**Published April 2013**

# Report

Serious incident on **7 September 2010**
at **Lyon (69 France)**
to the **Boeing 737-400**
registered **TC-TLE**
operated by **Tailwind Airlines**

BEA

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

Ministère de l'Ecologie, du Développement durable et de l'Energie

# *Safety Investigations*

*The BEA is the French Civil Aviation Safety Investigation Authority. Its investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liability.*

*BEA investigations are independent, separate and conducted without prejudice to any judicial or administrative action that may be taken to determine blame or liability.*

## SPECIAL FOREWORD TO ENGLISH EDITION

*This report has been translated and published by the BEA to make its reading easier for English-speaking people. As accurate as the translation may be, the original text in French is the work of reference.*

# *Table of Contents*

# *Glossary*

| | |
|---|---|
| AIP | Aeronautical Information Publication |
| AIs | Aeronautical Information Service |
| DSAC-IR | Direction de la Sécurité de l'Aviation Civile Inter-Régionale<br>(Inter-regional Civil civil aviation safety directorate |
| DSNA | Air navigation services |
| EGPWS | Enhanced Ground Proximity Warning System |
| EHSI | Electronic Horizontal Situation Indicator |
| FAF | Final Approach Fix |
| FAP | Final Approach Point |
| FMC | Flight Management Computer |
| MCP | Mode Control Panel |
| MDA | Minimum Descent Altitude |
| MOCA | Minimum Obstruction Obstacle Clearance Altitude |
| MSAW | Minimum Safe Altitude Warning |
| NM | Nautical Mile |
| OM | Outer Marker |
| PF | Pilot Flying |
| PM | Pilot Monitoring |
| QAR | Quick Access Recorder |
| SNA-CE | Centre-East air navigation services |

# Synopsis

**Date**
7 September 2010 at 17 h 10 min(1)

**Place**
Lyon Saint-Exupéry Airport (69)

**Type of flight**
Scheduled international public transport of passengers

**Aircraft**
Boeing 737-400 registered TC-TLE

**Owner**
ILFC

**Operator**
Tailwind Airlines

**Persons on board**
Crew: 2 flight crew and 5 cabin crew
Passengers: 98

(1)Unless otherwise specified, the times in this report are expressed in Universal Time Coordinated (UTC). Two hours should be added to obtain the legal time applicable in Metropolitan France on the day of the event.


## SUMMARY

On arrival at Lyon Saint-Exupéry, the crew made a non-precision localizer/DME approach to runway 36R. The cloud ceiling was close to the MDA. The final descent began before the final approach point published for the altitude of the aircraft and remained below the theoretical profile for the approach. An MSAW warning was generated in the control tower. The controller ordered a go-around. The crew made a go-around. The minimum height provided by the radio altimeter was 250 ft at 1.4 NM from the runway threshold.

The incident was due to:

- Misidentification of the step-down fix by the crew and;
- Inadequate control of the final glide path by the crew.

The publication of two FAPs, one of which is to be used on instruction from the controller, including the fact that its use was extended to the non-precision approach, and the absence of information to the crew concerning the exact identification of the final approach procedure to use, constituted contributory factors.

The BEA sent the DGAC various safety recommendations with regard to:

- Communication to crews of the complete identification of the final approach procedure;
- Identification and removal of any publications of non-precision approaches with multiple FAFs;
- Clarification of reference materials used by procedure designers;
- Radar vectoring practices.

## ORGANISATION OF THE INVESTIGATION

After an MSAW warning, SNA-CE controllers drafted an aviation incident report (FNE) that was sent to the BEA the following morning. This delay prevented the BEA from removing the flight recorders and obtaining the testimony of the crew, who left with the aircraft later that night.

The initial information in possession of the SNA-CE and forwarded to the BEA included a flight identification of the Tunisair airline. The registration number of the aircraft was not mentioned.

In accordance with Annex 13, the BEA initially notified the aviation authorities of Tunisia on 8 September, as the State of the Operator of the aircraft.

By 9 September, it appeared that the aircraft had been registered in Turkey. The Turkish aviation authorities were notified the same day as the authorities of the State of Registry of the aircraft. It then appeared that the aircraft had in fact been leased, with its crew, by Tunisair to Tailwind Airlines, which holds an Aircraft Operator Certificate issued by the Turkish authorities. The aircraft was to be returned to the airline in the days following the incident. For this reason, within the meaning of Annex 13, Turkey is the State of the Operator.

The information received by the BEA for the investigation was essentially provided by the Tunisian authorities and by Tunisair in the few days preceding the return of the aircraft to Turkey. The information included in particular a flight parameter file from the aircraft's QAR. The participation of Tunisia in this investigation is therefore in line with paragraph 5.23[(2)] of Annex13. The Turkish authorities did not respond to the request from the BEA investigators to arrange meetings with the crew and executives of the airline.

The U.S. National Transportation Safety Board (NTSB) was notified on 9 September, the U.S. being the State of Design and Manufacture of the aircraft.

[(2)]"Any State which on request provides information, facilities or experts to the State conducting the investigation shall be entitled to appoint an accredited representative to participate in the investigation."

# 1 – FACTUAL INFORMATION

## 1.1 History of the flight

Note: The numbers listed below after the times of flight refer to the positions shown in Figures 1a and 1b below.

At 16 h 52, the crew of TC-TLE, whose radio callsign is TAR 750, contacted the Lyon approach controller. The ATIS information code 'Y' was in use. It indicated that the localizer procedure for runway 36R was in use for landing on that runway, and that the glide for the 36R ILS was out of service.

At 17 h 02 min 12①, the crew was descending to 4,000 ft, with radar vectoring on heading 270°. They were instructed to turn to heading 320° and to intercept the localizer for runway 36R. The crew replied that they would intercept the 36R localizer. The readback of the intercept heading was not recorded in the radio-communications with the control tower.

At 17 h 03 min 22②, the crew signalled that they were approaching the localizer. Their heading was 270°. The controller asked them to turn to heading 020° and to intercept the localizer. The aircraft started to turn when it crossed the localizer, and then established on the requested heading.

At 17 h 04 min 52③, the controller cleared the crew to descend to 3,000 ft and cleared them to approach.

At 17 h 05 min 15④, the controller asked the crew to accelerate to 200 kt. The crew agreed.

At 17 h 06 min 58⑤, the crew was transferred to the tower frequency.

At 17 h 07 min 12⑥, the aircraft was aligned with the localizer and stable at 3,000 ft. It started its final descent 10 NM from the threshold.

Note: At 3,000 ft, the final approach point for an ILS approach (FAP) is indicated at 6.9 NM on the approach chart "ILS Y [...] or LOC 36R" published by the AIS.

At 17 h 09 min 09, the preceding aircraft reported that it broke out of cloud cover at the MDA.

At 17 h 09 min 32⑦, the controller relayed this information to the crew of TC-TLE.

At 17 h 09 min 52⑧, the controller had received no answer. While he was repeating his message, the MSAW warning was activated. He ordered a go-around three times.

At 17 h 10 min 03⑨, the crew performed a go-around.

The whole of the final descent was made under the published approach profile.

