an ACCREP, and the BEA teams sent to accident sites (Go teams).

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.

Accidents in France in 2018				
	Number of accidents		Number of injuries	
	Total	Of which fatal	Fatal	Serious
COMMERCIAL AIR TRANSPORT				
Aeroplanes	1(*)	0	0	0
Balloons	2	0	0	2
Commercial Air Transport Total	**3**	**0**	**0**	**2**
AERIAL WORK				
Aeroplanes	4	1	1	3
Helicopters	2	0	0	1
Microlights	1	1	1	0
Aerial Work Total	**7**	**2**	**2**	**4**
GENERAL AVIATION				
Aeroplanes	111(*)	15	31	10
Helicopters	10	5	8	2
Gliders (including motorised gliders)	19(*)	4	5	6
Microlights (including gyroplanes)	126(*)	21	28	32
General aviation Total	**266**	**45**	**72**	**50**
CIVIL AIRCRAFT ON STATE MISSION				
Helicopter	1	0	0	0
Civil aircraft on state mission total	**1**	**0**	**0**	**0**
OTHERS				
Aeroplanes	2	0	0	0
Microlights	1(*)	0	0	0
Others total	**3**	**0**	**0**	**0**
TOTAL	**280**	**47**	**74**	**56**

(*) *It should be noted that the number of accidents reported may differ from the number of damaged aircraft because the same accident may involve several aircraft. Thus, the number of damaged aircraft is the following:*

- ◊ *2 commercial air transport aeroplanes,*
- ◊ *113 general aviation aeroplanes,*
- ◊ *20 gliders (including motorised gliders),*
- ◊ *127 general aviation microlights,*
- ◊ *2 unspecified operation microlights.*

The only commercial air transport accident to an aeroplane, mentioned in this table, is a ground collision at Paris Charles-de-Gaulle between two Airbus A330 (one was taxiing on a taxiway and the other was stopped at a taxiway to the runway). This accident only had material consequences. Furthermore, the two accidents involving balloons occurred during revenue sightseeing flights: in both cases, a passenger was injured during the landing.

The two fatal aerial work accidents correspond to the loss of control of a microlight while towing a glider and the death of a parachutist wearing a wingsuit following his collision in flight with the drop plane.

The accidentology specific to general aviation is detailed in part 3.

1.2.2 Investigations opened by the BEA

Investigations opened by the BEA in 2018						
Type of event	**Commercial air transport**	**General aviation**	**Aerial work**	**Other or State flights**	**Total**	***(Total in 2017)***
Accidents	3	126	9	1	**139**	*(109)*
Serious incidents	1	4	0	0	**5**	*(10)*
Incidents	2	2	1	0	**5**	*(3)*
TOTAL	**6**	**132**	**10**	**1**	**149**	*(122)*
(Total in 2017)	*(12)*	*(104)*	*(6)*		*(122)*	

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

The number of investigations opened by the BEA increased by more than 20% in 2018. This rise is linked, notably, to the significant increase in the number of accidents to general aviation aircraft (cf. chapter 3).

With respect to commercial air transport, besides the investigations opened into the three accidents mentioned in paragraph 1.2.1, three other investigations were opened into incidents, one of which classed as a serious incident (according to the ICAO definition), namely, the loss of a main landing gear door from an ATR42-500 during the descent to Aurillac.

Furthermore, two investigations were delegated to France by foreign authorities, one of these being a fatal accident in Mauritania to an aeroplane operated by a French company, during an aerial spraying flight.

1.2.3. Investigations opened by a foreign investigation body for which the BEA nominated an accredited representative (ACCREP)

Foreign investigations opened in 2018 for which the BEA nominated an ACCREP							
Type of event	**Commercial air transport**	**General aviation**	**Aerial work**	**State aircraft**	**Other (not specified by State of occurrence)**	**Total**	***(Total in 2017)***
Accidents	37	52	16	2	19	**126**	*(114)*
Serious incidents	151	4	2	0	9	**166**	*(144)*
Incidents	25	2	1	0	0	**28**	*(21)*
TOTAL	**213**	**58**	**19**	**2**	**28**	**320**	*(279)*
(Total in 2017)	*(176)*	*(59)*	*(22)*	*(6)*	*(16)*	*(279)*	

The number of investigations for which the BEA was called upon as ACCREP has again sharply increased in 2018 (+15%). This increase is linked, notably, to the increasing number of events classed as "serious incidents" by the BEA's foreign counterparts. However, it is important to note that the criteria used for this classification by the various investigation bodies is heterogeneous and that consequently, the importance of the various investigations can be very variable.

To address this growth, in 2018, the BEA, which has relatively stable human and budget resources, coordinated with its main industrial partners in order to target and better adjust its level of involvement in foreign investigations.

1.2.4. Go Teams

In the case of a particularly serious accident (in France or abroad), the BEA immediately sends a team of investigators to the site. The size and composition of this Go Team are defined on a case-by-case basis.

In 2018, 68 Go Teams were dispatched, of which six abroad. This represents a significant increase on last year (in which 43 Go Teams were mobilized) and can be directly correlated with the accidentology in general aviation in France and notably, the increase in number of fatal accidents.

Go Teams abroad

The six Go Teams sent abroad concerned the following events:

- ◊ collision of an ATR 72-200 with high ground, during the approach near Yasouj (Iran) on 12 February, leading to the death of the 66 occupants;
- ◊ uncontained failure of a CFM 56 engine on a Boeing B737-700 in flight between New York and Dallas (USA) on 17 April, leading to the death of a passenger following the decompression of the cabin caused by debris striking a window;
- ◊ collision with the surface of the water by an Airbus AS365 N3 helicopter in India, on 13 January, leading to the death of the seven occupants;
- ◊ collision with the ground by an Airbus EC-120B helicopter, at Romana (Dominican Republic), on 22 November, leading to the death of five people;
- ◊ hard landing of an Airbus A320 following a malfunction of the flight controls during a training flight at Tallin (Estonia) on 28 February;
- ◊ rupture of the windscreen of an Airbus A319 en route, in China, on 14 May.

Go Teams on national territory

Amongst the 62 Go Teams sent out on the national territory, there were those concerning the following events:

- ◊ collision with vegetation of the BELL - AB206 – B helicopter registered F-HGJL close to Cacao (Guyana), on 2 May;
- ◊ controlled-flight-into-terrain of a Baron BEECH - 55 aeroplane at Saint-Laurent-La-Roche (Jura), on 17 February;
- ◊ loss of control shortly after take-off of a ROTORWAY - EXEC (162 HDF/A600) helicopter at Saint Pierre et Miquelon, on 5 November;
- ◊ runway overrun during the landing roll of a CESSNA Citation - 525 aeroplane at La Môle Saint Tropez airport, on 6 June.

2. Investigations closed, reports published in 2018

2.1 Investigations closed and investigation reports published

Over and above the number of accidents and investigations opened, the number of investigations closed and reports published are the most relevant indicators of the BEA's activity.

Regulation (EU) No 996/2010 specifies that each Safety Investigation must be concluded with a report in a format that is adapted to the type of event. The closing of an investigation is thus marked at the BEA by a report that can take two forms:

- **ICAO reports**: these reports follow a systematic format, defined by Annex 13 to the Convention on International Civil Aviation. They are generally reserved for the most important events. In 2018, the BEA published 4 reports of this type (see table).
- **Simplified reports**: these reports contain only the relevant elements specified in Annex 13. They are specifically for events such as commercial air transport incidents or general aviation accidents. In 2018, the BEA published 4 simplified reports relating to commercial air transport, and 99 simplified reports relating to general aviation or aerial work.

