BEA
Bureau d'Enquêtes et d'Analyses
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SAFETY INVESTIGATION REPORT

# **Accident** to the Piper PA30 registered **F-BPIR** on Monday 4 December 2023 at Villejuif

| | |
|---|---|
| **Time** | 17:13[1] |
| **Operator** | Trimaille Aéro Formation[2] |
| **Type of flight** | Instruction |
| **Persons on board** | Pilot in training, instructor and one passenger |
| **Consequences and damage** | Aeroplane destroyed, pilot in training and instructor injured |
| This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference. | |

## Unpriming of fuel system, uncontrolled engine shutdown, forced landing in urban area at night



[1] Except where otherwise indicated, the times in this report are given in local time.
[2] Approved Training Organisation (ATO).

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BEA

## 1 HISTORY OF THE FLIGHT

*Note: the following information is principally based on statements, radio-communication recordings, radar data and the data from the aeroplane's on-board GNSS[3] system.*

The pilot in training prepared the aeroplane for an instruction flight under IFR for the instrument flight rating on multi-engine aeroplanes (IR/ME). A passenger (also a pilot) (see paragraph 2.5.3) joined the student pilot at the end of the preflight check. Ready for departure, the pilot in training began the start-up procedure. When he asked for clearance to start up at 15:07, the controller informed him of a CTOT[4] of 15:12. The instructor joined the two persons on board the aeroplane.

The pilot in training took off from Toussus-le-Noble aerodrome[5] at 15:22, near the very end of the CTOT slot. After cruising at FL 070, he carried out an RNP approach to Rouen-Vallée de Seine airport and landed at 16:10. Due to a CTOT of 16:25 departing from Rouen, the engines were kept running during the hold on the ground.

The pilot in training took off from Rouen at 16:22 bound for Toussus-le-Noble. He anticipated an RNP approach to land on runway 25R. The aeroplane cruised at FL 080. At 16:54:08, he asked the controller for clearance to descend due to incipient icing. The Orly approach controller cleared the descent to FL 070 and then 5,000 ft[6], with the aeroplane reaching this altitude shortly before flying overhead the TSU VOR[7] at 17:01:53. The Orly approach controller asked the pilot in training to fly toward the Intermediate Fix (IF) IN25R from overhead TSU (see Figure 1, point 1) and to descend to 4,000 ft, on the radial 070°. The aeroplane passed overhead IN25R at 17:05:30 (point 2).

During the descent to 4,000 ft, the aeroplane's stall warning was triggered[8] and remained active until the end of the flight.

At 17:07, the controller asked the pilot in training to turn right to join IN25R in order to start the final approach. Forty-five seconds later, the controller asked the pilot in training to descend to 3,000 ft which the aeroplane reached two minutes later with a vertical speed of around -500 ft/min.

At 17:09:43 (point 3), around 2 NM before IN25R, the pilot in training did not stabilize the altitude at 3,000 ft and the aeroplane continued to descend. The vertical speed of the aeroplane was around -200 ft/min at this time. At 17:11:19, at 2,650 ft, following the controller's question, the pilot in training reported that he was established. The controller asked him to contact the Villacoublay approach controller. During this sequence, the passenger, the pilot in training and the instructor observed the shutdown, in succession, of the two engines. The instructor, with the pilot in training, tried to restart the RH engine but to no avail. The instructor took the controls. The pilot in training declared an emergency situation over the frequency.

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[3] The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.

[4] In order to organise and sequence the inbound traffic at an aerodrome, Calculated Take Off Times (CTOT) are assigned by the Eurocontrol Central Flow Management Unit (CFMU). These CTOT have a five minute tolerance before and a ten minute tolerance after the time, defined as a slot. If the slot is exceeded, a new CTOT must be requested which can generate a considerable waiting time.

[5] Also called Paris-Saclay-Versailles airport.

[6] QNH = 996 hPa, meaning a difference of 476 ft between the AMSL altitude and the altitude 1013.

[7] The TSU VOR is located on Toussus-le-Noble aerodrome.

[8] The stall warning can be heard on all the ground-aircraft communications from the message sent at 17:06:46 onwards. During the previous message sent at 17:03:37, the warning could not be perceived.

At 17:11:40 (point 4), overhead IN25R and at 2,400 ft, the flight path of the aeroplane took a southerly direction. The vertical speed was -1,400 ft/min during the descent. One minute and thirty seconds later, the instructor tried to land in the courtyard of a building. The aeroplane came to a stop against a low wall, the occupants evacuated the aircraft.