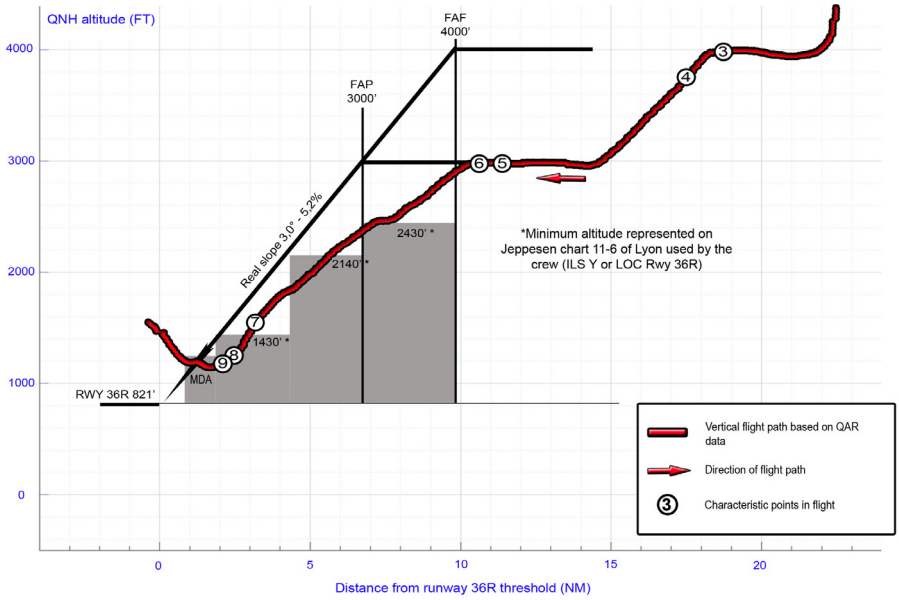



Figure 1a: Vertical flight path

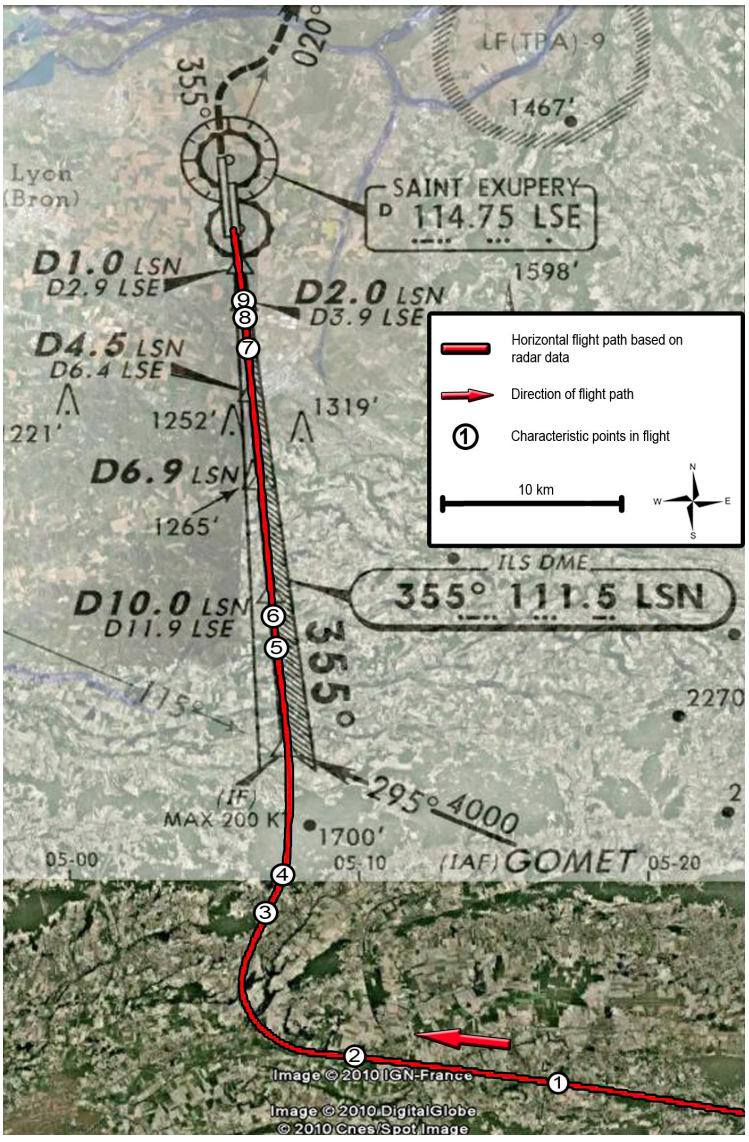



Figure 1b: Horizontal flight path

### 1.2 Killed and Injured

Not applicable.

### 1.3 Damage to Aircraft

No damage was caused to the aircraft.

### 1.4 Other Damage

No other damage was caused.

### 1.5 Personnel Information

#### 1.5.1 Captain

Male, 64, of Turkish nationality

- Valid ATPL license issued by Turkey in 1989;
- Valid B737 300-900 type rating;
- Valid Class 1 medical certificate;
- Experience:
  - Total: 22,310 flying hours;
  - On type: 16,000 flying hours;
  - In the previous thirty days: 80 flying hours.

His last recurrent training course with simulator training and check, including a non-precision instrument approach down to the MDA, was taken in March 2010. His last line check was in April 2010.

The training and check were performed within Tailwind Airlines.

#### 1.5.2 Co-pilot

Male, 31, of Swedish nationality, holder

- Of a valid CPL license issued by Sweden in 2005;
- Of a valid B737 300-900 type rating;
- Of a valid Class 1 medical certificate.
- Experience:
  - Total: 1,150 flying hours;
  - On type: 700 flying hours;
  - In the previous thirty days: 91 flying hours.

His last simulator check, including a non-precision instrument approach up to the MDA, was undertaken in March 2010. His last line check was undertaken in July 2010.

These checks were performed within Tailwind Airlines.

### 1.6 Aircraft Information

| | |
|---|---|
| Manufacturer | Boeing |
| Type | 737-4Q8 |
| Serial number | 27628 |
| Registration | TC-TLE |
| Entry into service | 1997 |
| Certificate of airworthiness | Valid |

### 1.7 Meteorological Conditions

The Lyon region was affected by an unstable, stormy cold front associated with a high-altitude wind from the south-west. There was a high risk of turbulence.

The wind forecasts, prepared on the day of the event at 12 h 00 and valid at 18 h 00, indicated a south-southwest wind of 40 to 45 kt at FL 100, a southerly wind of 45 kt at FL 50, and a southerly wind of 15 kt at FL20. On the ground, the wind speed was low, and the wind northerly.

The Lyon Saint-Exupéry TAF issued at 05 h 00 on the morning of the event forecast for the day the presence of showers and gusts of wind, the probability of thunderstorms and cumulonimbus, and a cloud ceiling higher than or equal to 1,000 ft.

The automatic METARs valid at 17 h 00 and 17 h 30 were as follows:

- At 17 h 00: wind 340° at 6 kt, visibility 5,000 meters, rain, mist, few clouds at 600 ft, broken at 2,500 ft, broken at 3,400 ft, the presence of cumulonimbus, temperature 16°C, dew point 15°C, QNH 1003 hPa;
- At 17 h 30: wind 330° to 040° at 5 kt, visibility 5,000 meters, rain, mist, thunderstorms in the vicinity of the aerodrome, few clouds at 500 feet, scattered at 2,400 feet, broken at 3,000 ft, the presence of cumulonimbus, temperature 16°C, dew point 15°C, QNH 1003 hPa.

### 1.8 Aids to Navigation

#### 1.8.1 Radio

From GOMET, the published initial approach fix was based on the VOR VNE which was in working order. The crew, however, benefited from radar vectoring like the other aircraft arriving in the same period.

The LSN localizer and the LSN DME were working. The associated glide path was down for maintenance and was not broadcasting. A NOTAM (A4832/10) stated that unavailability: "GP runway 36R 332.9 MHz U/S." It was included in the crew's flight dossier.

The go around was based on the LSE VOR / DME which was in working order.

### 1.8.2 Minimum Safe Altitude Warning system

The Lyon approach has a minimum safe altitude warning system, as shown in the publications associated with the aerodrome (AIP France AD2 LFLL-7). The operational conditions of use are also published in the AIP (AIP France AD 1.0). Relevant details are listed in section 1.17.2.2.

The principle of this system is to calculate an extrapolated position approximately 35 seconds from the radar track. This position is then compared with a digital model of the terrain and a database of obstacles. If the extrapolated position is located at a height below a certain threshold in relation to the ground or to obstacles, respectively 300 ft or 600 ft for one and the other of the two extrapolation hypotheses, a warning is generated. It is then displayed on all the radar screens in the IFR room and in the control tower cab, except if it is located in the exclusion zones that are intended to avoid false warnings. All the labels of the track flash red and white alternately. An aural "Low altitude alert" warning is also issued.