Events that led to publication of an ICAO report in 2018

Registration	Type of aircraft	Place	Date of event	Type of event	Number of recommendations
TC - OBZ	AIRBUS – A321	Deauville airport	26 September 2013	Near-collision with ground in last turn during a visual manoeuvre	1
F-HCCG	SCHROEDER FIRE BALLOONS G (G50/24)	Cazes-Mondenard	5 October 2014	Turbulence en route, hard landing, basket upset, fire	7
F-GRHX & F-ZWBS	AIRBUS - A319 & AEROSPATIALE - AS532 (ALe)	Marseille Provence airport	27 June 2016	Dangerous loss of separation between two aircraft in approach	5
F-GUOC	BOEING - 777	Paris Charles-de-Gaulle Airport	22 May 2015	Calculation of take-off parameters with an erroneous weight, take-off at low speed, opposite threshold flown over at low height.	10

***Note** : all BEA reports are published in French, but some of them are also published in other languages, mainly English. In 2018, the BEA thus translated 13 final reports.*

Regulation (EU) No 996/2010 specifies that an investigation report should be published rapidly and if possible within the twelve months following the date of the event. For the BEA, a maximum length of twelve months for each investigation is thus a general objective and a monitoring indicator. This is defined as the percentage of investigations closed within one year among the investigations opened the previous year. On 31 December 2018, the value of this indicator was 0.372, i.e. 45/121 (cf. paragraph 2.2. below).

The tables below show the number of investigations closed in 2018, by types of event and operation. They also show the year of the events as well as investigations more than one year old that were not closed as of 31 December 2018.

Investigations closed by the BEA in 2018 (by year of occurrence)													
Event year	**Before 2016**			**2016**			**2017**			**2018**			**Total**
	CAT	GA	AW	CAT	GA	AW	CAT	GA	AW	CAT	GA	AW	
Accidents	2	8	1	0	10	0	2	38	5	0	27	1	**94**
Serious incidents	3	1	0	2	1	0	0	3	0	0	1	0	**11**
Incidents	1	0	0	0	0	0	0	0	0	0	1	0	**2**
Total	**6**	**9**	**1**	**2**	**11**	**0**	**2**	**41**	**5**	**0**	**29**	**1**	**107** *

* (92 in 2017)

Investigations undertaken by the BEA and open for more than one year as of 31 December 2018					
	Commercial air transport	**General aviation**	**Aerial work**	**State aircraft**	**Total**
Accidents	8	90	7	1	**106**
Serious incidents	14	14	0	0	**28**
Incidents	9	4	1	0	**14**
Total	**31**	**108**	**8**	**1**	**148** *

* (125 in 2017)

2.2 Comments on the BEA's activity and performance in 2018

In 2018, the BEA was confronted with an increase in the number of fatal accidents in France and a noticeable increase in the number of investigations opened. One of the first consequences of this increase in the number of fatal accidents was the significant increase in the number of Go Teams sent on site. The availability of personnel for on-site actions means that the investigations can be carried out in the best possible conditions and thus ensures their quality; however, this also means, of course, less availability for processing the investigations previously opened.

The BEA can call on Field Investigators who are, in the majority, DSAC personnel assigned to its various sites on the national territory: they are able to rapidly intervene on request by the BEA and under the BEA's authority to carry out certain investigation actions, notably on site. However, the number of Field Investigators has greatly diminished over the last few years.

In other respects, the general aviation investigation policy, implemented in 2015, was designed to simplify the investigations into events the least rich in safety lessons in order to release resources and investigate a greater number of more serious accidents (including non-certified aviation accidents). After a few years of application, we observe that this policy has, ultimately, increased the BEA's workload.

The result of this situation is:

- ◊ an increase in the stock of open investigations (from 125 to 148);
- ◊ a decrease in the percentage of investigations where the report is published less than one year after the occurrence. This indicator, reflecting the BEA's annual performance under the LOLF (programme 614), has thus deteriorated, decreasing from 56% in 2017 to 37% in 2018 and this despite the greater number of reports published (92 in 2017 and 107 in 2018).

The increase, in 2018, in the number of investigations opened by foreign bodies and notified to the BEA is notable: 15% corresponding to 320 occurrences. This number principally reflects the greater commitment of the BEA's international counterparts in the investigation effort into incidents and serious incidents. However, the number of international reports published does not seem to follow this trend.

In light of this, in 2018, in collaboration with French manufacturers and EASA, the BEA introduced procedures designed to reduce France's involvement in certain commercial air transport events of an operational nature and without any consequences. Over a six-month period, nearly 63 occurrences concerning Airbus aircraft were not assigned an ACCREP by the BEA or a technical adviser by the manufacturer or EASA. The BEA made sure for each of these occurrences, that there was no express request from the State in charge of the occurrence and reported this situation on its website. Even when taking into account the impact over a full year of these foreign occurrences without the BEA's participation, the international investigation activity represents the greatest share of its work.

2018 was also marked by the reorganization of the Investigations department in order to better meet the support needs of newly appointed BEA investigators in terms of training and integration.

A greater effort to coordinate with EASA resulted in its needs in investigations being better taken into account and led to wider discussions in the ENCASIA network on the coordination between continuing airworthiness and the safety investigation (cf. paragraph 6.2.2).

Finally, the BEA participated in several airport accident exercises concerning the application of the emergency plans produced by the various French prefectures. This was a considerable investment involving BEA management and various investigators in order to make known the BEA's work and to guarantee in the future, that the application of the emergency plan produced at the French level, is in keeping with Regulation (EU) No 996/2010 concerning safety investigations.

3. General considerations on air safety in France in 2018

3.1. Commercial air transport

2018 was a positive year with respect to safety in commercial air transport in France.

There were no injuries in commercial air transport by aeroplane on the national territory. However, there was an accident involving a French operator abroad where, during take-off, a passenger was struck and injured by a sales trolley which had not been stowed. The most notable event which occurred on national territory was the collision between two Airbus A330 type aeroplanes, while taxiing, at the Paris Charles-de-Gaulle airport. This type of event can generate significant material damage which, for various reasons, may not be immediately detected by crews: in the scope of such investigations, the BEA pays particular attention to the way in which the crews were alerted in order to prevent a possibly unairworthy aeroplane from taking off.

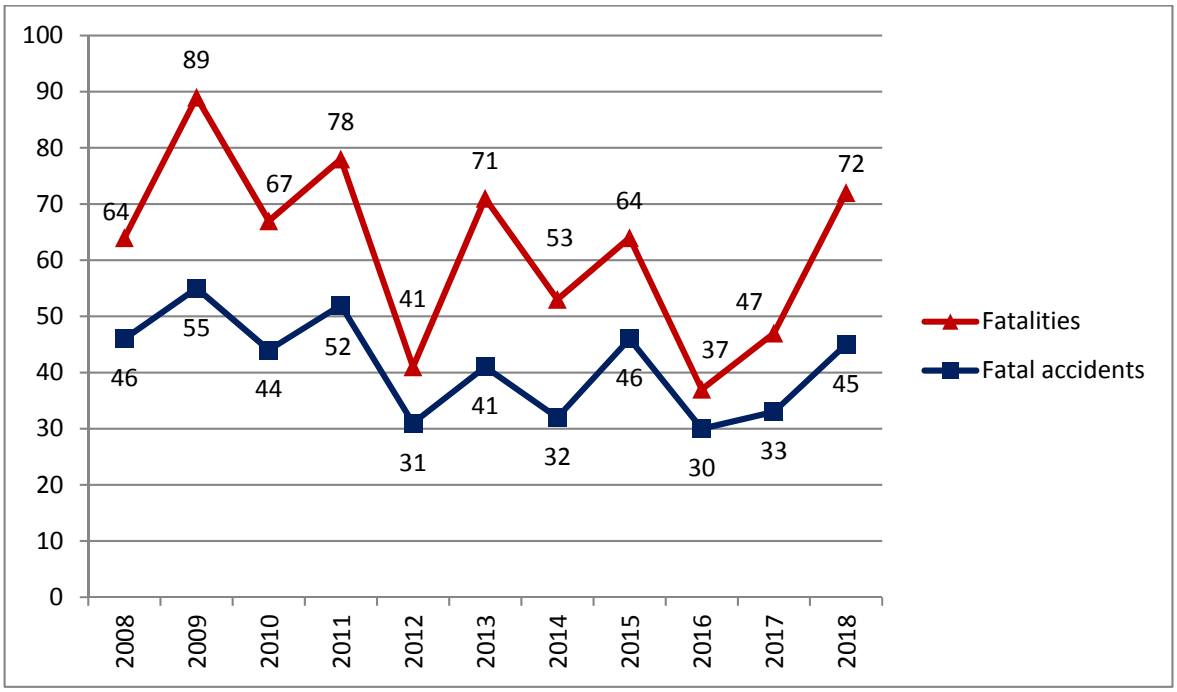
There were two accidents in commercial air transport by balloon which occurred during hard landings and which each caused injuries to a passenger. The BEA has observed that this type of event occurs practically every year: in the past, there have been fatal injuries to passengers either following their ejection from the basket or due to a fire breaking out after the basket had turned over. Among the considerations being studied as part of the investigations in progress, is the search for a satisfactory safety position which can be adopted by each passenger, whatever the configuration of the basket.