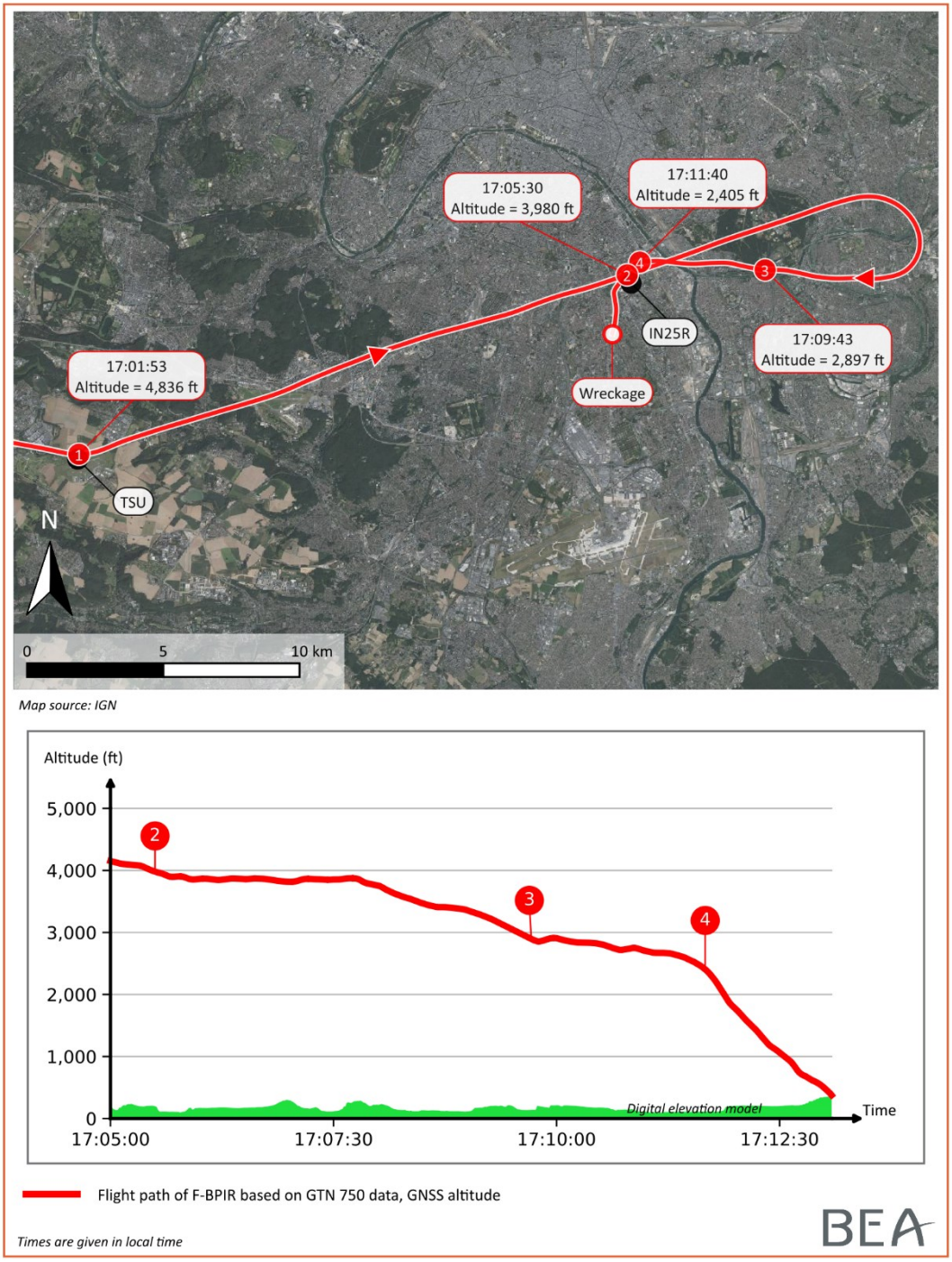


*Figure 1: end of flight path*

# 2 ADDITIONAL INFORMATION

## 2.1 Toussus-le-Noble aerodrome information

Toussus-le-Noble aerodrome has two parallel runways, 07L/25R and 07R/25L.

In the "west facing" configuration and for an RNP 25R approach, controllers generally clear pilots to arrive overhead TSU at 5,000 ft, and then follow the 070° radial. After IN25R, controllers ask pilots to carry out a RH turn, at a minimum altitude of 4,000 ft so as not to interfere with traffic bound for Toussus-le-Noble aerodrome and Vélizy-Villacoublay aerodrome. Pilots are then cleared to descend to 3,000 ft and join the IF IN25R. The final approach then begins at FAF FN25R, 4.5 NM from IF IN25R.

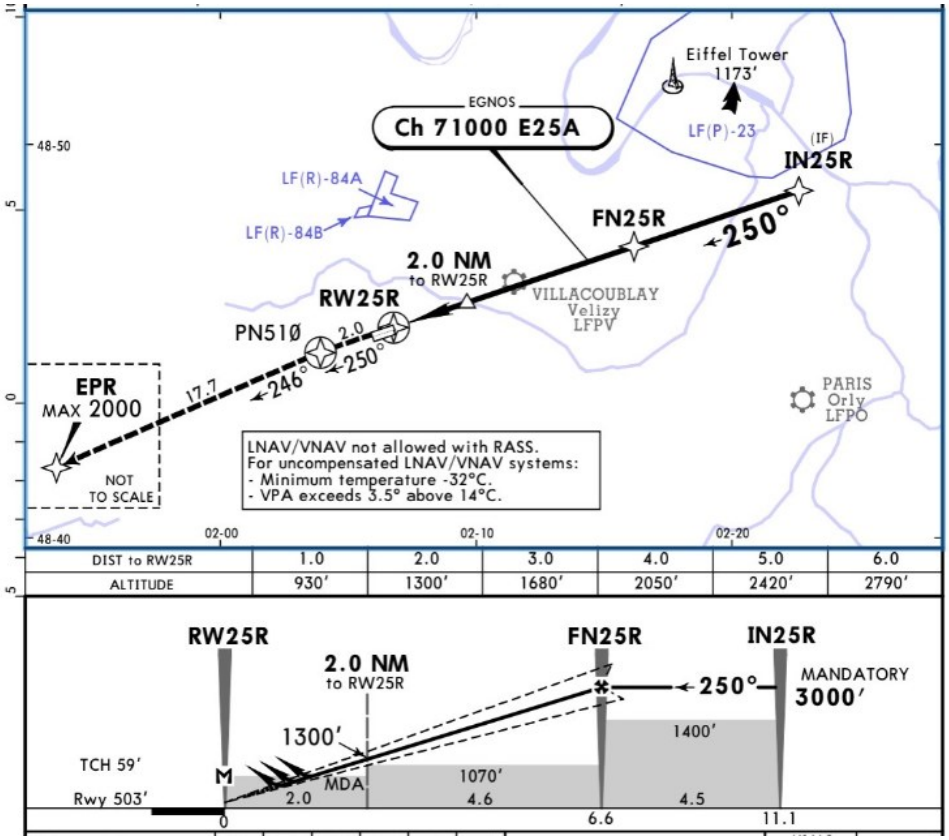


*Figure 2: excerpt from RNP 25R procedure (source: Jeppesen)*

## 2.2 Meteorological information

On Monday, 4 December 2023, sunset was at 16:55.

In the area of the accident, the 16:00 SIGWX chart (used by the pilot in training when preparing the flight) forecast:

- visibility greater than 8 km, locally reduced to between 5 km and 8 km, or even between 1.5 km and 5 km;
- rain;
- stratus clouds, locally broken (BKN), based between 700 and 1,000 ft with cloud tops exceeding 1,500 ft;

- layer of broken clouds (BKN), locally overcast (OVC), based between 1,500 and 4,000 ft with cloud tops above 15,000 ft;
- freezing level at 5,500 ft;
- moderate icing from 5,500 ft to over 15,000 ft.

The 17:00 METAR for Paris-Orly airport[9] indicated:

- wind 190°, 9 kt;
- visibility of 8 km;
- rain;
- overcast (OVC) at a height of 900 ft;
- temperature 9°C;
- dew point temperature 8°C.