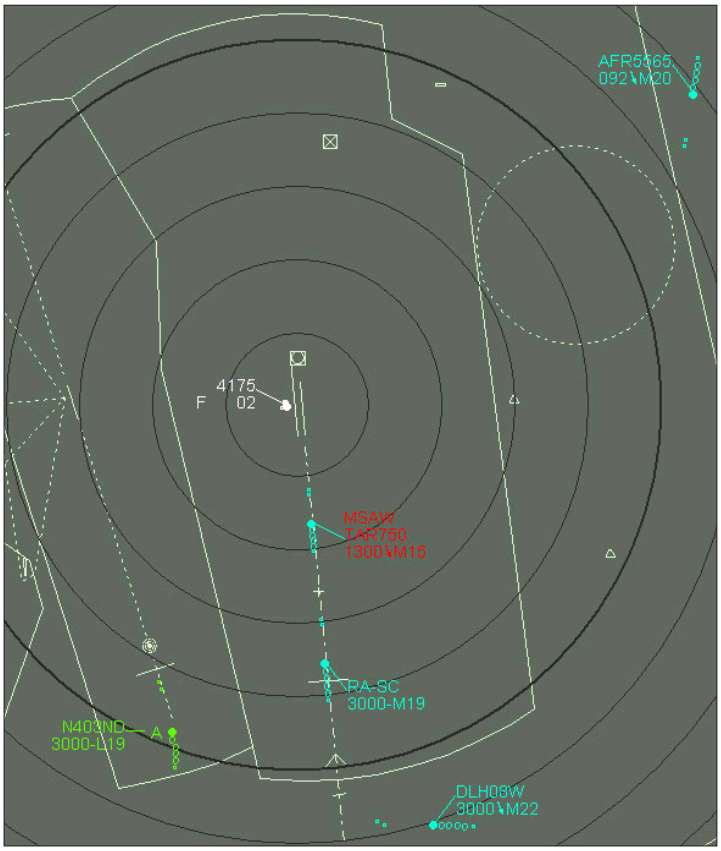



Figure 2: Extract from the radar playback for the event

## 1.9 Telecommunications

### 1.9.1 ATIS frequency

ATIS information code 'X' recorded at 16 h 11 min indicated among other things:

- "Type of approach TALAR RUNOM ARBON GOMET approach loc 3 6 right";
- "Caution glide 3 6 right out of order";
- "Wind 080° 3 knots, estimated visibility more than 10 kilometres, light rain, clouds few 1,800 feet, scattered 3,100 feet and tower cumulus".

ATIS information code 'Y' recorded at 16 h 47 min and used by the crew indicated among other things:

- "Loc 3 6 right approach";
- "Caution glide 3 6 right is out of service";
- "Wind 240° 7 knots, estimated visibility 5 kilometres, moderate rain, clouds few 2,000 feet, broken 2,700 feet, broken 3,400 feet, cunimbs".

### 1.9.2 Control frequencies

Communications between the controllers and the crew of flight TAR750 took place in English. Taking into account the accent of the messages transmitted by the crew and their nationalities, Turkish for the captain and Swedish for the co-pilot, we can attribute these messages to the captain.

Only the important points are described below.

At 16 h 52 min 55, the crew of flight TAR750 contacted the Lyon approach, as they were descending to FL 150, at AMVAR. The controller informed them that they would be provided with radar vectoring for the "localizer" approach to runway 36R.

At 16 h 59 min 53, the crew was transferred to the next controller at heading 270° to FL 100, and at 220 kt. The latter value was not read back by the crew.

At 17 h 01 min 28, the crew was cleared to descend to 4,000 ft.

At 17 h 02 min 12, the crew was instructed to turn right to heading 320° and then to intercept the 36R localizer. The crew read back the intercept instruction but not the heading.

At 17 h 03 min 22, the crew signalled that they were approaching the localizer. The controller requested they turn right to heading 020° for a new intercept; the message was read back by the crew.

At 17 h 04 min 52, the controller cleared the crew to descend to 3,000 ft and cleared them for approach to runway 36R; the message was read back by the crew. A few seconds later, the controller asked the crew to increase their speed from 170 to 200 kt. The crew was then transferred to the next controller.

At 17 h 07 min 48, the controller cleared (in French) an aircraft to land and indicated the last wind value before the event: 350°, 7 kt.

At 17 h 09 min 09, the crew of the aircraft had just landed and said (in French): "... we broke through the cloud ceiling at minimum altitude..." and suggested that the glide be put back into service. The controller replied that the glide was down for maintenance and asked "...at approximately what altitude did you break through cloud ceiling?". The crew replied "uh, 1,250 ft, it was almost go-around and so uh, I think the left-hand 36 would be welcome."

At 17 h 09 min 32, the controller relayed this information to the crew of flight TAR750: "TAR 750 for information preceding traffic get out of the ceiling about 1,200ft ... above ground." The crew did not respond.

At 17 h 09 min 49, the controller tried to contact the crew again. While they were replying, the MSAW warning was triggered, the controller said "*traffic alert heu go around! Go around!*". The crew asked him to repeat. The controller ordered twice to go-around ("*Terrain alert, go around!*") followed immediately by "*Tunisair750 go around!*").

At 17 h 10 min 03, the crew called out the go-around.

After the go-around, the crew received vectoring for a new approach on the 36L ILS.

During the period recorded, all the crews were given 3,000 ft as the last vertical clearance before being cleared to make a final approach.

## 1.10 Aerodrome Information

### 1.10.1 Environment

The aerodrome is located in the Rhone valley at an altitude of 821 ft. To the southeast of the aerodrome, towards the Alps, the first high ground is located about twenty nautical miles away. In this sector, the minimum radar safety altitudes are high, as shown in the following illustration, taken from AIP France map ref. AD2 LFLL AMSR:

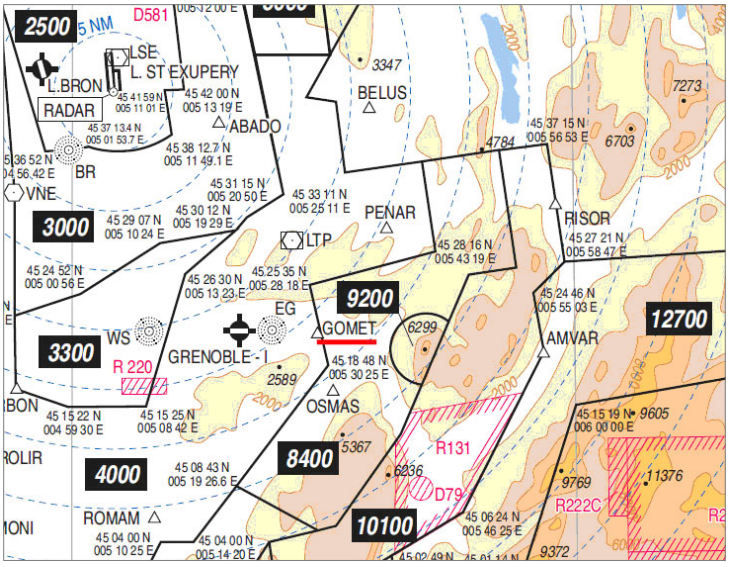



Figure 3: Excerpt from the map of minimum radar safety altitudes
The GOMET initial approach fix is highlighted in red. The blue dotted circles are spaced 5 NM apart

### 1.10.2 Infrastructure

Lyon Saint Exupery has a pair of parallel runways.

In normal conditions of use, runway 36L/18R, which is 4000 m long, is used for takeoffs, and runway 36R/18L, which is 2,670 m long, is used simultaneously for landings. All movements can be assigned to a single runway, in the event of closure of the other runway, for example. However, there is no working method defined for simultaneous use of runway 36R/18L for takeoffs and runway 36L/18R for landings.