3.2. General aviation

3.2.1. General aviation, all activities

Concerning general aviation (all activities together), 2018 saw an increase in the number of fatal accidents with respect to 2017. There were:

- 45 fatal accidents (versus 33 in 2017 and 36 per year on average from 2015-2017);
- 72 fatalities (versus 47 in 2017 and 49 per year on average from 2015-2017).



Evolution between 2008 - 2018 in fatal general aviation accidents (all activities included)

Beyond this general picture, it is interesting to note the significant differences between the different aircraft categories.

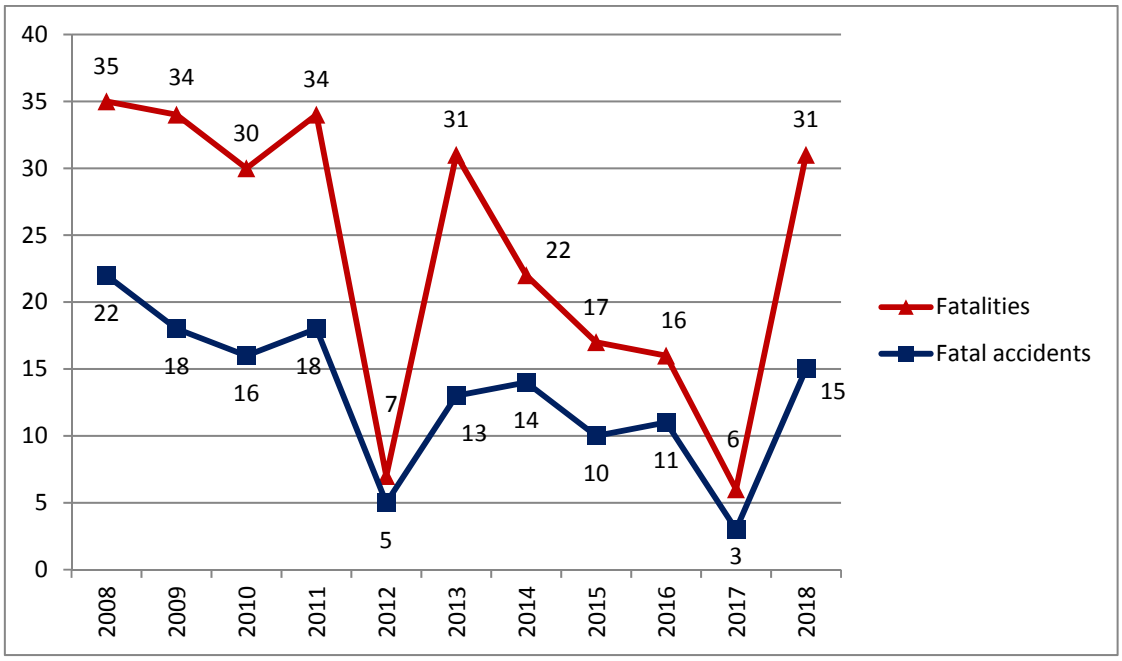
Note : *the reader's attention is drawn to the fact that the figures given below concern the number of accidents and not the accident rate. They should therefore not be interpreted as a comparison of the safety level of aeroplane and microlight activities (any comparison of safety levels should take into account, in particular, fleet size, number of flights or flight hours for each activity).*

3.2.2. General aviation: Aeroplanes

In 2018, the number of fatal accidents involving general aviation aeroplanes was the highest level recorded since 2011. There were:

- ◊ 15 fatal accidents versus 3 in 2017, 11 in 2016 and 10 in 2015 (and 8 per year on average over the 2015 – 2017 period);
- ◊ 31 fatalities, versus 6 in 2017, 16 in 2016 and 17 in 2015 (and 13 per year on average over the 2015 – 2017 period).

Compared with 2017 which confirmed a downward trend for the last ten years, 2018 constitutes a new reference peak.



Evolution between 2008 - 2018 in fatal general aviation accidents (aeroplanes only)

Among the fatal aeroplane accidents which occurred in 2018, two are probably due to loss of control resulting from a reduction in engine power on take-off. One of them occurred at Mureaux during a training flight on a Tecnam P2002. The other took place at Charleville-Mézières during an introductory flight for three passengers onboard a DR400-180.

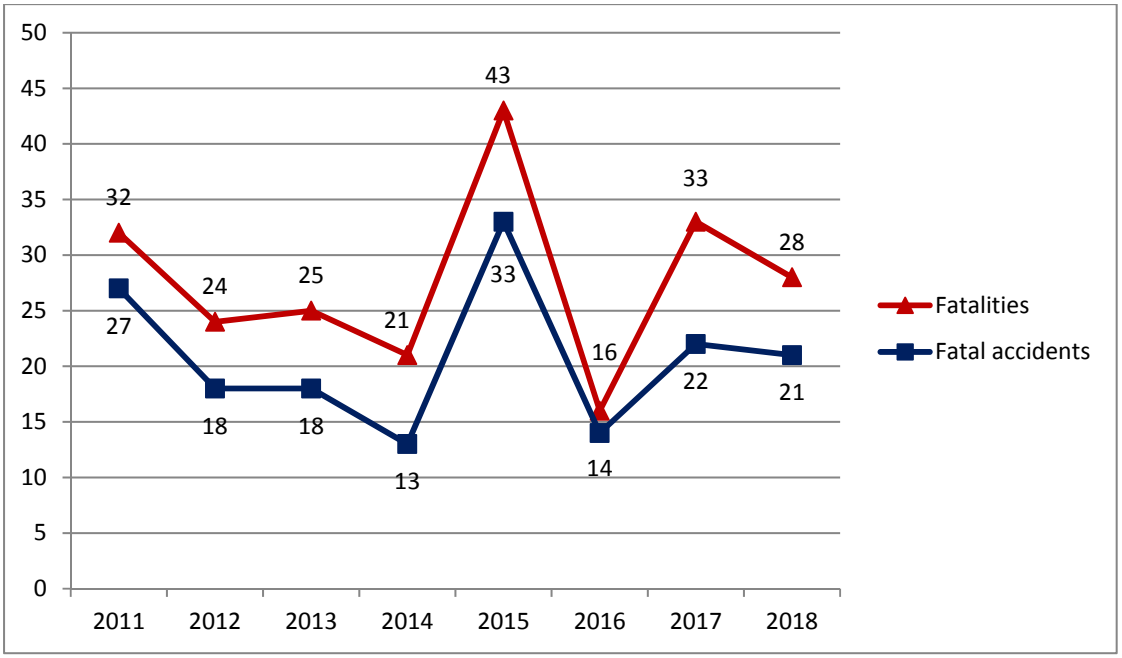
Two other fatal accidents seem to be due to unnecessary pilot manoeuvres in normal flight management. There was the collision of a Yak-18 with the ground during an aerobatic manoeuvre after flying over the runway at a low height and the collision of a TB20 with the surface of the sea when flying at a very low height close to the shore.

