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pour la sécurité de l'aviation civile

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REPORT
SERIOUS INCIDENT

Unstabilised approach, triggering of GPWS and MSAW warnings, dual input, missed approach, at night under instruction

Aircraft	Airbus A320 registered SX-BHV
Date and time	April 11 2012 at around 00 h 24[1]
Operator	Hermes Airlines
Place	On approach to runway 36L at Lyons Saint-Exupéry airport (69)
Type of flight	Non-scheduled public transport of passengers
Persons on board	Student pilot-in-command (PF), instructor (PNF); 5 cabin crew members; 178 passengers
Consequences and damage	None

[1]Unless otherwise specified, the times in this report are expressed in Universal Time Coordinated (UTC).

1 - HISTORY OF FLIGHT

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

Note: The following elements are based on data recorded on the flight data recorder (FDR), the cockpit voice recorder (CVR) and accounts from the flight crew.

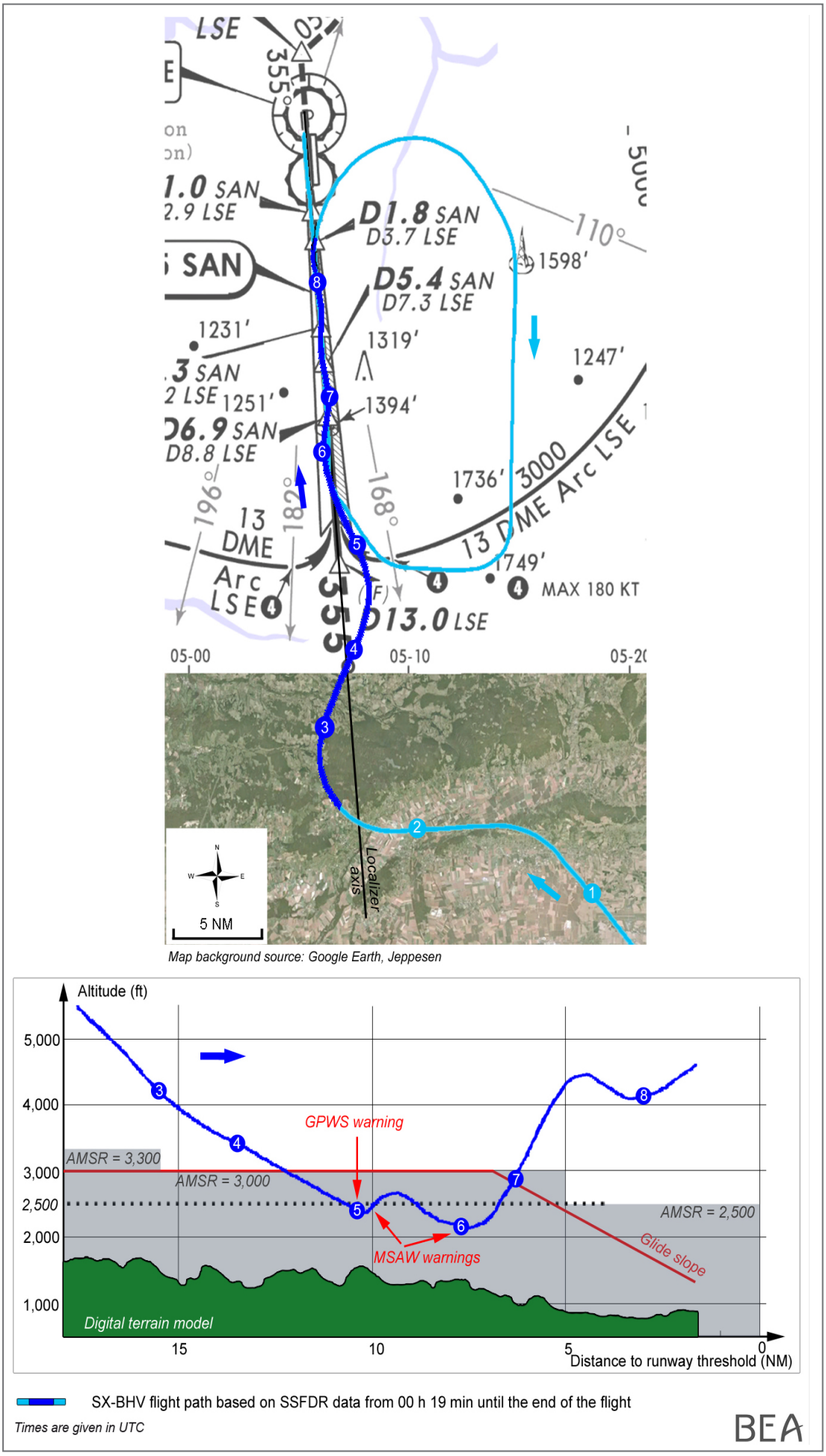
The crew took off from Ajaccio (2A) bound for Lyons Saint-Exupéry. The flight was chartered by Air Méditerranée and performed by Hermes Airlines. The Captain was the instructor (PNF) and was sitting in the right-hand-side seat. The student /pilot-in-command was PF in the left seat. When preparing the radio navigation for takeoff, the PNF manually entered the frequency of the Ajaccio AC ILS in the NAV RADIO page of the multi-function control and display unit (MCDU) to prepare for a possible quick return flight (QRF). This frequency remained selected throughout the flight until the approach. The flight was carried out with the AP1 autopilot engaged.