The left-hand and right-hand runways 36 are equipped with ILS and runway approach lights.

### 1.10.3 Approach procedures to runway 36R

- ILS or localizer procedure:
  - File AD2 LFLL IAC 03 of the AIP France (see appendix 2) describes the trajectories to reach the approach centreline from the three initial approach fixes TALAR, RUNOM and ARBON. These initial approach fixes are followed by the intermediate and final approach fixes "ILS z [...] or LOC 36 R" described on file AD2 LFLL IAC 08. The last part of the initial approaches provides for a descent to 3,000 ft, the altitude of the intermediate step-down fix and of the final approach fix (for the localizer procedure) at 6.9 Nm from the LSN DME.
  - The approach from the initial approach fix GOMET, "ILS y [...] or LOC 36R", provides for a descent to 4,000 ft minimum, the level-off altitude of the intermediate approach. The final approach fix is located at 10 NM from the LSN DME. A box stipulates "In the case of clearance at 3000 ft, FAP at 6.9 NM LSN", as illustrated by the following extract (see the complete file AD2 LFLL IAC 10 in appendix 2):

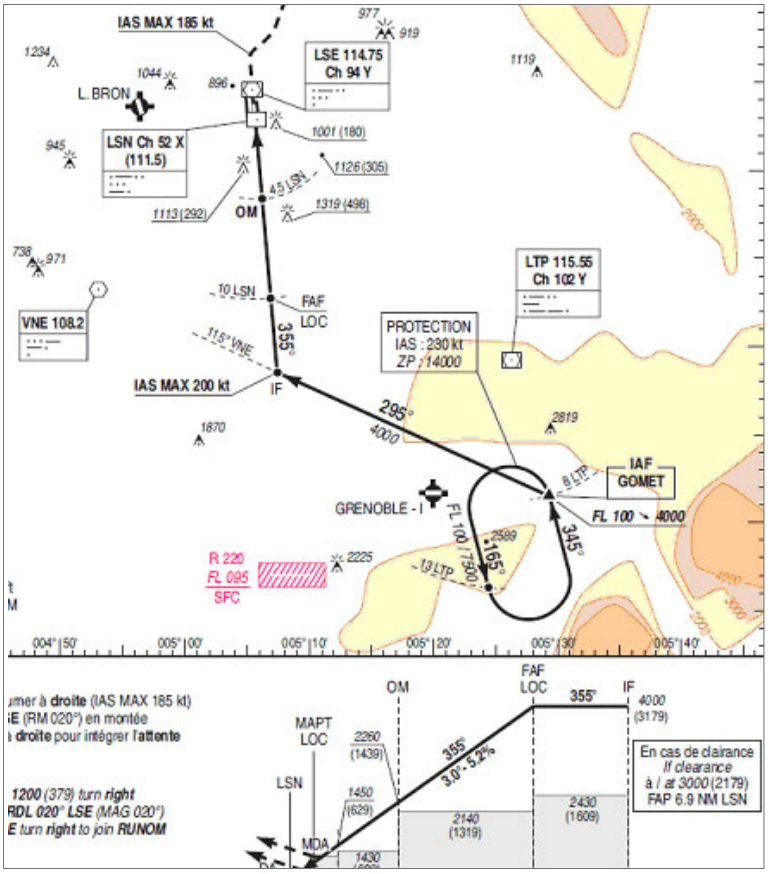



Figure 4: Extract from file AD2 LFLL IAC10 showing the "ILS y […] or LOC 36R procedure"

The MDA published for the LOC 36R approach is 1,250 ft. The threshold elevation is 821 ft.

- VOR procedure (LSE, located on the runway 36R extended centreline):
  - The four initial approaches published provide for a descent to 3,000 ft, the level-off altitude of the intermediate approach. From GOMET, this descent is only possible after passing a marker beacon fix near the approach course. Upstream of this point, the minimum altitude is 4,000 ft.

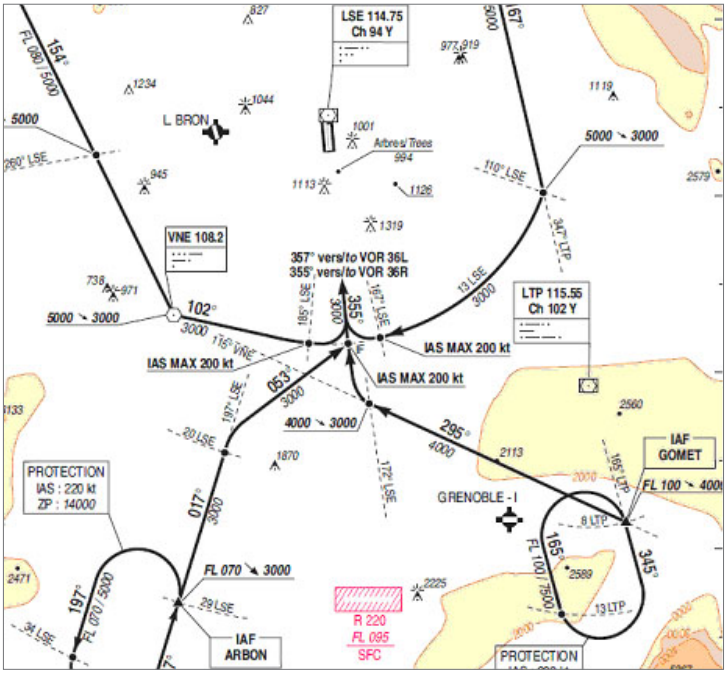



Figure 5: Extract from the file AD2 LFLL IAC 04 describing the initial approaches based on the VOR LSE

## 1.11 Flight Recorders

Tailwind Airlines provided a parameter file from the on-board QAR. The main parameters are presented in Appendix 1.

A summary of the key events is shown below and includes information from the QAR, the radar and radio recordings.

In addition to this information, the following points should be noted:

- No failure of any item of equipment was recorded;
- The ground speed was approximately 40 kt higher than the calibrated airspeed for altitudes above 3,000 ft although the aircraft was flying northwards, turning or stable on heading 020°. It was no longer higher than about 10 kt when the aircraft was at 3,000 ft and aligned with the localizer. The two speeds were very close to each other during the final approach, indicating a stable, low wind component. The drift value was also low during this phase;
- During the first convergence towards the localizer (events referenced one to two in the illustration on page 18), the lateral mode of the autopilot was HDG. The VOR/LOC mode was not armed;
- At a height of approximately 1,000 ft agl, the calibrated airspeed was stable at approximately 150 knots, the flaps were extended to 30°, the landing gear was extended, the heading was stable at 354°, the localizer gap was zero;
- The minimum altitude recorded in the FAF-OM segment was 1,837 ft or 303 ft below the minimum safe altitude of 2,140 ft. In this segment the MO was 90 m or approximately 300 ft (see paragraph 1.17.3.1). On the next segment, the minimum altitude recorded was 1,153 ft or 277 ft below the published minimum safe altitude (1,430 ft). The MOC was 75 m or approximately 250 ft;

- The autopilot was engaged in CMD mode until a recorded altitude of 1,277 ft, reached at 17 h 09 min 49 s, three seconds before the controller indicated the MSAW alert to the crew. The auto-throttle was engaged in MCP speed mode until 17 h 10 min 02, i.e. when the crew called out the go-around;
- Parameters N1 and N2 for the engines followed the Thrust Lever Angle (TLA) parameters of the throttles for the duration of the approach and go-around;
- The minimum radio altitude of 250 ft. was recorded at 17 h 10 min 21. At that time the barometric altitude was 1,181 ft;
- The recording of the parameters associated with the EGPWS showed no triggering of any warning. Analysis of the flight parameters shows that the criteria for triggering basic GPWS warnings (modes 1 to 5) were not met during the approach.This analysis was not carried out with the «advanced» functions which depend on the digital terrain model used.