Météo-France indicated that in the Villejuif sector (altitude 350 ft), convective columns embedded in the air mass were conducive to rain of irregular intensity, associated with low ceilings, at a height of around 1,000 ft. Out of the clouds and in the heaviest rain, visibility might have temporarily dropped to below 5 km.

## 2.3 Aircraft information

### 2.3.1 General

F-BPIR, put into service in 1967, was equipped with two Lycoming IO 320 B1A engines each providing 160 hp. The aeroplane had logged 5,350 flight hours and the engines 360 hours since their last general overhaul. The aeroplane was exclusively used by the ATO for training purposes.

F-BPIR was equipped with EADI and EHSI systems with a digital display, conventional instruments with needles and an on-board GNSS system, a Garmin GTN 750 equipped with a fuel monitoring function[10].

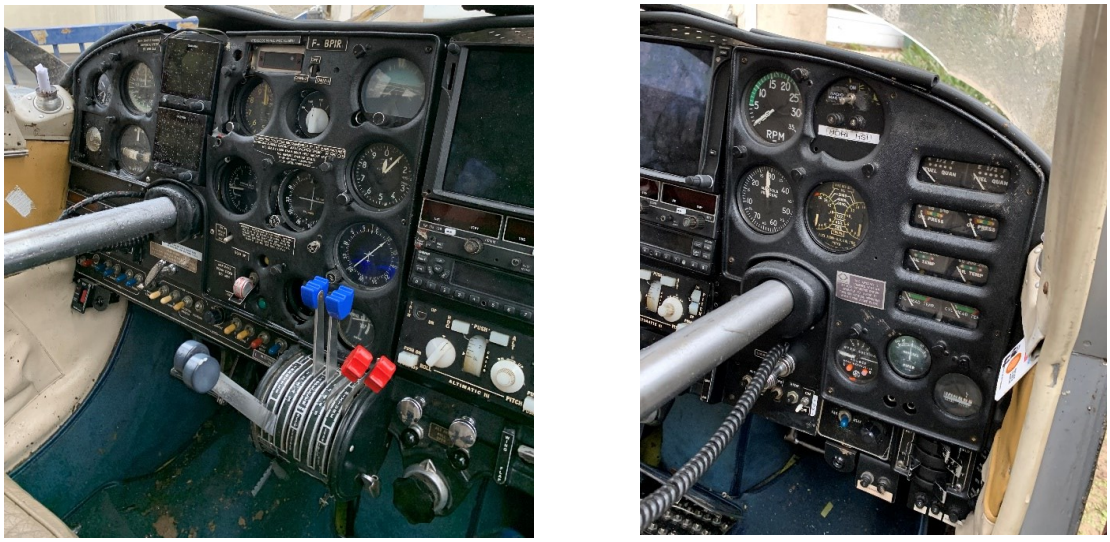

*Figure 3: photos of instrument panel (source: BEA)*

[9] Altitude = 289 ft. The accident site was at a distance of around 7 km from Paris-Orly airport.

[10] The system was not connected to the aeroplane's fuel system.

### 2.3.2 Icing conditions

The aeroplane was not certified to fly in known icing conditions.

The accountable manager of the ATO specified that when there is a risk of icing, the general principle is to ensure, before the flight, that the freezing level is above the safety altitude, for example 3,000 ft in the Paris region. In practice, the ATO's pilots are not to remain at the level where the onset of icing is observed, by requesting a higher or lower flight level depending on the cloud cover and temperature observed. The ATO accountable manager added that in over thirty years of using this class of aeroplane, he had never been confronted with icing conditions that could affect flight safety.

### 2.3.3 Fuel system

F-BPIR had six fuel tanks situated in the wings:

- two MAIN inboard fuel tanks each holding 30 US gallons[11] (27 US gal being usable);
- two AUX outboard fuel tanks each holding 15 US gal (15 US gal being usable);
- two TIP fuel tanks each holding 15 US gal (15 US gal being usable).

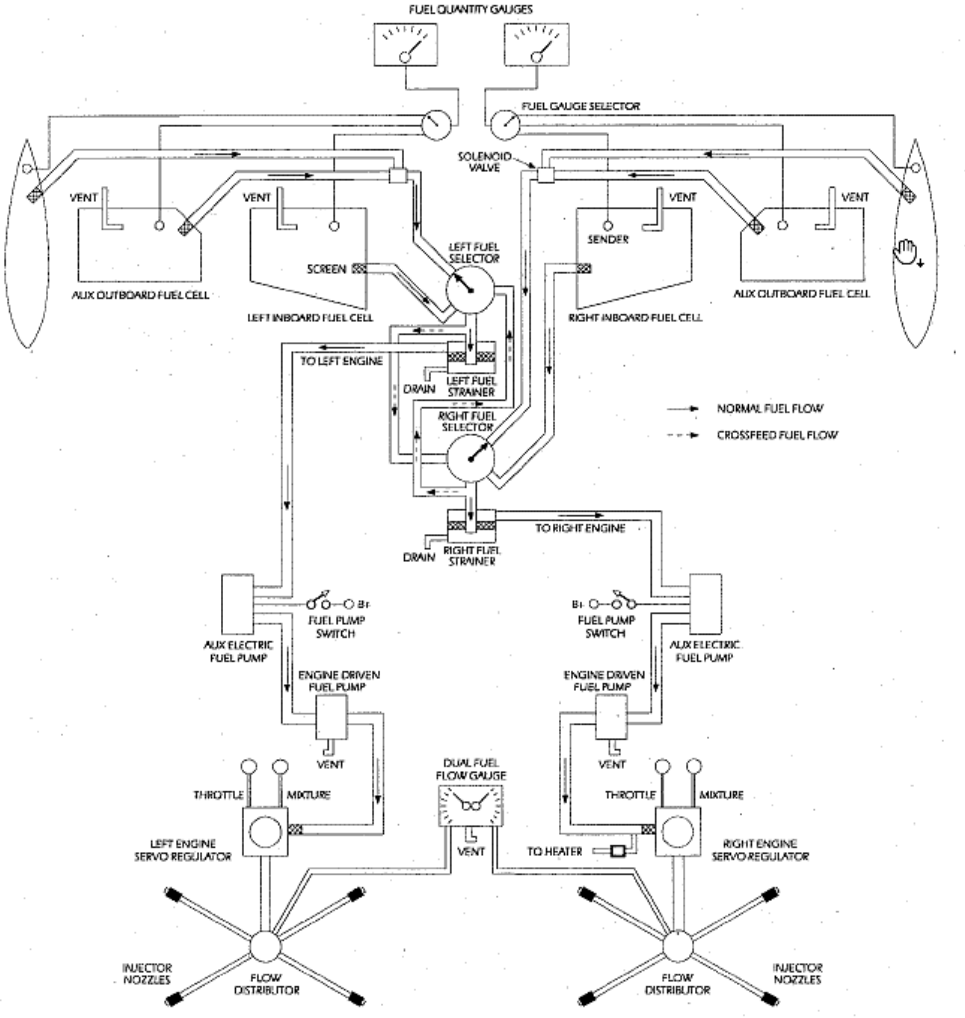


*Figure 4: fuel system of PA30 (source: Piper Aircraft)*

[11] Anglo-Saxon unit of volume, the symbol being US gal. A US gallon corresponds to around 3.78 l.