During the flight, the crew listened to the ATIS which stated that the ILS approach to runway 18L was in force. They programmed the navigation system (Flight Management Guidance System - FMGS) for this approach. When the aeroplane was cleared for an arrival at PINED 1, the approach controller announced low wind and suggested radar vectoring for an ILS approach to runway 36L, which was accepted by the crew. It was dark and instrument meteorological conditions (IMC) applied.

During this arrival, the crew noted inconsistencies in the DME distances displayed on the ND: the PNF called out 99 NM and the PF 40 NM[2].

[2]The frequency of the ILS DME active at the time was that of Ajaccio (AC 110.30 MHz), inserted by the crew at takeoff. The DME received at the time was that of Marseille (ML), with the same frequency, at about one hundred nautical miles.

About one minute after the beginning of radar vectoring, the controller, who realized that the aeroplane was high on the glide, asked *"…forty nautical […] is that OK for you, four zero?"*. The crew, while programming the FMGS for an ILS approach to runway 36L, answered *"Actually we... we'll need to make a thirty six"*. The controller, who interpreted the response of the crew as a confirmation of a landing on runway 36, did not understand that the crew wanted to make a late turn onto heading 360. He provided a heading of 315° to the localiser axis for runway 36L. As the Ajaccio AC ILS had not been deselected, the FMGS did not automatically select the ILS for runway 36L at Lyons.



About three minutes later❶, the controller gave a heading of 270° in order to extend the flight path as the aeroplane was too high on the glide. The crew was busy solving the inconsistency in the ILS frequency display and, due to a readback error by another crew, turned thirty seconds later. The PF and the PNF discussed, for about two minutes, entering the approach in the MCDU and the validity of the ILS frequency.

The controller specified a heading of 320° so that the aeroplane would intercept the localiser axis for runway 36L❷. As the frequency of the ILS for runway 36L was not active, the aeroplane crossed the axis without intercepting it. About 30 seconds later, noting that the aeroplane had overshot the axis, the controller ordered the crew to follow a right heading of 020°, to descend to 3,000 ft and then cleared them for an ILS approach to runway 36L. The PNF read back and asked the PF to set the frequency: *"[Set the frequency, set SAN, ILS is SAN][3]"* The ILS frequency switched from 110.30 MHz (Ajaccio ILS frequency) to 110.75 MHz (ILS frequency of runway 36L at Lyons Saint-Exupéry)❸. The aeroplane then crossed the localiser axis for a second time.