BEA

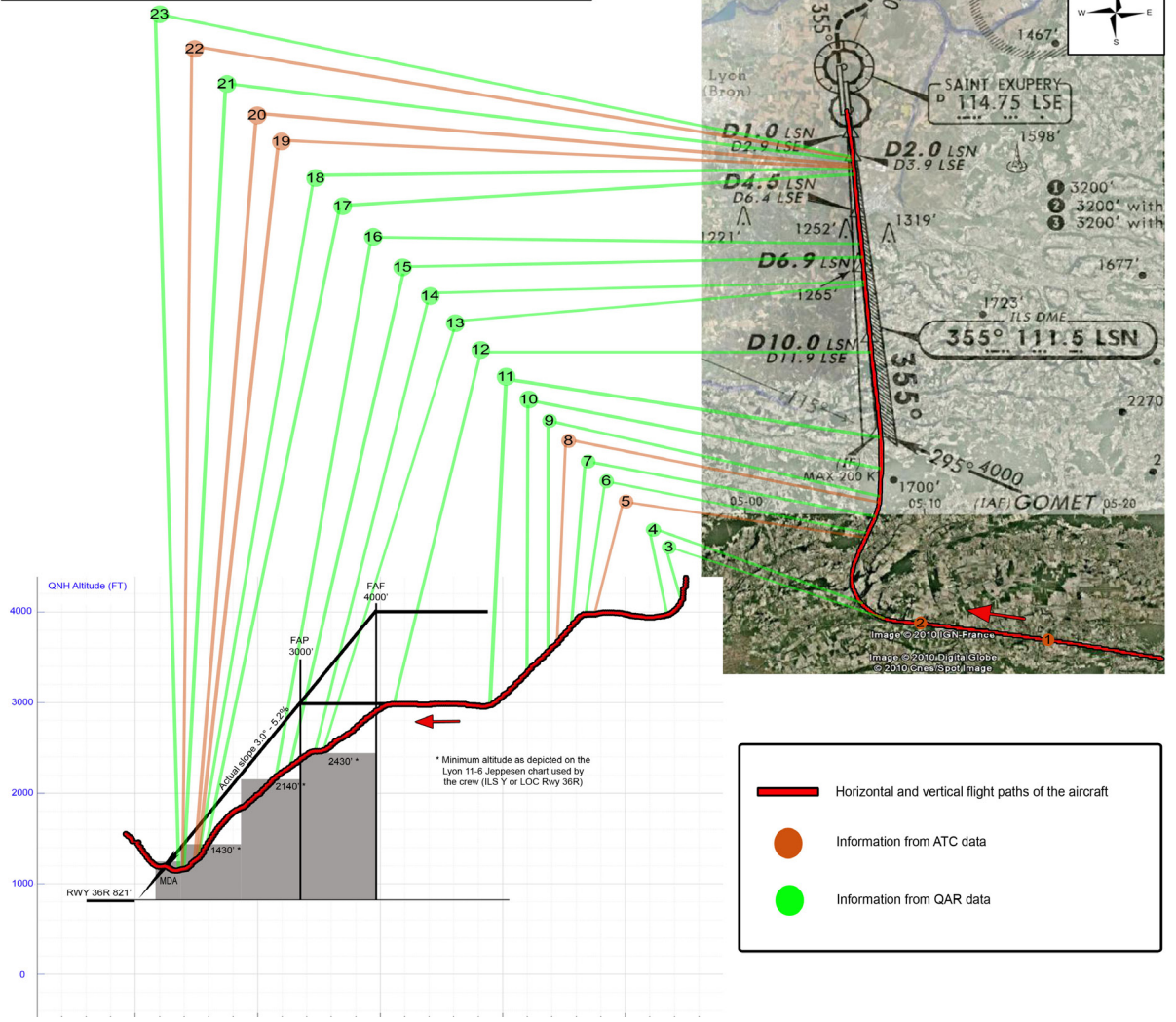
**TC-TLE B737-400 07/09/2010**

**Horizontal flight path from radar data**
**Vertical flight path from QAR data**



## Sequence of events:

1. 17h02min12s: "Turn right heading 320 intercept localizer 36R"
2. 17h03min24s: "Turn right heading 020 to intercept LOC 36R"
3. 17h03min45s: Flaps 1
4. 17h03min59s: A/P mode *ALT Hold* engaged
5. 17h04min52s: "Descend 3000 ft cleared approach 36R"
6. 17h04min55s: A/P mode *Vertical Speed* engaged
7. 17h05min10s: A/P mode *VOR/LOC* engaged
8. 17h05min21s: "Increasing 200 Tunair 750"
9. 17h05min26s: Flaps retraction
10. 17h05min42s: A/P mode *Approach* engaged
11. 17h06min08s: A/P mode *ALT Hold* engaged
12. 17h07min12s: A/P mode *Vertical Speed* engaged
13. 17h08min03s: A/P mode *ALT Hold* engaged
14. 17h08min06s: A/P mode *Vertical Speed* engaged
15. 17h08min26s: Flaps extension
16. 17h08min37s: Landing gears extension
17. 17h09min44s: A/P mode *ALT Acq* engaged
18. 17h09min49s: A/P disengaged
19. 17h09min50s: MSAW alert
20. 17h09min52s: "750 traffic alert err... Go Around ! Go Around !"
21. 17h10min02s: A/P mode *TOGA and ATS mode GA* engaged
22. 17h10min03s: "Go Around Tunair 750"
23. 17h10min04s: ATS disengaged



## 1.12 Wreckage and Impact Information

Not applicable.

## 1.13 Medical and Pathological Information

Not applicable.

## 1.14 Fire

Not applicable.

## 1.15 Survival Aspects

Not applicable.

## 1.16 Tests and Research

Not applicable.

## 1.17 Information on Organisations and Management

### 1.17.1 Tailwind Airlines

#### *1.17.1.1 Background information*

According to the information available on its website, Tailwind Airlines had the following approvals issued by the Turkish Civil Aviation authority:

- An air transport certificate (N° TR-022) issued for the first time on 12 May 2009, renewed on 27 April 2010 and valid until 3 May 2012, certifying compliance with JAR-OPS 1. The aircraft used are of the Boeing 737-400 type;
- Approval for the maintenance of Boeing 737-400, and JAR-145 approval, both valid;
- A valid certificate for type rating training on Boeing 737-400 (No. TR-TRTO (A) -23) certifying compliance with JAR-FCL 1.

#### *1.17.1.2 Control of the flight during non-precision approach flight conditions*

Part B of the Tailwind Airlines Operations Manual includes the following information for a non-precision approach on a Boeing 737-400:

- Non-precision approaches are normally conducted with Vertical Speed and VOR/LOC or HDG modes;
- The auto-pilot and the two flight directors should be used;
- The PF should use the MAP representation on the EHSI, the PM the VOR / ILS representation;
- The proper approach should be selected in the FMC. The points on the Jeppesen chart to be flown over between the final approach fix and the point at which the MDA is reached should be deleted;

- For most non-precision approaches, the point at which the MDA is reached must be calculated[3] and inserted into the FMC, if this point is upstream of the MAP. Otherwise, the MAP is to be inserted;
- When the autopilot is in ALT HOLD mode when approaching the FAF, the MDA rounded off to the next highest 100 ft must be displayed on the MCP;
- The landing configuration must be obtained before the flying over the FAF;
- When crossing the FAF, the vertical speed should be adjusted on the MCP in order to place the green arc[4] just before the previously calculated point. The PM should monitor the crossing points and intermediate altitudes;
- At 300 ft above the MDA, the go-around altitude must be displayed on the MCP. At the MDA, the PM should call out whether the runway is in sight or not. The descent must only be continued below the MDA if the runway threshold is in sight;
- If the runway is in sight at the MDA or before, the autopilot and auto-throttle must be disconnected and the flight directors recycled (OFF and ON) in order to reset them for the go around.