The fuel tank selectors were situated between the two front seats. They were used to select the OFF, auxiliary (AUX or TIP), MAIN or CROSSFEED positions. On each side, when the auxiliary position was selected, a switch could be used to change from the AUX fuel tank to the TIP fuel tank.

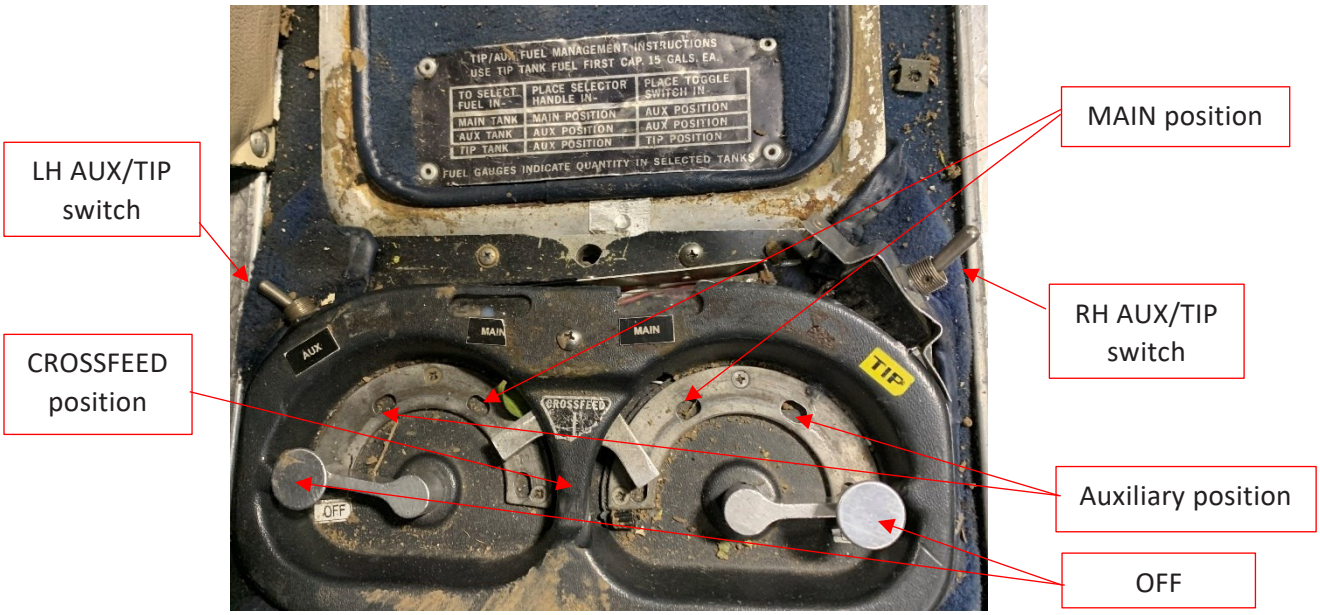


*Figure 5: F-BPIR fuel tank selectors, set to OFF (source: BEA)*

It can be seen that certain MAIN, AUX, TIP, OFF indications are missing. They were not damaged during the accident or during the examinations. It was found that this was also the case on the other two PA 30s in the ATO fleet.

Handles situated between the seats, behind the fuel tank selectors, are used to drain the fuel tanks. It is the selected fuel tank that is bled.

The aeroplane was not equipped with a low fuel level light. Two gauges, one for each side, were situated on the instrument panel, opposite the RH seat (instructor's position). Each gauge indicated an estimation of the quantity of fuel contained in the selected fuel tank.


*Figure 6: fuel tank gauges (source: BEA)*

## 2.4 Site and wreckage information

The aeroplane collided with the ground in a clean configuration (landing gear and flaps retracted), on a southerly heading, close to a tree approximately ten metres tall, in the middle of an inner courtyard belonging to a building of several floors. At night, this courtyard was not lit.


*Figure 7: final flight path (source: GTA drone, annotations BEA)*

The examinations of the accident site and wreckage found that the aeroplane had a quite low vertical speed when it came into contact with the ground. The LH wing severed several branches of the tree. The tip of the aeroplane's RH wing then came into contact with the front of the building, causing the separation of the tip fuel tank, propeller and part of the wing. The airframe then pivoted around 180° before coming to a stop against the low rear wall of a row of garages. The rear of the airframe absorbed the energy by compressing against the low wall. The rear section of the tail still integral with the tailplane separated from the airframe and came to a stop on the roof of the garages.


*Figure 8: aerial view of accident site (source: GTA drone, annotations BEA)*

The wreckage of the aeroplane was complete and grouped together. No sign of engine power was observed on the elements of the site or on the propeller blades.

The examinations carried out on the fuel system found that all of the system was functional on the aeroplane. The fuel quantities found in each fuel tank and the statements from the first responders who had safetied the aeroplane were consistent with the fuel tank selectors being set to the AUX position before the accident.

| Fuel tank | | Condition | Estimated fuel |
|---|---|---|---|
| Left | MAIN | **Functional** | Full or nearly full |
| | AUX | **Functional** | Empty |
| | TIP | **Deformed and punctured** | Contained fuel |
| Right | MAIN | **Functional** | Full or nearly full |
| | AUX | **Functional** | Empty |
| | TIP | **Deformed and punctured** | Found empty, the fuel tank may have emptied on impact or during the night preceding the examination of the wreckage. |

*Figure 9: table summarizing the condition of the fuel tanks and the fuel held in the tanks on the wreckage*

The LH TIP fuel tank was wedged between the ground and the rest of the LH wing. No visual observation was therefore possible before the wreckage was raised, during which time fuel leaked from this tank.