[3][..] Translated from the Greek language, the mother tongue of both crew members.

While the Capture mode engaged for a selected altitude of 3,000 ft at a speed of 240 kt, the crew decided to select an altitude of 400 ft on the control panel (FCU)❹[4], which caused a mode reversion of the autopilot from ALT* to VS 1200 ft/min, the current vertical speed of the aeroplane at that time. They set the approach mode and engaged the AP 2 autopilot. The crew turned left to intercept the localiser axis, and then the aeroplane descended below the radar minimum safe altitude of 3,000 ft.

[4]Altitude lower than the runway threshold elevation.

The controller asked the crew whether they had the correct ILS frequency, which they confirmed.

While the aeroplane was in clean configuration at a speed of 230 kt and an altitude of 2,460 ft (height of 950 ft), the GPWS *"TERRAIN TERRAIN PULL UP PULL UP"* alarm sounded❺. The instructor took over sole control of the inputs, pushed the thrust levers to the TOGA detent and selected a maximum pitch attitude of 9.5°, without calling out that he was taking over control. Autopilots AP 1 and 2 disengaged. The airplane being in clean configuration, the SRS mode did not engage and did not give the crew the expected nose-up instructions corresponding to the avoidance manoeuvre in progress. The vertical and horizontal guidance modes VS -1200 and HDG were still activated[5]. When the pitch attitude of the aeroplane reached 9°, the instructor applied nose-down inputs.

[5]The common guidance GA mode can be activated only if the flap control lever is placed at least in detent 1.

In response to an MSAW warning that triggered a few seconds later, the controller called out: *"you maintain 2,500 ft, you are too low, you are below the glide"* and requested to be called back once the aeroplane was established on the glide path. The aeroplane was at 2,420 ft in a climb. The instructor continued applying nose-down inputs while converging on the localiser axis and simultaneously acknowledged the message. He probably tried to stabilise the aeroplane at an altitude of 2,500 ft. The nose-down inputs were maintained for about twenty seconds. The thrust lever was positioned in the CLIMB detent. At this moment the crew was waiting for the controller's instruction to climb. The calibrated airspeed increased sharply and the aeroplane started to descend again to an altitude of 2,150 ft. At 320 kt and a height of 900 ft❻, the thrust levers were positioned in the IDLE detent. At this time, a second MSAW alert was triggered. The controller intervened again: *"…check your altitude immediately, you are too low"*.

A few seconds later the student in the left seat applied nose-up inputs on the sidestick for about ten seconds while the instructor was applying nose-down inputs. The aural and visual DUAL INPUT warning triggered for a minute. During this dual input phase, the PNF continued to communicate with ATC and requested radar vectoring to abort the approach. Communications, probably referring to taking over control, were confused *"PF: "[leave it, leave it]"*, PNF *"[you take it]"*, PF *"[I have the controls, 5,000 ft, leave it, 5,000…. ;]"*. The controller asked the crew to climb to 5,000 ft❼. As the instructor applied nose-up inputs the student applied nose-down inputs. During this period the aeroplane climbed. The crew placed the thrust levers in the CLIMB detent.

The DUAL INPUT warning stopped. The instructor in the right seat then took over the controls. The AP2 autopilot was connected❽.

The aeroplane parameters stabilised. A second approach was performed and the crew landed on runway 36L.

2. ADDITIONAL INFORMATION

2.1 Selection of ILS

The aeroplane is equipped with two ILS receivers. The FMGS allows the crew to select an ILS frequency:

- automatically (*"auto-tune"* function), according to elements in the flight plan; this function is normally used ;
- manually, by selecting an ILS frequency on the RADIO NAV page of the MCDU; selection remains unchanged until manual de-selection is performed.

Where there is a difference between the frequency of the ILS approach FMGS entered manually and the RADIO NAV page, the post RWY / LS MISMATCH is displayed at the bottom of the MCDU screen (see example below).