Lastly, at least three other fatal accidents seem to be linked to the pilots' determination to get to their destination despite the unfavourable weather conditions for flights under visual flight rules.

3.2.3. General aviation: Microlights

Concerning the microlight activity, after a peak in fatal accidents in 2015 and a good year in 2016, 2018 is an average year, compared with 2017. There were:

- ◊ 21 fatal accidents versus 22 in 2017, 14 in 2016 and 33 in 2015 (and 23 per year on average over the 2015 – 2017 period);
- ◊ 28 fatalities, versus 33 in 2017, 16 in 2016 and 43 in 2015 (and 31 per year on average over the 2015 – 2017 period).



Evolution between 2011 - 2018 in fatal general aviation accidents (microlights only)

At this stage, in many cases, the circumstances of these accidents have not been established.

However, it is already possible to identify risky types of behaviour such as those mentioned for the aeroplane activity. Thus, among the fatal microlight accidents there is the collision with the surface of the water by a paramotor while flying at very low height over a swollen river and the collision between two gyroplanes while flying close together.

Furthermore, several fatal accidents correspond to a loss of control. The circumstances are varied: first flight on type, solo training flight, flight on modified gyroplane, reduction in engine power on take-off, over-piloting the paramotor wing, field take-off with a tail wind, etc.

4. Safety recommendations

4.1. General context

For the International Civil Aviation Organisation (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. They must relate to the measures to be taken to prevent occurrences with similar causes.

Follow up of safety recommendations

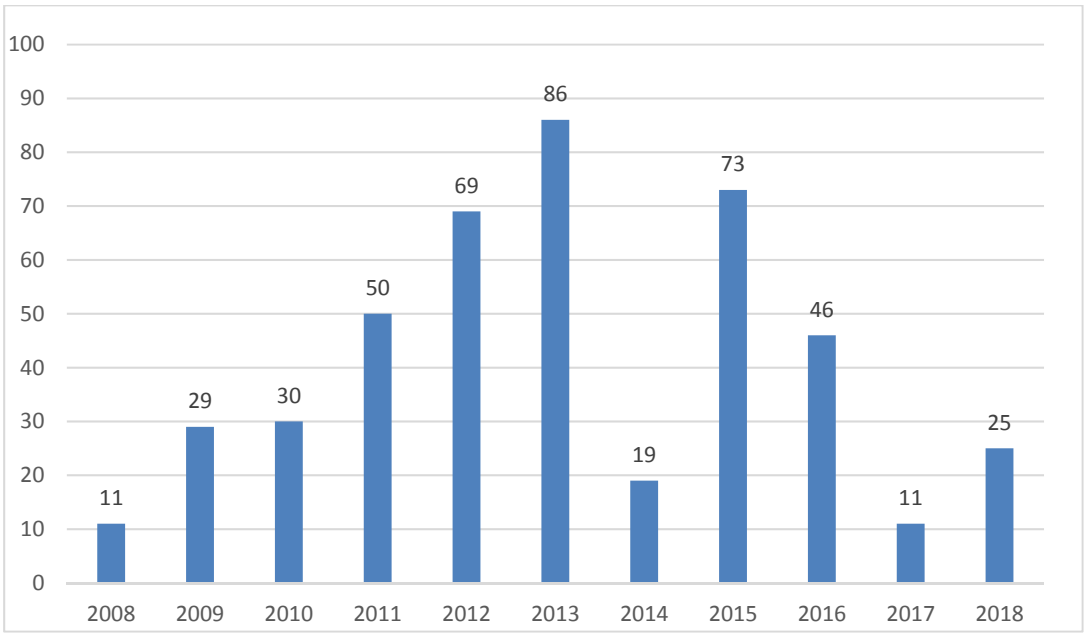
The provisions of Regulation (EU) No 996/2010 of the European Parliament and Council on investigations and the prevention of civil aviation accidents and incidents makes mandatory, for Member States, that recipients of safety recommendations acknowledge receipt and inform the issuing authority, responsible 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 make known to the recipient of the Safety Recommendation if it considers its response as adequate or, if it disagrees with the response, to give the reasons for this.

4.2. Safety recommendations issued

In 2018, the BEA issued 25 recommendations.

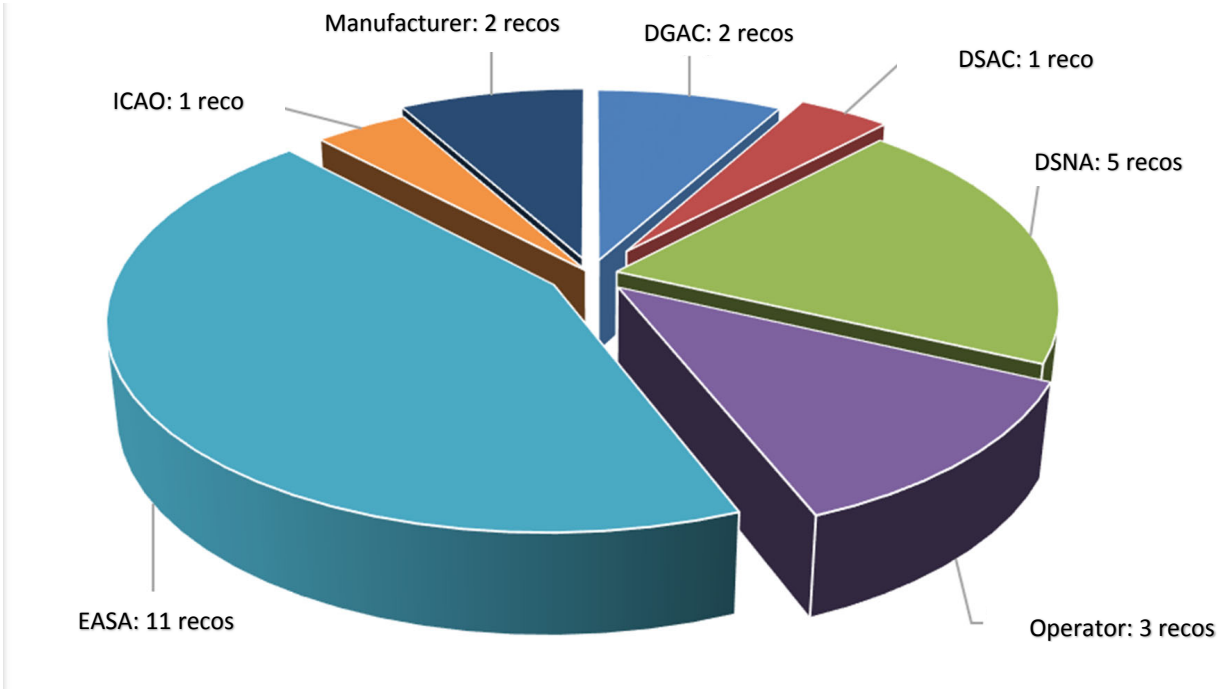


Recommendations issued

Breakdown by addressee

In 2018, EASA, DGAC, DSAC and DSNA were the main addressees of recommendations.

Some recommendations were sent to an aircraft manufacturer, an airline operator and ICAO.