Note: This flight control technique is consistent with the procedures published by Boeing in its Flight Crew Training Manual (FCTM).

[3]The method to use consists of calculating the distance from the point to the threshold using the equivalence of 1,000 ft / 3 Nm for an approach slope at 3°.

[4]«Altitude Range Arc» is a green arc represented on the EHSI in MAP mode. It indicates the approximate position at which the aircraft will reach the altitude selected on the MCP, taking into account the current ground speed and vertical speed.

### 1.17.2 Air Traffic Services

#### *1.17.2.1 Content of ATIS messages*

The regulation (SCA 4.3) provides that ATIS messages include the "types of approach to foresee".

#### *1.17.2.2 Procedures associated with a MSAW*

ICAO document ref. PANS-ATM stipulates the standard phrases to be used by a controller in case of a terrain proximity alert. The message is divided into three parts:

- Call sign of the aircraft;
- "Terrain alert";
- Suggested manoeuvre, if possible.

The AIP (AIP France AD 1.0 section 2.2) describes the terms of use of the MSAW based on Air Traffic Regulations (RCA) (RCA 3, paragraph 2.2.2.3.4). It is stated that "it is up to the captain to whom this information is provided to determine the action to be undertaken and to inform the controller as soon as possible." The phraseology to be used immediately by the controller when the aircraft is not being radar vectored is as follows: "[call sign], terrain alert check your altitude immediately".

The operations manual of the SNA-CE uses the same phraseology. It does not explicitly state that it is up to the captain to determine the action to be undertaken. It states that any MSAW warning must be communicated to the control tower manager for notification to the BEA.

Note: After local feedback, the Service Quality subdivision verbally recommends controllers to give a go-around instruction when an MSAW alert occurs for an aircraft on a final approach at night or in poor weather conditions. This phraseology is considered to be more effective than the phraseology of the AIP and the operations manual, both of which generate checks or questions from the crew at a time when there is no time.

### 1.17.3 Study and publication of the ILS or LOC 36R approach procedure via GOMET

The localizer procedure for runway 36R from GOMET with an intermediate approach at 4,000 ft was commissioned on 18 March 2004 after major restructuring of the airspace in the Lyon region.

As part of this operation, dubbed "Clarines", several procedures were designed or redesigned to optimise the integration of the constraints related to the new airspace, operational needs, the location and nature of ground radio facilities, to residents and, of course, to obstacles and the technical regulatory requirements, as shown in Appendix 3. Among the innovations resulting from this operation, the GOMET IAF was created with its associated hold and the initial approach trajectories.

These procedures were designed by one and then two members of the DAC-CE staff (Central East Civil Aviation Authority) between mid 2002 and mid 2003, a schedule imposed by the date of commissioning of the procedures in question. It should be noted that the obstacles were then studied using transfer paper upon which the trajectories and protected areas were drawn by hand. When superimposed on maps of the area, they were used to identify obstacles and to deduce the minimum altitudes with which to comply.

No technical and operationally realistic solution was found to be satisfactory in order to publish an intermediate approach at 3,000 ft for the ILS 36R approach while respecting the above constraints. This possibility, however, was chosen for the VOR DME approach, due to the various technical requirements for this type of approach (see Appendix 3). The compromise adopted for the ILS approach was to publish an intermediate approach at 4,000 ft accompanied by an insert mentioning the possibility of descending to 3,000 ft with an FAP[5] shifted to 6.9 nm, to enable radar vectoring as soon as the aircraft was flying in sectors where the AMSR is compatible with this strategy. Other approach charts for other aerodromes included this type of insert.

Note: At the time of writing of this report, the possibility of an insert is mentioned in the "Compendium of Cartographic Techniques" that can be used by procedure designers (see Appendix 3).

It was not considered necessary to request an exemption from one of the technical criteria, a possibility provided by the regulation, since a regulatory solution was available.

In the autumn of 2003, a consultation on the overall system was organised for the main airlines using the airport and local residents. This did not result in any significant items justifying the amendment of the scheduled procedures. The Director of Civil Aviation then signed the charts, and publication requests were sent to the AIS.

Publication of this procedure was subsequently amended to reflect the changes in the regulations set out in Appendix 2. The update of the ILS Y or LOC 36R procedure in effect on the day of the event dates from 24 September 2009.

[5] For a precision approach (complete ILS), the top of the final descent is identified by an FAP. For the associated non precision approach (ILS without glide), statutorily represented on the same chart, the top of descent is marked by an FAF. Section 1.18.4 specifies these two concepts.

The publication of this procedure was amended on 25 August 2011. The insert indicating the FAP at 3,000 ft was deleted. There remained only the intermediate approach at 4,000 ft and the associated FAP.

For the final segment of the non-precision approach (ILS without glide):

The FAF - OM segment has an MOC of 90 m leading to the minimum altitudeof 2,140 ft. The penalizing obstacle is located between the FAF and the upstream FAF[6], i.e. at a distance slightly greater than 10 NM from the threshold.

The OM – 2 NM segment has an MOC of 75 m leading to the minimum altitude of 1,430 ft. The penalizing obstacle is located between the OM and the upstream OM, i.e. at just over 4.5 NM from threshold.

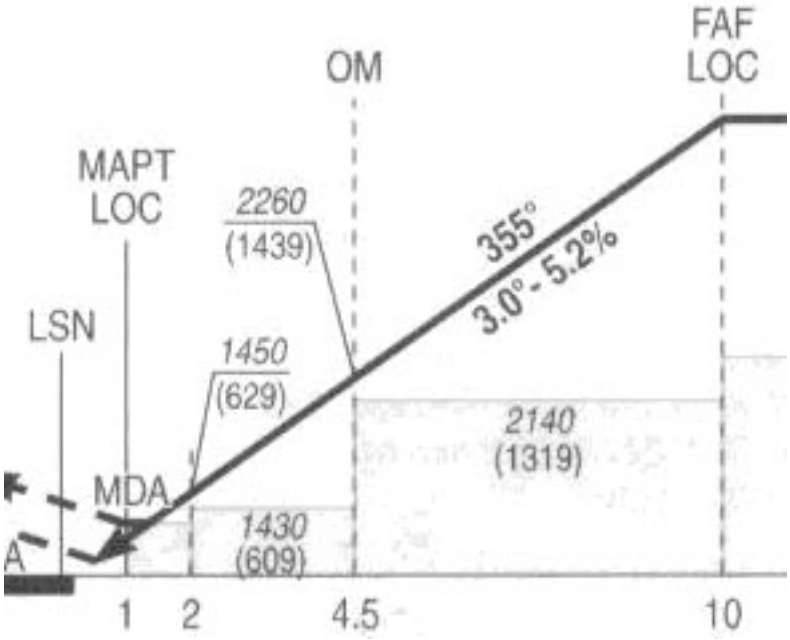



Figure 6: Final approach segment

## 1.18 Additional Information

### 1.18.1 Crew testimony

This testimony comes exclusively from the Captain's flight report, sent by the airline. The key points are listed below:

- The crew used the ATIS Y information, and noted the unavailability of the glide;
- The crew was prepared for an approach «ILS y or LOC y RWY 36 R» using the Jeppesen 11-6 procedure plate below, with an MDA of 1,250 ft defined for the procedure without glide;
- Second in the arrival sequence, they were instructed to intercept the localizer for runway 36R and was instructed to «clear to app RWY 36 R LOC»;
- The crew was aware of the weather conditions;
- During the descent, they heard the controller order the preceding aircraft to go around.

[6]The procedure design principles require the definition of the upstream and downstream fixes associated with the theoretical fix. They are constructed according to the uncertainties due in particular to the radio facilities used to identify the vertical location of the fix.

On approaching the MDA, the Captain called out that the runway and its lights were in sight.

As he was about to ask permission to land, the crew was instructed to go around, according to him because of the presence of another aircraft («due to traffic»).