In this example, the font size of the frequency automatically entered by the FMGS (e.g. VOR1 and 2) is by default smaller than that manually entered (e.g. ILS).

The information relating to the ILS (identifier, scales and deviations) is displayed on the control panel (PFD) when the ILS signal is received and the LS pushbutton of the FCU has been selected.

The operator's procedures state that the crew must check before departure, on the RADIO NAV page of the MCDU, the frequencies of the radio facilities that have been automatically selected by the FMGS: VOR and ILS. They can change them if necessary and must check that the ILS ID is correctly displayed on the navigation and control displays (ND and PFD).

When climbing through FL100, the PF must check the RADIO NAV page and deselect the radio navigation equipment which may have been selected manually upon departure.

Before the descent, the PF must check and update the flight plan (standard arrival, approach procedure in force and active runway), and must then check on the RADIO NAV page the consistency between the radio navigation equipment selected by the FMGS and that of the proposed approach. With regard to the ILS, he must check the code, frequency and axis. This information must be checked by the PNF

The crew indicated that they had, at takeoff, manually entered the Ajaccio ILS frequency in case of QRF. They did not deselect this frequency afterwards, which therefore remained active until the approach to Lyons Saint-Exupéry.

Note: The ILS frequency for runway 18L is 109.1 MHz. That of the ILS for runway 36L is 110.75 MHz.

2.2 Warnings in Case of Dangerous Proximity with the Ground

2.2.1 To the crew: GPWS TERRAIN TERRAIN PULL UP warning

The aeroplane is equipped with a GPWS designed to alert the crew in case of dangerous ground proximity. When the *"TERRAIN TERRAIN PULL UP PULL UP"* warning is triggered, the Operations Manual (FCOM) provides for the following actions:

- *"at night or in IMC, the emergency procedures must be applied immediately: the PF must disconnect the autopilot and simultaneously apply and maintain a full nose-up input on the sidestick, set the thrust levers to TOGA, check that the speedbrakes are retracted and keep the wings level until a safe flight path is recovered".*

He must simultaneously call out *"PULL UP TOGA".*

Note: the procedure does not mention any callout to the controller.

2.2.2 To controllers: MSAW warning

This system provides a warning to the controller in case of dangerous proximity between an aircraft and terrain or an artificial barrier.

The operations manual of the ATC service at Lyons Saint-Exupéry airport reproduces the DO No. 5951/08 directive and specifies the phraseology to be used in case of activation of a MSAW warning:

- *"if the aircraft is not being vectored, the controller must notify the pilot and give him the instruction to check his altitude immediately using the following phraseology: "…terrain alert, check your altitude immediately, QNH XX".*

- *"if the aircraft is being vectored, the controller gives the pilot the instruction to immediately reach an altitude greater than or equal to the radar minimum safe altitude and, where necessary, gives the pilot a new radar heading using the appropriate phraseology: "immediately climb XXXX ft QNH and turn YY heading XX° immediately due terrain".*

In this case, the aeroplane was not stabilised on its final approach flight path and therefore was still considered being vectored. When the first MSAW warning occurred, the controller should have asked the crew to climb immediately to an altitude greater than or equal to 3,000 ft QNH (radar safety altitude). The phraseology used *"you maintain 2,500 ft you are too low you are below the glide"* probably prompted the crew, who had initiated a climb following the GPWS PULL UP warning, to stop this manoeuvre to maintain an altitude of 2,500 ft.

2.3 Control Take-over by a Crew Member, Activation of the Sidestick Priority Button and Dual Input

In case of control take-over by a pilot, the latter must call out *"I have control"* and press the sidestick priority button. During the flight, when applying the PULL UP emergency procedure after the GPWS warning, the Captain, PNF, made inputs on the sidestick without making any callout or pressing the sidestick priority button.