Lastly, the examinations carried out on the end part of the fuel system, just downstream of the engines, led to the conclusion that the engines had been starved of fuel, leading to their complete shutdown.

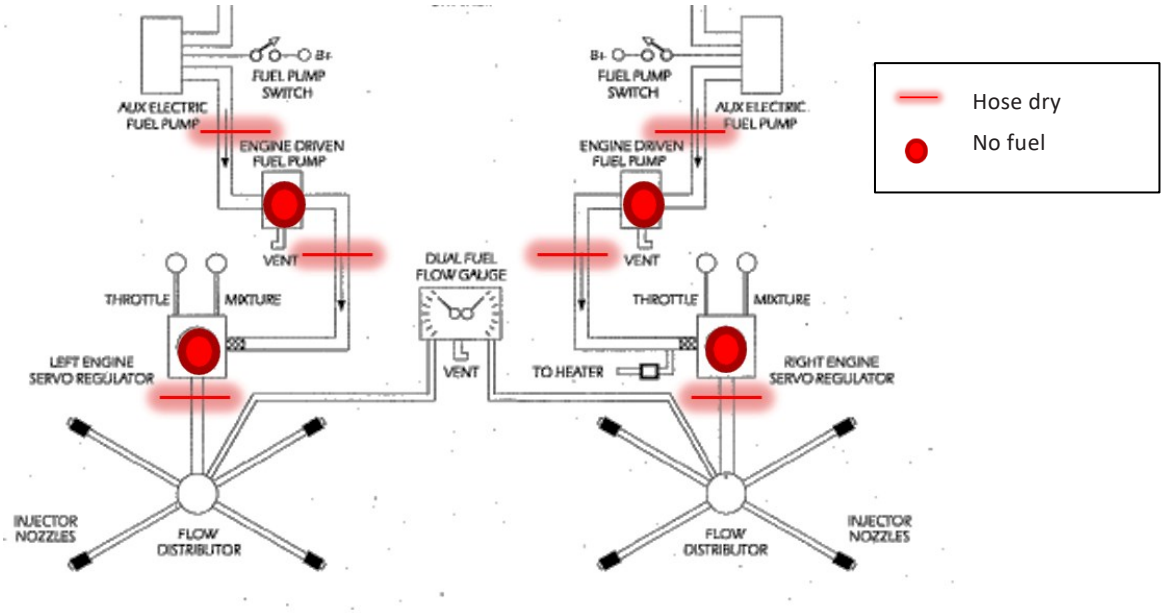


*Figure 10: end parts of fuel system where the absence of fuel was observed (source: Piper PA30 Service Manual, annotations BEA)*

## 2.5 Persons on board information

### 2.5.1 Pilot in training

The 29-year-old pilot in training held a CPL(A) obtained in August 2023. He had obtained a PPL(A) in 2020. He had logged around 210 flight hours. He had totalled 30 h 48 min on simulators[12] and 15 h 16 min on twin-engine PA30s, including 9 h 34 min under IFR, as part of the training for the MEP[13] and IR/ME ratings with the ATO. The accident flight was his sixteenth flight on a PA30.

The student pilot was solely supervised by the instructor present on board the aeroplane for the MEP and IR/ME rating training. Another instructor from the ATO had supervised his CPL training. Initially started in another ATO, this CPL training had been transferred due to financial difficulties experienced by the original ATO.

[12] The pilot in training indicated that the simulator fuel selector was different to that on the aeroplane and that he had not touched it during the simulator sessions.

[13] The pilot in training did not yet hold this rating. His technical knowledge on the aeroplane had not been assessed.

### 2.5.2 Instructor

The 82-year-old instructor held a CPL(A) obtained in 1971, along with the IR/ME rating. He had obtained a PPL(A) in 1962. He had been an instructor since 1975, and was also an examiner. He had logged more than 40,000 flight hours.

The instructor held several positions within the ATO:

- accountable manager;
- training manager;
- SMS manager;
- instructor and examiner.

The instructor indicated that he had no particular difficulties in carrying out the various tasks for which he was responsible and that he considered that he was given good assistance in these tasks. The DSAC (French Civil Aviation Authority) responsible for the oversight of the ATO, specified that holding several positions concurrently is common practice in this type of organisation and not against regulations. However, according to the DSAC, such a combination of positions is rare for an ATO of this size. The workload of the instructor associated with these tasks was not assessed in the scope of the investigation.

The instructor was in an age bracket where an age-related decline in cognitive and physical abilities is commonly observed. The investigation took this aspect into account and did not find any evidence of this phenomenon during the flight.

### 2.5.3 Passenger

The 27-year-old passenger held a CPL(A) licence obtained in Canada in 2022 along with MEP and IR/ME ratings. He had obtained a PPL(A) in 2018, also in Canada. He had logged around 210 flight hours. He had contacted the ATO in the autumn of 2023 with a view to obtaining a European licence. The ATO had authorized him to come and observe instruction flights while waiting for his training to start.

## 2.6 Statements

The instructor indicated that the pilot was nearing the end of his training and that the purpose of the flight was to check his knowledge. The instructor indicated that he had detected a lack of motivation and investment on the part of the pilot in training and that he had teamed him up with another pilot in training for the instruction flights, in an attempt to increase his motivation by mutual emulation. On the day of the accident, this pilot was ill and therefore absent. On this subject, the pilot in training stated that the instructor had never given him any feedback regarding a possible lack of motivation and investment[14]. Moreover, during the investigation, the pilot in training provided the BEA with a letter from the chief pilot and deputy training manager from his previous ATO. This letter expressed his motivation and interest in training to become an airline pilot.

The pilot in training indicated that the flight plan had been filed the evening before. He added that there had been no formal briefing with the instructor before the flight because the instructor was busy. However, the pilot in training was able to discuss the threats he had identified with the

[14]The pilot in training's training record had not been filled in by the instructor. However, his progress appeared to be standard, as he had not needed any re-training sessions.

instructor shortly before he went to the aeroplane to carry out the preflight check. According to him, the threats identified for this flight were the icing conditions indicated on the SIGWX chart and the CTOTs for the outbound and return flights. He had also shared this information with the passenger. He added that with respect to the icing, the instructor had indicated that they would adapt to the conditions during the flight. The instructor, for his part, specified that he was not aware of the CTOT for the departure from Toussus-le-Noble.