He made a go around.

During the second approach, the captain informed the passengers that the crew had had to go around at the request of the controller. It appeared to them that the reason for this instruction was linked to the presence of another aircraft.

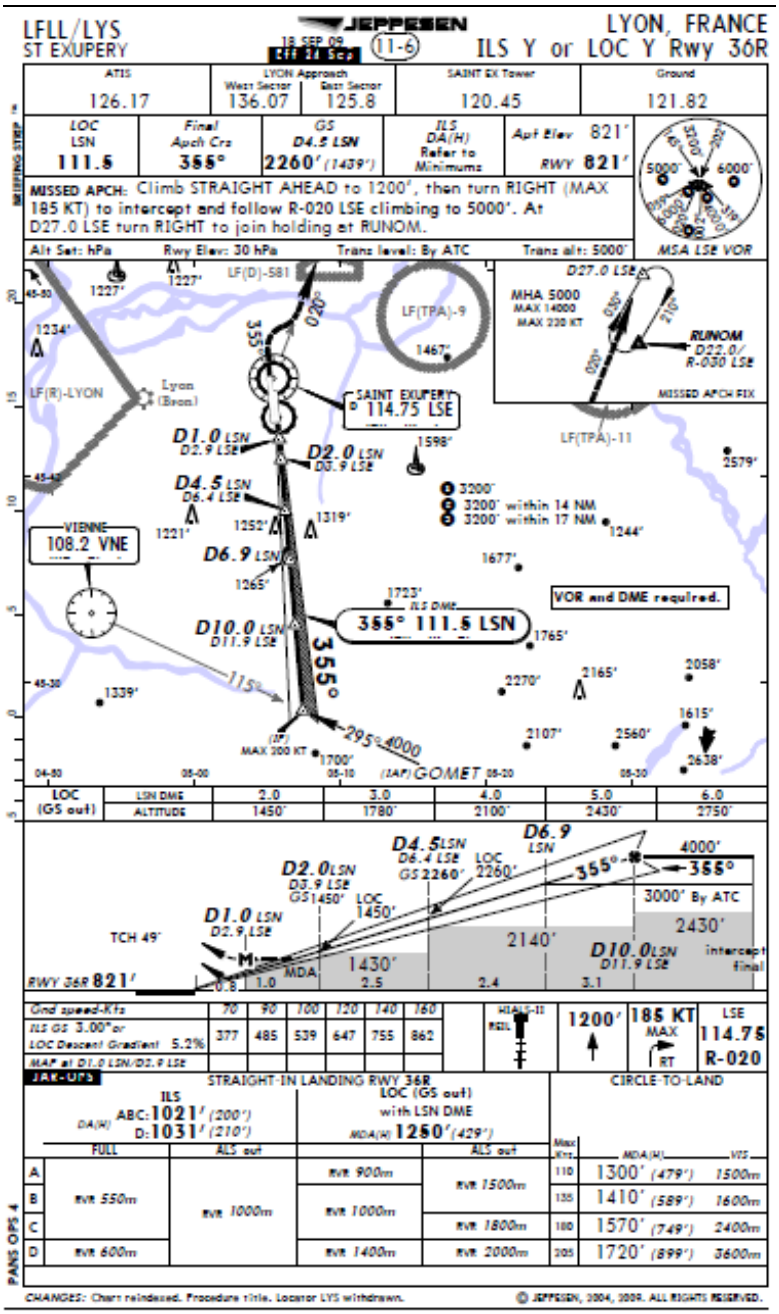



Figure 7: Approach chart used by the crew. The Jeppesen glossary indicates that the symbol (cross), used here at the intersection of the step-down fix at 4,000 ft and the final approach, means an FAF.

### 1.18.2 On-board navigation database

The information obtained from the crew and from Tailwind Airlines did not indicate how the approach was shown on the navigation screens and on the FMC at the time of the event.

However, in order to try to estimate what that representation might be, the investigators contacted a European operator of Boeing 737-300s that uses a database provided by Jeppesen. The following photographs were taken, at the gate, while preparing a fictitious flight plan for an ILS y arrival by GOMET at Lyon. The database does not provide a localizer-type approach. When this type of approach is effective, the crew must select the corresponding ILS approach.


Selection of the ILS y 36 R approach


Sequence of ILS y 36 R approach points by GOMET

The following can be seen:

- The intermediate approach fix IF36R to cross at 4,000 ft or more;
- The final approach fix 10LSN, located at 10 Nm from the DME LSN to fly over at 4,000 ft;
- An intermediate fix LSN45, located at 4.5 NM from the DME LSN to cross at 2,260 ft.

The selected approach is shown in the following photograph, in a mode corresponding to the preparation of the flight plan, at the gate.


Figure 9 : Presentation of the approach on the EHSI

In conclusion, the approach is built with the final approach fix at 4,000 ft and 10 nm.

### 1.18.3 Similar incident

On 16 September 2010, during the day, an aircraft from a French airline was preparing for a localizer approach to runway 36R at Lyon Saint-Exupery. The glide was down for maintenance. The weather conditions were CAVOK.

By mistake, the crew selected the approach final chart corresponding to the ILS X 36R approach, corresponding to an approach of the "continuous descent" type under experimentation at night for some operators only (intermediate stepdown fix published at 4,000 ft with a fix for the start of final descent at 10 Nm from the LSN DME) instead of the approach file ILS z 36R (intermediate stepdown fix at 3,000 ft with a fix for the start of final descent at 6.9 Nm from the LSN DME). During the approach under radar vectoring, the crew was cleared to descend to 3,000 ft and then cleared for the "36R localizer" approach.

At 3,000 ft, the crew began its final descent at 10 Nm as shown on the map it was using. During the descent, it carried out a check of the glide path, using the distance/altitude correlation table published on the map, and detected the error. They stepped down at 2,400 ft, rejoined the normal glide path and landed. There was no MSAW warning.

The following extract can be found in the local analysis document of the event prepared by the SNA-EC: "*At Lyon Saint Exupery, arriving aircraft are given radar vectoring and brought down to the altitude of 3,000 ft on the centreline of the approach procedure being used. This vectoring replaces the initial and intermediate approach. Neither the approach controller nor the ATIS specify "Z" or "Y" procedure, the latter procedure being almost never used. Traffic is cleared for the final approach once it has been cleared to descend to 3,000 ft with a suitable intercept angle.*"

### 1.18.4 Precision final or non-precision approach

The start of a precision final approach (in the case of an ILS) is defined by a Final Approach Point (FAP). For this type of approach, once the aircraft is already established on the localizer, one would expect the pilot to initiate the descent of the aircraft on intercepting the glide slope, or to verify that the autopilot initiates the descent. When a DME distance is published for the FAP, it confirms that the glide slope is correct, to avoid following "false glides." It is not a criterion for the top of descent. Depending on other parameters, temperature in particular, the pilot can see a close DME distance but different from that published when intercepting the glide slope.

The start of a non-precision final approach (no glide) is represented by a final approach fix (FAF). When it is defined by a DME distance, and the aircraft is in level flight at the altitude of the intermediate approach, one would expect the pilot to initiate the descent at the precise value specified. Depending on the temperature on the day, its true altitude may be materially different from the value read on the altimeter. The position of the aircraft, therefore, is not necessarily on the theoretical approach profile.

### 1.18.5 Similar aeronautical publications

Without claiming to be a comprehensive review of the approaches to French aerodromes, a few may be mentioned that cite a second or third FAP for use on instruction from the controller: the ILS or LOC 04R or 04L approaches in Nice, the ILS or LOC approaches for each runway at Paris Charles de Gaulle.

The air navigation services at Paris Charles de Gaulle explain they have not registered any event that might correspond to a confusion of FAPs in recent years. The FAPs mentioned in the inserts are occasionally used in case of change of strategy in the regulation of an arrival sequence. The FAP primarily used is that published on the approach profile. The FAP to foresee is not mentioned on the ATIS or on the frequency.