On an Airbus A 320, when both sidesticks are used simultaneously, the orders are algebraically added. When dual input is detected, the two lights "SIDE STICK PRIORITY" light up green on the glare shield and the "DUAL INPUT" voice message is generated and repeated during the dual input situation. Each pilot can take priority by pressing the autopilot disconnection pushbutton on the sidestick. Priority will be retained as long as the pushbutton is being pressed. Pressing the pushbutton for more than 40 seconds deactivates the other sidestick.

No activation of the sidestick priority button was recorded during the flight. During the dual input phase, the inputs made by the two pilots were often in opposite directions. The altitude of the aeroplane evolved from 2,200 ft to 4,460 ft and then 4,130 ft, and the aeroplane attitude varied between -1° and 15°.

2.4 Personnel Information

2.4.1 Instructor

The instructor had 17,000 flying hours experience, including 13,000 as Captain, 620 hours on type, 100 hours in the previous three months, including 72 on type and 28 on B737 and about 2 hours in the previous twenty-four hours. He held an ATPL (A) license issued by the Greek civil aviation authorities.

He had participated in the start-up of Hermes Airlines in March 2011.

He held a valid Airbus A320 type rating, obtained in September 2010 and a valid Boeing B737 type rating , obtained in 1990.

He had been an instructor and examiner (TRI/TRE) on B737 since 1994.

He was in charge of air operations and had held the position of TRI/TRE on Airbus A320 at the airline since its creation in 2011.

2.4.2 Student Pilot-in-command

He had 10,500 flying hours experience, including 33 as Captain on ATR42, 25 hours on type, 20 hours in the previous three months and about 2 hours in the previous twenty-four hours. He held an ATPL (A) license issued by the Greek civil aviation authorities.

He held a valid Airbus A320 type rating, obtained in November 2011. He had held type ratings on B737, Metro Fairchild and ATR 42/72, but these were no longer valid.

He had not flown for two years, between September 2009 and November 2011, after the cessation of activity of Olympic Airways. He was recruited directly as Captain on A320 by Hermes Airlines on 1 March 2012. During the event, he was undertaking his line-oriented flight training.

As of the day of the event, he had performed 13 legs including 9 as PF and 3 as PNF.

2.5. Conditions to Serve as a Captain

The European regulation (EU-OPS Subpart N) applicable on the day of the event indicates that the conditions for appointing a Captain include the following:

- a minimum level of experience specified in the operations manual of the operator and acceptable to the national civil aviation authorities;
- participation in a *"Captain"* course;
- completion of at least 10 sectors if qualified on type.

Part A of Hermes Airlines operations manual (A 5.2.2.2) specifies the requirements to operate as Captain:

- a minimum of 3,500 flying hours in air transport;
- successful completion of the "Captain" course as defined in Part D of the manual;
- line-oriented flight training with a minimum of 10 legs;
- to be appointed *"Captain"*.

A note indicates that the minimum experience requirements listed above may differ depending on the needs of the airline.

Part D (Training, 2.1.3.1) reproduces the minimum requirements to become a Captain and specifies a requirement for a minimum of 3,000 flying hours, including 500 hours on type. A co-pilot with less experience but with an above-standard level, as considered by the operations manager and the chief pilot, can be selected to attend the Captain training.

Airline officials indicated that, during this period, the airline had received 4 Airbus in addition to the Boeing 737 already in service. Given the urgent need for flight crew and regulatory documentation, the operations manual was drafted hastily and contained inconsistencies in the criteria for appointments to various positions.

2.6 Meteorological Information

Weather conditions observed at the airport at 00 h 30: wind from 110° of 6 knots, visibility 7,000 m, rain, few clouds at 800 ft, covered at 3,300 ft, temperature 6°C, dew point 4°C, QNH 1003 hPa, no significant change expected within 2 hours.

2.7 Interviews

2.7.1 Instructor

He stated that this was the first flight with the student pilot-in-command.