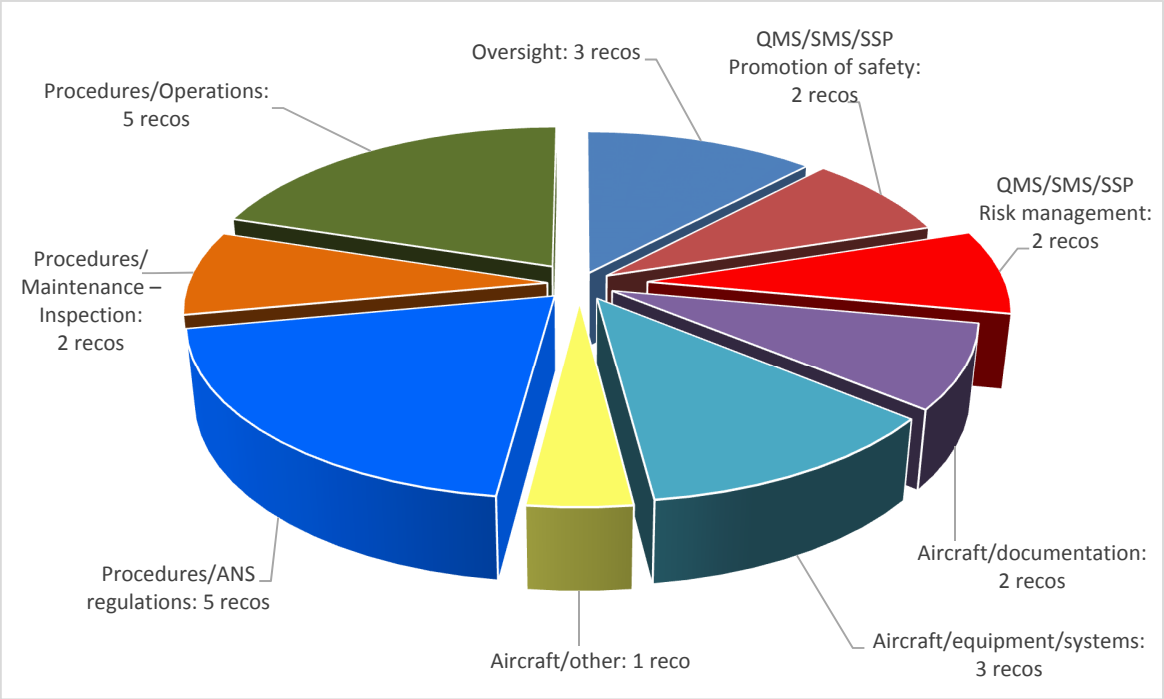
Addressees of recommendations

Breakdown by type of operation

The recommendations issued in 2018 only concern events linked to commercial air transport operation; no recommendation regarding general aviation (GA) or aerial work (AW) was issued.

Themes of recommendations

The breakdown of recommendations by theme issued in 2018 indicates nine areas in which safety actions were recommended. The breakdown is as follows:



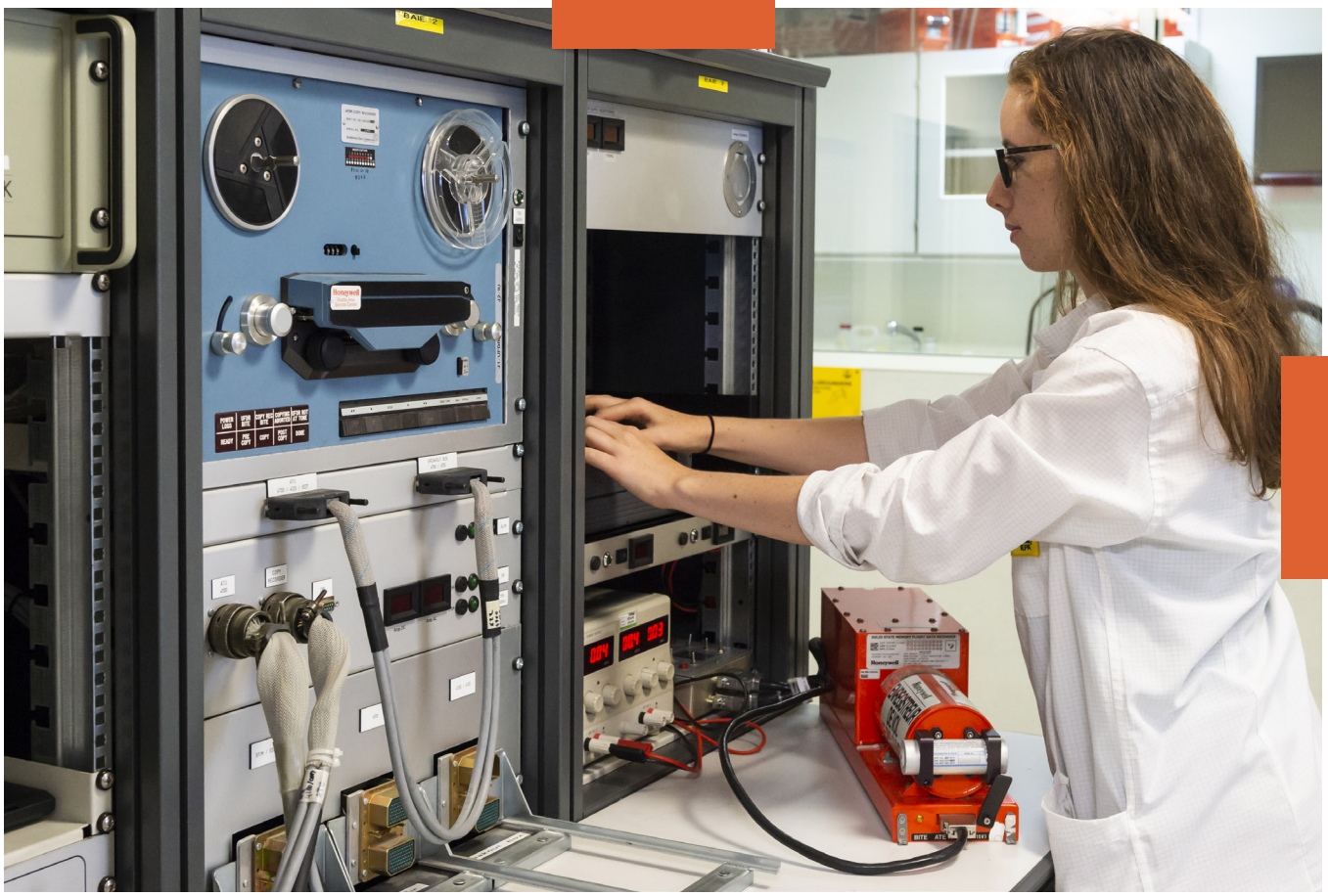
QMS = Quality Management System
SMS = Safety Management System
SSP = State Safety Plan

Breakdown of recommendations by theme

4.3. Responses to safety recommendations

As regards the follow-up to the 25 recommendations issued by the BEA in 2018:

- ◊ seven recommendations have been closed by their addressee with a favourable response for three of them and partially favourable for the four others;
- ◊ two recommendations received a response indicating that action was under way by the addressee;
- ◊ sixteen recommendations are still awaiting a response from the addressee authority, ten of these were issued on 21 December 2018.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Honeywell

5. Engineering department activities

5.1. Overview of engineering department activity in 2018

The volume of activity of the Engineering Department increased once again in 2018, with a total of 599 examinations of all types (versus 526 the previous year).

Among the most striking activities there were:

- the uncontained failure of an A380 engine on 30 September 2017 over Greenland and issues concerning the search for parts from this engine in a difficult to access, hostile area which continued to generate a high workload for the BEA (see Focus page 35);
- technical assistance provided to the Swiss Transportation Safety Investigation Board (STSB) to read out a considerable number of telephones, digital cameras and video cameras as part of the investigation into the accident to a Junkers-JU52 in Switzerland on 4 August 2018.

5.2. Work by flight recorders and avionic systems (PESA) section

5.2.1. *Flight recorders*

In 2018, 46 CVR recordings and 66 FDR recordings were downloaded and read out at the BEA, i.e. a total of 112 recordings, which is more than the previous year. More than half of these recordings concerned investigations in which the BEA participated as an accredited representative. Some work was also done in the context of technical assistance to third countries.

	BEA investigation	BEA accrep	Technical assistance	Total
CVR recordings read out at the BEA	5	19	22	**46**
FDR recordings read out at the BEA	8	41	17	**66**

5.2.2. AVIONIC SYSTEMS

In 2018, the BEA's avionics lab read out 131 computers, to which can be added work on photo/video and computer/smartphone recordings. With a total of 231 examinations (versus 189 in 2017, 152 in 2016 and 137 in 2015), the activity of the avionics lab has grown substantially.