The pilot in training had allowed around thirty minutes for the preflight check, including the preparation of the cockpit. In particular, he visually checked that the two MAIN fuel tanks and the two AUX tanks were full, and he bled the two MAIN fuel tanks and then the two AUX fuel tanks. During these actions, he indicated that he was not distracted. He carried out these actions from memory and then glanced through the ATO "checklists" (see paragraph 2.7). In retrospect, he thought that he may have omitted an item or read it without actually carrying out the check. This was not the first time he had done this from memory. He specified that this technique saved preparation time. Once he was ready, as the CTOT was approaching, he went to find the instructor in his office[15]. The instructor asked him to begin the before starting engine actions. The instructor indicated that he visually checked for the presence of fuel in the two MAIN tanks before boarding the aeroplane.

The pilot in training indicated that while taxiing, the RH engine stalled. The instructor explained to him that the engine rating was probably too low. The engine was restarted. The engine tests were then carried out without any problems.

The pilot in training indicated that in cruise from Toussus-le-Noble to Rouen (outbound flight), a light layer of ice settled on the wings. The instructor considered that this did not affect the safety of the flight and they continued as cleared.

The pilot in training explained that at Rouen, he made a full-stop landing, and then returned to the holding point to take off. He did not shut down the aeroplane's engines.

The pilot in training specified that in cruise from Rouen to Toussus-le-Noble (return flight), a light layer of ice settled on the wings that was slightly thicker than the outbound flight. The instructor also considered that this did not affect the safety of the flight and they continued as cleared. The pilot in training asked for clearance to descend a short time later.

After passing overhead TSU and flying towards IN25R, the pilot in training and the passenger indicated that the stall alarm was triggered when the aeroplane left the icing conditions. It remained active until the end of the flight. They explained that the instructor told them that water or ice could have jammed the stall warning sensor. The pilot in training explained that effectively, the icing was beginning to disappear from the wings at that point. The instructor indicated in his statement that he had no recollection of the activation of the stall warning or of these explanations.

The pilot in training and the passenger indicated that after turning to join IN25R, the RH engine began to misfire, followed by a partial loss of power. The propeller was driven by the relative wind. The pilot in training indicated that he instinctively corrected the yaw movement, he thought it was

[15] This part of the statement is consistent with that of the passenger's, but is contradicted by the instructor, who explained that he went to the aeroplane before departure without the pilot in training coming to get him.

an engine failure simulation exercise. He quickly realised that this was not the case, as the instructor seemed worried. The passenger said that the instructor mentioned possible water ingestion. The instructor indicated in his statement that he had no recollection of this affirmation. About 30 s later, the LH engine showed the same symptoms. The pilot in training transferred the controls to the instructor. They tried to restart the RH engine. At the instructor's request, the pilot in training switched the fuel pumps ON and reselected the ignition switches, then the instructor pushed the engine controls forward. The instructor indicated that he moved the fuel tank selector of the RH engine from the MAIN position to the AUX position[16]. The pilot in training thought that the instructor had effectively done this, but the passenger indicated that at no time during the flight or during the fault troubleshooting, did he see the pilots make an input on the fuel tank selectors. The pilot in training stated that during his training he had never had to handle the selectors in flight, and that he had no knowledge regarding their use to select the TIP tanks. With respect to this point, the instructor specified that the pilots in training had the aeroplane's flight manual at their disposal.

The instructor indicated that they were in sight of the ground when the engines shut down. For their part, the pilot in training and the passenger indicated that they were in the cloud layer. The passenger estimated that they emerged from the cloud layer at around 1,500 ft. It had been dark for about 20 min.

The instructor reported he saw a small platform and headed for it. He aimed for an open area to avoid further damage. He did not extend the flaps or the landing gear in order to glide as far as possible. He did not feather the propellers because he was hoping that the engines would restart. The aeroplane remained controllable until the collision with the ground.

After landing, the passenger was quickly able to secure the aircraft and then contact the emergency services.

## 2.7 Procedures applicable to the PA30

This paragraph contains details relating to fuel management, excerpts from the manufacturer's procedures in the flight manual and the ATO's procedures. To this end, the ATO provides pilots with "checklists" in its aeroplanes, case for F-BPIR, containing actions to be carried out and checked. For the normal procedures, the "checklists" are the following:

- *Preflight inspection*/74 items;
- *Before start-up*/13 items;
- *Cold engine start-up*/12 items;
- *Hot engine start-up*/14 items;
- *After start-up*/9 items;
- *Departure briefing*;
- *Taxi*/4 items;
- *Engine run-up*/11 items;
- *Before take-off*/10 items;
- *Safety briefing*;
- *Line up* (the items highlighted in yellow are memory items)/7 items;
- *After take-off* (the items highlighted in yellow are memory items)/7 items;

[16] This information was not corroborated by what was observed at the accident site (see paragraph 0). For the RH side, if the instructor turned the selector from the MAIN to AUX position without looking, and if the selector was initially in the AUX position, the final position is OFF.

- *Climb*/2 items;
- *Cruise*/7 items;
- *Arrival briefing*;
- *Descent*/3 items;
- *Approach*/5 items;
- *Before landing* (the items highlighted in yellow are memory items)/8 items;
- *Go around* (the items highlighted in yellow are memory items)/10 items;
- *After landing*/8 items;
- *Parking*/17 items;
- *Aircraft leaving*/10 items.

It should be noted that the content of these "checklists" is not checked by the DSAC.

The accountable manager of the ATO stated that he had drawn up its procedures and "checklists" in the 1980s, based on English-language documentation, without any support from the manufacturer.

### 2.7.1 Excerpts from procedures mentioning the fuel tanks

The flight manual specified several checks and actions linked to the fuel system, before take-off:

- check the fuel quantity gauges for each tank (*Preflight check: cabin section*);
- check the fuel level of each tank (*Walk around inspection*);
- drain fuel tank (*Before starting engines*);
- set selectors to MAIN position (*Before starting engines* and *Before take-off*).

The ATO "checklists" specified for the same subject:

- drain fuel tanks by setting the selectors to the MAIN position first, then the AUX position and then return the selectors to the MAIN position (*Preflight inspection*, *Fuel drain procedure* section);
- check fuel level in each tank (*Preflight inspection*, *Left wing* and *Right wing* sections);
- check the fuel selectors are set to MAIN (*Before start-up* only).