He also stated that on departure he manually selected Ajaccio ILS (110.30 MHz) in the RADIO NAV page of the MCDU, in case of QRF.

In flight, he listened to the Lyons Saint -Exupéry ATIS and set the FMGS for an approach to runway 18L. He said that the briefing was conducted 80 NM from top of descent. During the descent, the approach controller at Lyons Saint-Exupéry proposed an arrival on runway 36L. Thinking he was too high, he remembered having asked for clearance to turn to 360° but received only radar headings. Runway 36L was selected on the F-PLN page of the MCDU. After some difficulties in obtaining a correct ILS display, he confirmed the frequency displayed on the ND was 110.30 MHz with a distance of 99 NM, which seemed erroneous to him.

He finally managed to change the frequency and realized they were very low. At the same time, the GPWS warning was triggered. He said that he could see the ground and tried to locate the runway

2.7.2 Student pilot-in-command

Before initiating the descent to Lyons, he said he entered an arrival on runway 18L into the FMGS and gave a briefing for this arrival. When the approach procedure was changed, he extended the speedbrakes and indicated that the instructor changed the approach procedure in the FMGS. The instructor programmed for runway 36L but the 110.30 MHz frequency was displayed on the RADIO page of the MCDU whereas the ILS frequency for runway 36L is 110.75 MHz. He said he tried to change the frequency, with no success. He indicated that the instructor decided to manually change the frequency of ILS 36L. The pilot stated that below 5,000 ft, he thought he was established on the ILS. He did not remember the reason why an altitude of 400 ft was selected on the FCU when they passed 3,400 ft while descending.

A GPWS warning triggered and the instructor took over control, he initiated an emergency GPWS PULL UP procedure, pushed the thrust levers to the TOGA detent and applied nose-up inputs. He said they were within sight of the ground. The ILS frequency was displayed in small font on the RADIO NAV page of the MCDU and he could not change it.

Control of the glidepath had been carried out for the ILS approach procedure to runway 18L but they did not have time to do it for runway 36L. It seemed to him that the instructor said: *"I have control"*.

2.7.3 Controller

The controller remembered that the weather conditions were poor. Runway 18L had been in use throughout the day. Given the fact that the wind had dropped, he proposed an arrival on runway 36L. The aeroplane was at FL216. He said that his strategy was to have it descend quickly. When the aeroplane was at 40 NM, he remembered having heard the number 36 and taken this callout as a confirmation for runway 36. He stated that he then provided headings to guide it towards the localiser axis.

Considering that the aeroplane was above the glide, he provided a heading of 270° to slightly extend the flight path. Having received no reply from the crew, he repeated the message, and again did not get any reply. The controller indicated that he felt that the crew was slow to reply and imagined they had a problem on board. After the aeroplane crossed the axis, he provided a heading of 020°. When it was 14 NM away, the aeroplane still had not intercepted the localiser axis. He called twice and proposed to give the ILS frequency. He saw the aeroplane arriving at 11 NM, 2,400 ft (under the MSA) at a speed of 240 kt and with a vertical speed of -1,200 ft/min. He stated that he immediately advised the crew when an MSAW warning triggered. He began to lose confidence in the ability of the crew to manage the arrival. He noted that the aeroplane stabilised once at 2,700 ft and descended again to 2,200 ft, generating a second MSAW warning. He heard the instructor calling out the go-around and the application of the missed approach procedure.

3 - LESSONS LEARNED AND CONCLUSIONS

3.1. Flight Management

The failure to carry out checks of the RADIO NAV page on the FMGS, which are normally carried out when passing FL100 in a climb and during approach preparation, did not allow the crew to detect that the FMGS had not automatically selected the ILS for runway 36L at Lyons Saint-Exupéry and that the Ajaccio AC ILS was still active on arrival.

Changing from runway 18L to runway 36L shortened the approach distance, resulting in the aeroplane being high on the arrival path. The crew, who had not repeated their request to make a turn– which the controller did not understand - had therefore less time to prepare for the arrival on runway 36L.