	BEA investigation	BEA accrep	Technical Assistance	Total
Computing systems(*)	73	42	16	**131**
Computers/Smartphones	41	1	22	**64**
Photo/video recordings	13	9	14	**36**

(*)*The term "computing systems" groups various avionic equipment and the GNSS (Global Navigation Satellite System)*

5.2.3. ATM RECORDINGS

In 2018, 50 events 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 previous year.

ATM work by type of investigation was split as follows:

	BEA investigation	BEA accrep	Technical Assistance	Total
Number of events	48	1	1	**50**

5.2.4. PESA DEVELOPMENT WORK

The BEA laboratory started work in the automatic transcription field which will make the transcription work of CVR audio recordings analysed during investigations, more efficient. The laboratory also continued developing its aircraft positioning tools based on video recordings.

There has also been major development work in the avionics laboratory to read new generation memories (NAND) which are increasingly present in on-board systems.

5.3. Work by structure, equipment and engines (PSEM) section

5.3.1. Examinations carried out

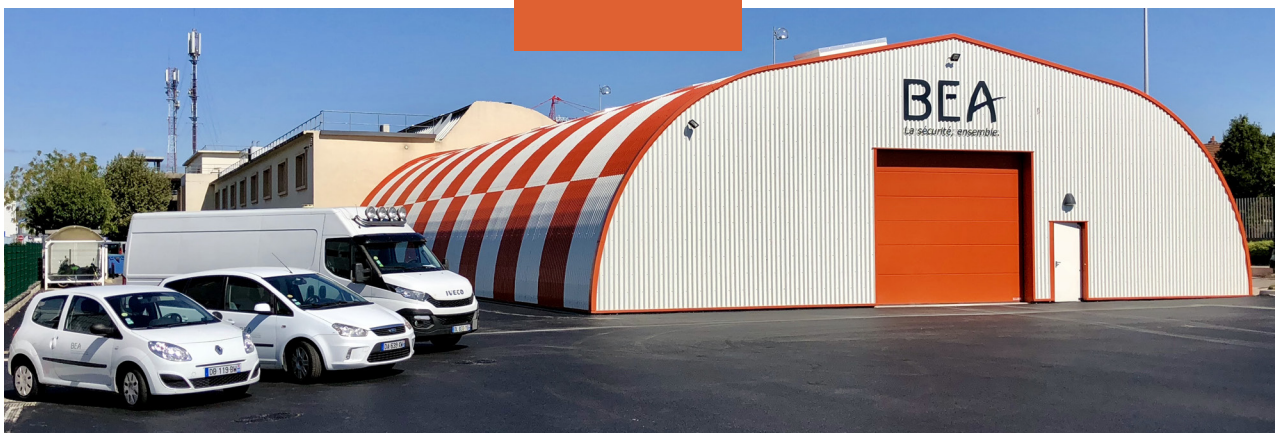
206 examinations were performed in 2018 (of which 33 in the scope of accredited representation). This figure was up on the previous year, where there were 181 examinations (of which 43 in the scope of accredited representation).

The examinations performed were split as follows:

	BEA investigation	BEA accrep	Technical Assistance	Total
Wreckage examinations	55	7	0	**62**
Engine examinations	18	3	0	**21**
Fluid examinations	11	2	0	**13**
Equipment examinations	87	21	2	**110**

5.3.2. Expansion of PSEM

A major event for the PSEM in 2018 was the inauguration, in the second quarter of the year, of the BEA hangar which is now operational. With a total surface area of around 650 m^2, it can accommodate wreckages and aircraft parts for the time required by the investigations. It is joined to the other BEA buildings on the Le Bourget site and and communicates with them which facilitates all the examination work. The area surrounding the building has been reorganized to facilitate the access of large lorries liable to transport parts to be stored.



The BEA has also increased its number of external partners in order to better meet the recurring needs for fluid (fuel, oil) analyses as part of its investigations.

FOCUS

SEARCH FOR AIRCRAFT PARTS WHICH HAVE FALLEN ONTO THE GREENLAND ICE CAP

2018 was marked by the large-scale search operations carried out in Greenland to try and find the "key" parts of engine No 4 of the Air France Airbus A380, registered F-HPJE: this engine had had an uncontained failure on 30 September 2017 while the AF066 flight was en route between Paris and Los Angeles. The aeroplane finally diverted to Goose Bay airport on the Labrador coast of Canada without any other incident.

An investigation was initially opened by the Transportation Safety Board of Canada (TSB) which was then taken on by the AIB DK[1] when the first available data showed that the event had occurred over the southern tip of Greenland. The AIB DK immediately accepted delegating it to the BEA, representing the state of the operator, registry and manufacture of the aircraft and Denmark and France worked in close collaboration to look for parts which had fallen onto the ice cap.

On 4 October 2017, the BEA defined an initial search area for debris; an hour later the AIB DK had diverted an Air Greenland helicopter on a scientific mission to the area. Debris was quickly located and recovered, including parts from the nacelle, fan blades and kevlar containment belt of the engine.

[1] *Danish Accident Investigation Bureau*

At the same time, the investigation team sent to Goose Bay who were examining what was left of the engine, quickly identified the importance of finding the titanium fan hub: this part was not then part of the debris already found.

Snow falls in the search area quickly prevented new helicopter flights and the parts which had not yet been recovered were soon no longer visible. Any visual search for new debris then became pointless which meant the end of Phase I of the search. New search strategies then had to be developed, taking into account the specificities of the area.

The search area was situated around 100 kilometres north-west of Narsarsuaq. It is a glacier whose surface, which is relatively flat, rises to an altitude of around 1,800 metres. The thickness of the ice extends to 800 metres. In this area, which is an accumulation zone, the snow does not sufficiently melt in the summer to allow the parts to reappear on the surface. The environment is particularly hostile due to the temperatures, sometimes extremely low, the presence of crevasses and its isolation.

Equipment to detect parts under the snow or under the ice had to be used in order to try and find the fan hub or fragments of the hub in particularly difficult conditions.

After a prospection phase, it was decided to breakdown phase II of the search into:

- air campaign carried out by ONERA[(2)]: the aim was to try and detect and locate debris under the surface using a synthetic aperture radar (SAR) carried under the wing of a Falcon 20 belonging to the AvDEF[(3)]; three campaigns of flight passes over the area were carried out over a total of three weeks on site; the experimental system had never been used in similar conditions.

- a ground search campaign of four weeks carried out by a team of scientists from GEUS[(4)] with the aim of recovering the debris detected by the air campaign, or if this had failed, carrying out a systematic ground search using ground penetration radars (GPR).

[(2)] *French Aerospace Lab*
[(3)] *Aviation Defense Service*
[(4)] *Geological Survey of Denmark and Greenland*

These two campaigns occurred one after the other in April and May 2018. On completion of the air campaign, a few targets were identified and their coordinates were given to the GEUS team for the ground searches. During these searches, it turned out that these targets were "false positives": in most cases they were ice lenses (pockets of melted snow which had re-solidified under the surface). Once all the targets had been checked, GEUS systematically scanned an area whose size had had to be relatively cut down with respect to initial objectives due to technical, weather and safety constraints (presence of crevasses).

Ultimately, phases I and II did not result in the fan hub or fragments from the hub being found. These phases will however be the subject of a dedicated report which will be published on the BEA site. It was considered that the search for titanium debris under the snow, using state-of-the-art technology in a particularly difficult environment was a challenge whose lessons should be shared.

Following these campaigns, ONERA continued post-processing the data that it had acquired. At the same time, new detection equipment was envisaged: in particular, the University of Aarhus HydroGeologic Group (Denmark) has developed an electromagnetic detector dedicated to the detection of titanium parts. This has made it possible to prepare phase III which will be officially initiated at the beginning of February 2019. It will consist of a final search campaign of an additional four weeks on site in May 2019 and is co-funded by the BEA and the Danish AIB.