The flight manual specified that the approach and landing were to be carried out on the MAIN tanks. This provision was not indicated in the ATO's *Descent*, *Approach* and *Before landing* "checklists".

### 2.7.2 In cruise fuel management

The flight manual specified for cruise flight, that it was possible to use the AUX and TIP fuel tanks, but only in level flight and that the TIP fuel tanks were to be used first.

In cruise, the ATO "checklist" contained the item, *Fuel tank…. Managed*.

The ATO operations manual specified for in-flight fuel management:

- calculate remaining fuel at turning points;
- calculate actual consumption;
- compare actual consumption, forecast consumption and remaining fuel;
- revise forecast fuel requirements according to actual consumption.

In reality, the ATO's practices for managing fuel were the following:

- replenishment of MAIN and AUX fuel tanks before the flight;
- in most case, exclusive use of MAIN fuel tanks for the flight, these having an endurance of 3 h 30 min, sufficient for the majority of flights lasting on average, around 2 h;
- in the case of a longer flight, the AUX tanks were used in cruise, with a five minute interval between setting the LH and RH selectors in order to guard against the possible omission of returning to the MAIN fuel tanks. In normal conditions, the MAIN fuel tanks are reselected before the final descent;
- fuel flow of 8.5 US gal/h per engine (cruise 65%);
- no use of fuel tank gauges, considered "unreliable" by the ATO accountable manager;
- use of the GTN 750 system to monitor fuel in-flight and to determine the quantity of remaining fuel (*Fuel tank* item of "checklist"), the total quantity carried and consumption parameters being entered first. The GTN 750 was not connected to the fuel system, the monitoring was therefore theoretical. The ATO accountable manager specified that monitoring using this system was reliable.

With respect to this latter point, the examination of the GTN 750 found that the flight settings were:

- total quantity on board before take-off = 83 US gal;
- fuel flow = 15 US gal/h i.e. 7.5 US gal/h per engine. It should be noted that this value was different to the one indicated as being used in practice. The pilot in training specified in his statement that he had not touched the fuel flow setting before the flight.

With a fuel flow of 8.5 US gal/h, the AUX fuel tanks allowed a flight time of around 1 h 45 min.

### 2.7.3 In-flight engine failure

The flight manual contained several procedures for an engine failure:

- *Determining inoperative engine*;
- *Engine power loss during flight*;
- *Engine securing procedure, feathering procedure*.

This last procedure specified that before securing the inoperative engine, the pilot must:

1. switch to a tank containing fuel;
2. carry out a crossfeed as required;
3. set the fuel pump to "ON";
4. set the ignition switches to "ON";
5. set mixture to full rich;
6. select alternate air;
7. check the engine gauges/indicators to determine cause of power loss.

The ATO *Engine failure in flight* "checklist" (a memory item highlighted in yellow) only contained the *Throttles & props …. Full power* item in addition to the actions to secure the inoperative engine. This "checklist" did not contain the items listed above. Another "checklist" to restart an engine in flight (*Air Start*), only contained items 2, 3 and 4.

Lastly, the ATO had not included in its "checklists", the procedure for landing with two inoperative engines, (*Power off landing, both engines out*), described in the flight manual.

## 2.8 Analysis of flight

### 2.8.1 Flight preparation

The flight plan filed the previous day was not modified by the pilot in training or the instructor to indicate the absence of a person on-board the aeroplane (the other pilot in training). It had been filed for four people on board. In the scope of the SAR operations carried out after the accident, additional checks had to be carried out by the emergency services in order to confirm that there were effectively only three people on board.

There was no formal briefing before the flight, however, the pilot in training had discussed the threats for the flight with the instructor just before he went to the aeroplane to carry out the pre-flight inspection.

He had identified a threat linked to the icing conditions forecast on the SIGWX chart at an altitude that was below the planned cruise altitude. As the associated altitude was higher than the safety altitude for the flight, the margin was considered as sufficient to carry out the flight based on the ATO's practices. The instructor had planned to adapt the cruise altitude according to the conditions actually encountered in flight. In the scope of the investigation, the BEA did not analyse the ATO's practices with respect to a departure for flight in forecast icing conditions.

The pilot in training stated that he also mentioned to the instructor, the two CTOTs, on departure from Toussus-le-Noble and on departure from Rouen. However, the instructor indicated that he was unaware of the CTOT for the departure, and thus of a potential departure under time pressure.

### 2.8.2 Preflight check and preparation of cockpit

The pilot in training had allowed around thirty minutes for this step. He considered that he could carry out the actions from memory. This was not the first time he had done this and he was very confident in his ability to carry out these actions correctly.

He was aware of the difference between actions to be carried out (do-list) and checks (checklist), however the ATO's "checklists" did not make a difference between actions and checks. The do-lists are lists of actions generally carried out from memory in the form of simple visual scans called "flows". The purpose of the checklists is to guarantee that the critical actions required to ensure flight safety have been carried out correctly. In the interests of effectiveness, the number of checklists is generally limited, as is the number of items on the list. The ATO documentation did not show such checklists.

The pilot in training specified that he checked the actions carried out from memory using the ATO's "checklists" but that he may have omitted an item or read it without actually carrying out the check. The critical action of correctly selecting the MAIN fuel tank was therefore probably not checked at the end of this phase.

### 2.8.3 Start-up, supervision of actions by instructor

The instructor asked the pilot in training to begin the before start-up actions. He considered this phase and the previous phases as having been assimilated by the pilot in training. The instructor's confidence, built up over years of instruction experience, may have led him to adapt his supervision of the pilot in training.

When the instructor took his seat on board the aeroplane, he was not aware of the actions that the pilot in training had carried out before his arrival and under the pressure of the CTOT (which been recalled by the controller when the clearance for start-up was requested). He did not check that the fuel tank selectors were in the MAIN position. The check of this item was specified in the *Before start-up* "checklist", the only "checklist" in the ATO documentation that specifies this check.

### 2.8.4 In-flight fuel management

The quantity of fuel taken on board for the flight - MAIN and AUX tanks full - was sufficient. It included the holding and diversion times. Furthermore, the ATO's recommendation to use only the MAIN tanks for flights similar to that of the accident was a solution considered sufficiently robust by the ATO to prevent in-flight fuel management from being considered a threat. According to the ATO, this recommendation made it possible to focus on the main objective of IR/ME training, i.e. managing the flight and IFR procedures with one of the two engines inoperative (n-1).