When trying to capture the localiser axis, the crew used a great deal of their resources managing the display of the ILS frequency to the detriment of their monitoring of the aeroplane's vertical flight path and its configuration. The selection on the FCU of a target altitude of 400 ft, while the altitude of Lyons airport is 880 ft, indicates a loss of situational awareness and introduced a risk of dangerous ground proximity.

During the GPWS PULL UP emergency procedure, the failure to maintain the control column to the rear stop meant that the aeroplane could not reach the best climb angle in a night-time environment with poor weather conditions in which the crew had few or no external visual references. The 9.5° attitude displayed did not correspond to the missed approach attitude (15°) or to that of the GPWS procedure (control column to the rear stop).

The controller's inappropriate phraseology, during a flight phase where the aeroplane was still being vectored, may have prompted the crew, who had already reduced the rate of climb, to try and stabilise the aeroplane at an altitude of 2,500 ft.

At the time of the first MSAW warning, the controller was not aware that the crew was reacting to the GPWS warnings. The GPWS PULL UP emergency procedure does not provide for an information message for the controller. The changes in the flight path performed by the crew without informing the controller did not help him understand the intentions of the crew.

The dual input phase occurred after the crew's decision to abort the approach, after the second MSAW warning. A period of confusion was observed during a flight phase that was inherently dynamic and required precise flight control, especially at high speed.

The occurrence of dual inputs, which is a reflex action, may have been encouraged by a combination of several factors:

- the instructor did not formalize his taking over the controls (no *"I have control"* callout); even though the dual input phase did not immediately follow the control take-over the lack of callout did disrupt the role sharing;
- the crew had extensive experience of aeroplanes with dual flight controls and although the instructor was dual-qualified to fly Boeing 737 and Airbus A320, whose interface with the flight controls is very different.

3.2 Requirements to serve as a Captain

The student pilot-in-command had recently been hired by the airline to serve as a Captain on Airbus A320. He was undertaking line-oriented flight training and had a total of 25 flying hours on Airbus A320. He had almost no experience as a Captain.

European legislation provides that the conditions to serve as a Captain should be specified in the operations manual of the airline. The conditions to become and serve as a Captain are described in several sections of the Hermes Airlines operations manual and specify different experience criteria. A phrase in the manual states that *"the experience criteria may vary according to the needs of the airline"*, allowing the latter to adapt the criteria it actually applies to the performance of this function. Under these conditions, the student pilot-in-command had to simultaneously assimilate a new aeroplane and a new function.

In addition, the instructor, who had extensive flying experience, also held management positions within the airline, involving an additional managerial workload and less frequent flights.

Both crew members had extensive flying experience on Boeing 737, whose operating logic and presentation of information are different from those of the Airbus A320.

3.3 Causes

The serious incident was due to:

- initially, continuing the descent during the ILS approach to runway 36L while the airplane was not configured or stabilised on the localiser axis, resulting in dangerous ground proximity;
- after the first GPWS warning, the inadequate application of the GPWS emergency procedure, in particular in terms of setting the attitude.

The following factors contributed to the serious incident:

- inadequate application of normal procedures, task-sharing and emergency procedures, resulting in highly degraded crew situational awareness (position in space, configuration);
- the limited experience on type of both crew members;
- the operator's desire to quickly train a pilot with low experience on type as a Captain;
- variable criteria to serve as a Captain;
- the use of inappropriate MSAW phraseology by the controller.

Note: In accordance with the provisions of European Regulation (EU) n° 996/2010, the BEA associated its Greek counterpart, the AAISB, with the investigation.

The AAISB made the following comment: "in the contributing factors mentioned in para. 3 .3 "Causes", the BEA could add "the crew's lack of CRM".

The BEA shares this aspect of the analysis but considers that the lack of CRM resulted from inadequate application of the standard, task-sharing and emergency procedures. These elements are already mentioned in the contributing factors.