6. International activities, communication, training & assistance to families

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

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

6.1. Communication actions

Every year, the BEA participates in several conferences and expert meetings. This allows the BEA not only to spread safety messages resulting from investigations that it has led or participated in, but also to make its investigation expertise more widely known abroad. This reputation and the keeping of close contact with its counterparts are essential tools for the success of its work during investigations abroad. In 2018, the BEA participated in the following international conferences:

- **International Society of Air Safety Investigators (ISASI),** at Dubai (United Arab Emirates): this conference provided an opportunity to give a paper on an investigation carried out by the BEA into a serious incident in which a crew made an error of 100 tonnes when entering the weight used for the take-off calculations.
- **European Society of Air Safety Investigators (ESASI)**, at Riga (Latvia): during the annual seminar of the European branch of the ISASI, the BEA presented a guide for assessing the quality of audio data from a cockpit voice recorder (CVR).
- **AIR (Accident Investigator on Recorders) meeting**, at Taipei (Taiwan): annual meeting of flight recorder specialists from world safety investigation authorities.
- **AIM (Accident Investigator on Materials) meeting**, at Beijing (China): annual meeting of material investigation specialists from world safety investigation authorities.
- **AIP (Accident Investigator on Performance) meeting**, at Washington (United States): annual meeting of aircraft performance investigation specialists from world safety investigation authorities.

6.2. Participation in work of international organizations

6.2.1. ICAO

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

- **Accident Investigation Group Panel (AIGP)**: the BEA chairs this group responsible for proposing amendments to Annex 13 in order to take into account technical or legal changes.
- **ICAO Flight Recorder Specific Working Group (FLIREC-SWG)**: this group of experts is responsible for proposing amendments to Annex 6 to the Convention on International Civil Aviation and in particular with respect to the carrying of flight recorders.

The BEA is also an active participant in an ICAO Ad Hoc Working Group (AHWG), the aim of which is to propose a new draft of the document defining the GADSS (Global Aeronautical Distress Safety System) concept, taking into account, in particular, the lessons learned from the AF447 accident (in the Atlantic in 2009) and the MH370 accident (which disappeared in the Indian Ocean in 2014).

Finally, in the context of the work being done 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 groups 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 with authorities in Eastern European countries (Russia, Georgia, Ukraine, etc).

6.2.2. 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 was elected chair of ENCASIA in 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 and in the organisation of exercises designed to help the smaller EU states to improve their capabilities in dealing with a major accident and test the cooperation mechanisms which more experienced investigation bodies, in particular the BEA, can provide.

6.2.3. European Civil Aviation Conference (ECAC)

The BEA's Director is the vice-chair of the investigation authorities group (ACC) of the 44 Member States of the ECAC, a forum for feedback and exchanges. It holds meetings every six months and in 2018, these provided an opportunity for the BEA to give an update on the investigations it had opened in 2017 and to present in a workshop, the BEA's work and investigation methodology concerning general aviation accidents.

6.2.4. Asia PACific/Accident Investigation Group (APAC/AIG)

The Accident Investigation Group (AIG) of Asia Pacific Member States (APAC-AIG) is a forum for feedback and exchanges similar to that of the ACC in Europe. The BEA was invited by Singapore to actively contribute with workshop presentations on investigation methodologies and in the APAC-AIG meeting which were held in Bangkok in 2018.

(*) ENCASIA website: https://ec.europa.eu/transport/modes/air/encasia_en
Annual report 2018: https://ec.europa.eu/transport/sites/transport/files/2018-encasia-report.pdf

6.2.5. EUROPEAN ORGANISATION FOR CIVIL AVIATION EQUIPMENT (EUROCAE)

The EUROCAE is an European organisation that publishes reference documents on the specifications for onboard systems. These documents are written by representatives of the aviation community. The BEA has chaired various EUROCAE working groups over the last 20 years, and in particular the latest WG-98. This working group, in close collaboration with American experts, has just published (December 2018) the EUROCAE ED-62B document which defines, in particular, the specifications for new generation emergency locator transmitters (ELT) activated in flight when an emergency situation is automatically detected by the aircraft systems. These specifications have come from recommendations from the investigation into the accident to the Rio-Paris flight AF447. These documents are referenced by ICAO standards and all international regulations (FAA, EASA, etc.). They are an essential component of effective regulatory changes to improve aviation safety.

6.2.6. INTERNATIONAL TRANSPORT SAFETY ASSOCIATION (ITSA)

The ITSA is a group, initially only composed of multimodal investigation bodies, that gives independent investigation organisations an opportunity to meet and exchange thoughts. Although it is not multimodal, the BEA has participated for several years, in view of its major international role. The annual meeting in 2018 took place in Bakou (Azerbaijan). It is a traditional opportunity for the directors of the major investigation organisations to share their experience.

6.3. COLLABORATION WITH FOREIGN INVESTIGATION BODIES

Through its experience and know-how, the BEA is recognized as one of the most important safety investigation authorities. As such, it is regularly consulted by many States for assistance involving the oversight of the implementation of standards and practices recommended by ICAO. It was in this context that in 2018 the BEA signed three Declarations of Intent for Cooperation in investigations into civil aviation accidents, respectively with Saudi Arabia, Poland and Mauritania. This brings the number of Declarations of Intent for Cooperation to 48. This approach proposes assistance, within the bounds of reasonable limits, in case of a major investigation. It should be noted that, with regard to Poland, this principle of cooperation is in keeping with the assistance procedures promoted by ENCASIA and mentioned in article 7 of Regulation (EU) No 996/2010.

To date, 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). In certain cases, it can lead to third-party states delegating investigations to the BEA.

6.4. Training organised by the BEA

In 2018, the BEA organised two types of investigator training courses:

- Basic Investigation Techniques. These courses are mainly intended to provide initial training for investigators recently assigned to the BEA and for Field Investigators (DGAC agents approved by the BEA and intervening at its request to gather and preserve evidence in the first few hours or days after a general aviation accident). They are also open to the air transport police (GTA), a few people from aviation associations and investigators from French-speaking countries, notably African countries. Two courses, each lasting two weeks, were organised on the BEA's premises at Le Bourget.

- Investigation methods and techniques (known as "phase 3"). These courses meet the need for advanced training of BEA investigators after their initial training and a few years experience to allow them to progress in their investigator career. The main goal is to have complete command of the safety investigation stakes in occurrences involving commercial air transport aircraft, 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. As each year the number of BEA investigators who need to follow this training course is naturally small, it was decided to open it up to other trainees from foreign investigation bodes or entities with whom the BEA has to interact during investigations (manufacturers, operators, professional organisations). A single three-week course was organised on the BEA's premises: for the first time, it was entirely conducted in English.

6.5. Information to families

Information to families is generally given in meetings. Depending on the case, these are held on the BEA's premises or elsewhere, sometimes abroad. In the case of accidents that occurred abroad but in which there were victims who were French or who lived in France, the meetings can be organised at the BEA in collaboration with the foreign investigation authorities responsible for the investigation.

In 2018, one meeting at the BEA 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 2015, 2017 and 2018.

FOCUS

THE BEA'S RELATIONS WITH THE MEDIA

In an increasingly reactive media environment with, in particular, the development of social networks, the BEA has introduced a dual external communication strategy with both the setting up of a Twitter feed @BEA_Aero and the reinforcement of links with aviation journalists.