The ATO's practices thus led PA30 pilots to manage fuel in a way that was comparable to that of an aeroplane equipped with a single tank. In-flight fuel monitoring was carried out via the on-board GNSS system. However, this was theoretical monitoring, based on the total quantity and consumption values initially entered in the system.

Given the ATO's practices, the fuel tank selectors could not, in the minds of the instructor and pilot in training, be in any position other than the MAIN position. The nature of MEP and IR/ME training flights meant that long flights requiring fuel management were not carried out. The short flights undertaken, of the POGO[17] type for example, therefore did not encourage pilots to carry out in-flight fuel management, nor to consult the fuel tank gauges. The ATO accountable manager considered that these gauges were not very reliable.

Information gathered by the BEA showed that these gauges could be fairly inaccurate for determining a volume of fuel, however they do show whether a tank is empty or not.

These fuel management practices, designed to simplify operations and lighten the workload, reduced situational awareness on this subject and meant, for example, that a fuel leak would not be detected[18].

As the engines were not shut down at Rouen, the ATO's procedures did not enable the identification of a fuel tank selection error: the explicit verification that the fuel tank selectors were in the MAIN position was only requested before starting the engines in the ATO's "checklists".

In its Light Aviation Safety Lessons section, the BEA mentions that the "Inadequate fuel management" risk is recurrent and that it appears in several occurrences each year.

### 2.8.5 Uncontrolled shutdown of both engines

During the accident sequence, the controls were quickly transferred to the instructor. After the first engine misfires, according to the passenger's statement, the instructor mentioned the possibility of water ingestion. Hoping that the engine would restart, the instructor did not feather the

[17] Flights over a very short distance under IFR.

[18] On this subject, the accountable manager of the ATO indicated that in over thirty years of operation, they had never observed an in-flight fuel leak.

propellers, which increased the sink rate and reduced the time available to analyse the fault. He chose the clean configuration for landing, resulting in a higher airspeed.

The instructor did not envisage that the selection of the fuel tanks was erroneous; the investigation was not able to determine whether he actually manipulated the fuel tank selector at the time of the shutdown. He did not check the fuel tank gauges in front of him, as they were not in his usual visual scan and were considered “unreliable”. Nor was this check mentioned in the ATO's *Engine failure in flight* “checklist”.

In addition, the poor condition of the fuel tank selector indications, combined with the reduced visibility at night, may have made it difficult to check that the selectors were in the correct position, both for the instructor and for the pilot in training, who had limited experience of the aeroplane and insufficient knowledge of the fuel system.

Lastly, the ATO's *Engine failure in flight* “checklist” did not contain an item on identifying the failure and restarting an engine in flight. The ATO had chosen to concentrate on training in piloting an aeroplane during a simulated failure of one of the engines. This choice did not allow the pilot to react effectively in the event of the unpriming of the fuel system.

## 3 CONCLUSIONS

*The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation.*

### Scenario

During the preflight check, the pilot in training probably omitted to put the fuel tank selectors in the MAIN position after having drained successively the MAIN and AUX fuel tanks. The *Before start-up* “checklist” was carried out under time pressure due to the CTOT slot for take-off coming to an end, and without the supervision of the instructor. The item of the “checklist” which consisted of making sure that the fuel tank selectors were correctly positioned to MAIN, was not checked.

The outbound and return flights were then carried out using the fuel in the AUX fuel tanks without the occupants being aware of this. The pilot in training and the instructor thought that they were carrying out the flight using the fuel in the MAIN fuel tanks, in accordance with the ATO’s practices which recommended their exclusive use for this type of flight. The fuel tank gauges were used neither on the ground or in flight.

During the descent to join the Toussus-le-Noble Intermediate Fix (IF) IN25R, in the cloud layer, the fuel system of each engine unprimed due to the fuel in the AUX fuel tanks having been completely used. The two engines no longer provided power. The instructor then took the controls and tried to restart the RH engine. He did not select a fuel tank containing fuel during his actions. He did not feather the propellers hoping to restart the engines and carried out a forced landing in the clean configuration, at night, in an urban environment.

The investigation was not able to determine what caused the untimely triggering of the stall warning for the last six to nine minutes of the flight when the aeroplane was in descent to start the approach. This warning probably generated a stressful situation and an additional workload, involving greater monitoring of the parameters, notably when conducting the forced landing.

In the scope of the IR/ME training given by the ATO, fuel management was simplified for short flights in order to allow the pilots in training to concentrate on the other aspects considered training priorities, such as the management of IFR procedures and controlling the flight with one engine inoperative. This simplification was based on the exclusive use of the MAIN fuel tanks in order to reduce the in-flight workload. The ATO "checklists" which differed from the flight manual procedures were consistent with this practice. This simplified approach may, however have led to a reduction in the pilot in training's knowledge of the fuel system and decreased vigilance with respect to certain aspects of fuel management.

## Contributing factors

The loss of engine power was linked to an error in the selection of the fuel tanks which was not detected during the before take-off and in-flight checks. The following factors may have contributed to this:

- the pilot in training carrying out actions from memory during the preflight check and the start-up, under time pressure, and carrying out an imperfect check using the ATO "checklist";
- insufficient checks by the instructor before both take-offs and in flight with the pilot in training;
- the ATO not assessing the risks associated with the simplification of the fuel management that had been implemented and its procedures (see paragraph 2.7.1). The ATO thus deprived itself of the means to detect and recover a tank selection error before take-off, even in the event of an engine shutdown.

## Measures taken by the ATO

In the scope of its Safety Management System (SMS), the ATO draws up a risk map in its organisation manual which it regularly updates. The version of the risk map in force at the time of the accident did not show any risk specific to the PA30/39.

A risk relating to the PA30/39, linked to the performance of the fuel drain which must be carried out in a precise order, starting with the AUX fuel tanks and then the MAIN fuel tanks, was introduced in the update of the ATO organisation manual at the end of December 2023.

A "Fuel drain reminder" was also published by the ATO. The ATO now requires that the fuel drain begin with the AUX tanks and end with the MAIN tanks. The ATO has updated its preflight check and fuel tank drain procedures to this effect.

The ATO has also added the item "*Fuel selectors .... MAIN*" in its *Descent* "checklist". However the *Before take-off, Approach, Before landing* and *Engine failure in flight* "checklists" have not been changed.

Lastly, the ATO stated that it had modified one of its aeroplanes with a system that displays fuel levels on the electronic instruments and that it is evaluating this modification before integrating it into the entire fleet.