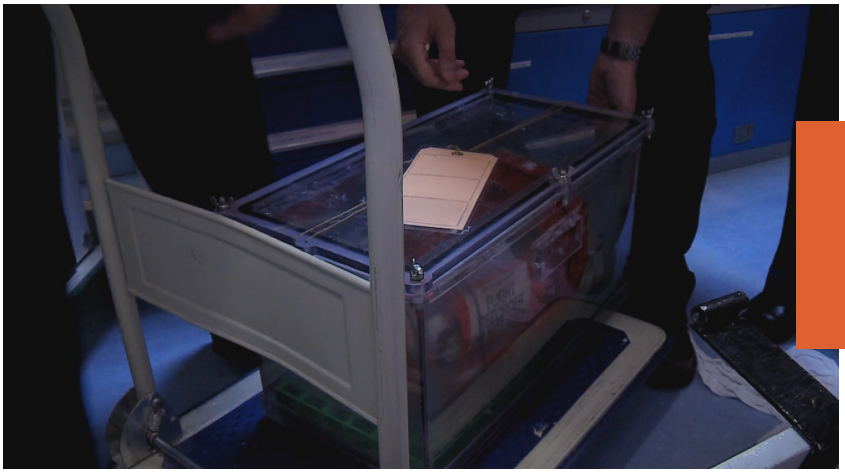
Twitter allows the BEA to join this network alongside all the stakeholders of the aviation ecosystem: manufacturers, operators, airports, oversight and investigation authorities as well as our counterparts throughout the world. This new communication channel enables the BEA to be more reactive with its statements as well as providing a more accessible media watch and greater agility in its communication strategy in the event of a major occurrence. At the end of 2019/beginning of 2020, this Twitter feed will be more fully integrated into our website bea.aero in order to be the support for all "news" type content.

With the ever increasing space taken up by social networks, this does not mean that the BEA must forget the aviation journalists whose expertise can help the BEA in its mission to communicate information about civil aviation safety. Last September, the BEA organised a day of discussions, interviews and filming on its Le Bourget premises with the association of professional aviation and space journalists (AJPAE). This was an opportunity for the journalists to discover the professions, expertise and technical resources within the various BEA facilities (in particular, the laboratories and engineering hangar).

AF 447 "The hunt for the Rio-Paris"

The accident to the Rio-Paris flight AF447 on 1st June 2009 is to date the most complex safety investigation and has been the subject of the most media attention in the history of the BEA, marked, in particular, by nearly two years of sea searches before finding the wreckage and the two flight recorders. Aware from the outset of the dimension of this investigation, the BEA decided to film in full the five phases of the sea searches between 2009 and 2011, mainly to monitor operations internally. While some of these images were shared on a regular basis with the media during the investigation, the vast majority had never been used.

Ten years after the accident, several documentaries on the circumstances and causes of the accident have been made but the sea search aspect had never been developed. Between 2017 and 2018, the BEA contributed to the making of a 90 minute documentary on this subject. In addition to showing previously unpublished images, this documentary describes in a transparent way, the technological, human and industrial stakes in these searches and in this investigation. Co-produced by ECPAD (who had filmed part of the images during the searches) and GALAXIE PRESSE, the documentary will be broadcast for the first time at the end of May 2019 on Planète +.

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7. Human resources & finance

7.1. Personnel

7.1.1. Staff as of 31 December 2018

As of 31 December 2018, the BEA had 97 agents divided as follows:

BEA staff	Civil servants	Contractual employees	Workers	Total
Flight crew	-	1	-	**1**
Engineers	42	14	-	**56**
Senior technicians	15	-	-	**15**
Workers	-	-	10	**10**
Administrative staff	14	1	-	**15**
Total staff	**71**	**16**	**10**	**97**

Note: 151 field investigators should be added to the staff listed above; these investigators are trained by the BEA and have been approved by the BEA director in accordance with the provisions of the Code of Transport.

From time to time, 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 national territory. They are principally called on for general aviation events but sometimes they are also called on for commercial air transport events, particularly on overseas territories

As required, BEA investigators join them, or not, on site. In all cases, the rest of the investigation is carried out by BEA investigators.

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.

7.1.2. Training of personnel

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, indispensable to its activity.

Thus in 2018, the budget devoted to professional training was 216,456 € for the 85 agents involved. This represents nearly 9 % of the annual operating budget and close to 8 % of the overall annual budget. There were 348 training actions undertaken over 1,465 days, which means an average of 17.23 days of training per agent.

The training courses representing 7 person-years 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 an agent who is type rated on passenger planes to periodically undertake commercial air transport flights was developed. Three agreements between the BEA and airline companies were in place in 2018. Three investigators thus acquired major experience in piloting commercial air transport flights, which is necessary for carrying out some complex investigations in this specific area.

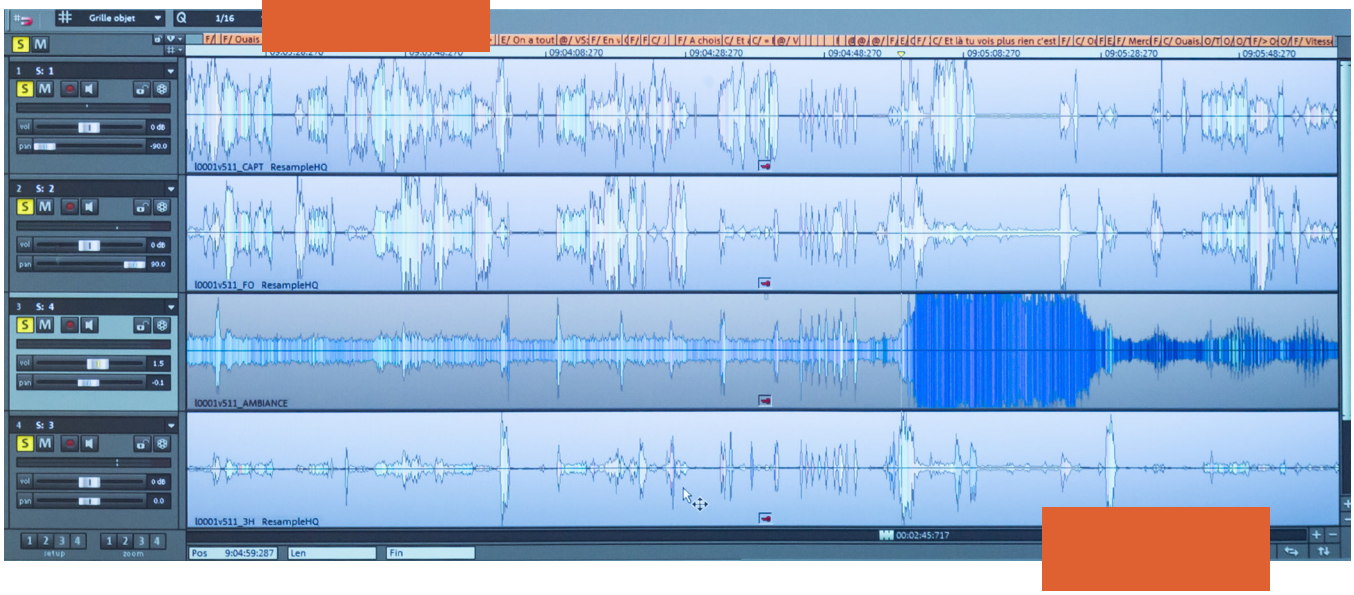
7.2. Budget

7.2.1. Allocations

The BEA budget for 2018 was set in the initial finance law at 2,856 M€ in commitment authorisations (CA) and 2,933 M€ in payment appropriations (PA).

This budget received an additional allocation during the year, of a total of 0.38 M€ in PA. Part of this allocation was the end of project redistribution of the 2017 PA not used in the construction of the hangar, of a total of 0.23 M€ and 0.15 M€, within the 614 programme for "air transport, oversight and certification."

Departments	Operations		Investment	
	CA (€)	PA (€)	CA (€)	PA (€)
Communication	85,241.16	75,982.98	0	0
Logistics	795,564.92	903,680.00	335,863.02	677,414.58
Engineering	328,933.90	328,773.09	34,247.13	50,746.64
Investigation support	37,658.56	37,436.80	0	0
Information Technology	223,341.63	210,258.11	0	0
Training	216,456.56	204,397.94	0	0
Travel	799,613.36	819,028.36	0	0
Total (€)	**2,486,810.09**	**2,579,557.28**	**370,110.25**	**728,161.22**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