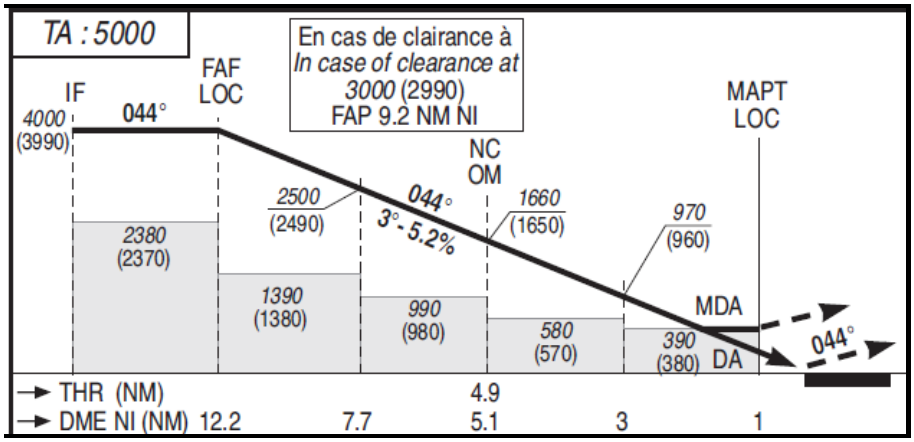



Figure 10: Extract from the AD2 LFMN IAC 03 chart for the approach to runway 04L

ATC services at Nice airport have not found a similar event in their database. They pointed out that in the case of a non-precision approach, only the intermediate approach at 4,000 ft is used. The FAP can only be changed for an ILS approach.

### 1.18.6 Example of an accident involving radar vectoring to a lower altitude than that published for the intermediate segment

On 17 December 1995, the Piper PA46 registered F-GIVF was conducting an ILS approach to runway 25 at Toussus-le-Noble, at night in the presence of fog and a cloud ceiling close to the decision altitude (DA)[7]. For this approach, the intermediate segment was published as 3,000 ft. The preceding aircraft had gone around. To provide separation for the aircraft, the controller gave the pilot of F-GIVF radar vectoring that brought him to intercept the localizer at 2,000 ft, i.e. 1,000 ft below the intermediate segment published. The approach chart contained no mention of a possible interception of the glide slope at 2,000 ft. The pilot began his descent at the specified DME distance indicated to intercept the glide slope at 3,000 ft. He had reported that he had not received the glide slope but had continued the descent. The aircraft struck the ground shortly after the outer marker.

The BEA had recommended "that the DNA verify that the practice of radar vectoring allows the pilot to follow a navigation or published procedure after the end of vectoring".

The DNA had responded to this recommendation by requesting that the position of the FAP, depending on the different altitudes of interception of the ILS, be indicated on the IAC charts.

[7]The report is available on the BEA website: www.bea.aero

More recently, the DSNA undertook to draft "Operation Summary Files" on good air traffic control practices and the regulatory references to be integrated into the operating manuals of ATC Authorities. The files are currently being validated. Radar vectoring and the interception of approach procedures are the subject of explanatory files.

The Air Traffic Regulation (RCA) indicates that:

***10.7.3 Procédures d'arrivée, d'approche initiale et d'approche intermédiaire***

10.7.3.1 Les phases d'arrivée, d'approche initiale et d'approche intermédiaire d'une approche au radar vont du début du guidage radar qui doit amener l'aéronef en position pour l'approche finale jusqu'au moment où l'aéronef :

a) est prêt à commencer une approche au radar de surveillance ; ou
b) est transféré du contrôleur chargé de l'approche au radar de précision ; ou
c) est sur la trajectoire finale d'un moyen autre que le radar à l'aide duquel le pilote exécute lui-même l'approche finale ; ou
d) est autorisé à effectuer une approche à vue.

10.7.3.3 Un aéronef qui se propose d'utiliser une aide d'approche finale dont les données sont interprétées par le pilote doit recevoir pour consigne de rappeler lorsqu'il est bien établi sur la trajectoire d'approche finale. Le guidage radar prend fin à ce moment.

## 2 - ANALYSIS

### 2.1 Scenario

#### 2.1.1 Approach preparation

The ATIS information obtained by the crew mentioned the type of approach in service (localizer 36R) but not the full title (Y or Z) of the procedure to use. Equally, the crew was informed on first contact that they would be provided with radar vectoring but the exact identification of the final procedure was not specified. The crew's choice to retain the Y approach procedure seemed logical, given that GOMET was the initial approach fix provided in the flight plan that had been filed. It was not possible to know whether the crew had retained the possibility of an intermediate stepdown fix at 3,000 ft instead of a stepdown fix at 4,000 ft. It should noted in this respect that on the approach chart published in the AIP France, as on the Jeppesen chart used by the crew, it is the FAP, a concept associated with a precision approach, which can be modified as instructed by the controller, not the FAF, a concept associated with a non-precision approach. It is therefore possible that the crew did not retain the possibility of an intermediate approach at 3,000 ft during the preparation of the non-precision approach. In addition, given the observations made during the investigation of the contents of a navigation database, the crew probably only had a display of the final approach fix (FAF) at 4,000 ft.

#### 2.1.2 Interception of the localizer

At the end of radar vectoring, which is systematic at Lyon, the interception of the localizer failed. A study of the parameters and radio exchanges shows that:

- The VOR / LOC mode was not armed by the crew, although they had read back the instruction from the controller to intercept the localizer;
- The intercept heading indicated by the controller was not read back by the crew, or selected for the autopilot, leaving the aircraft converging at an angle of approximately 80°, which conflicted with a successful interception.

The crew report did not clarify the reasons for these errors. The controller did not notice the lack of readback of the intercept heading  It is possible that because he was busy with the management of the sequence of incoming flights, he considered the readback of the essential instruction, namely to intercept the localizer, to be sufficient.

A second interception of the localizer was then necessary, combined  with other controller instructions: the instruction to descend to 3,000 ft and accelerate to 200 knots of indicated airspeed, which corresponds to a higher ground speed, given the tailwind component. In the two minutes and twenty seconds before beginning the final descent, the crew had therefore monitored the interception of the localizer, controlled and monitored the descent to 3,000 ft, controlled and monitored the speed increase and retracted the flaps that were already extended. Given this significant workload, the crew clearly did not perceive the inconsistency between the last vertical clearance and the FAF presented (10 Nm) at which the aircraft actually began its final descent.

### 2.1.3 Control of the descent profile

It is difficult to understand the logic used by the crew to control the descent. While a short stepdown was observed at the minimum altitude of the first segment of the final approach, the trajectory passed under those of the second and third segments, to the point where there were no more obstacle clearance margins. The aircraft was then in the cloud layer and the crew no longer had any effective protection against obstacles, apart from a possible EGPWS warning. The flight parameters show that during the final approach, the wind was light and did not significantly affect the flight path of the aircraft. The monitoring of the approach path using the published distance / altitude correlation table, a technique mentioned in the airline company's procedures in addition to the use of the green arc, was clearly not applied. The event mentioned in 1.18.3 shows, however, that it is an effective barrier against the misidentification of the FAF.

### 2.1.4 Missed approach

On approaching the MDA, three events occurred in approximately thirty seconds:

- The acquisition of visual references by the crew;
- The transmission by the controller to the crew of information about the height of the cloud ceiling;
- The triggering of the MSAW warning associated with the instruction to go around.

The crew report shows that they did not understand why the go-around was requested. They thought they went around because of the presence of another aircraft. The crew did not acknowledge the information given by the controller on the cloud ceiling. It is possible that the crew did not hear or understand the message because on the one hand, they had no reason to expect such an unusual message and secondly, they must have been paying attention at that time to their altitude and the external visibility conditions. Just as the controller started his sentence to repeat his message, the MSAW warning occurred causing him to the change his words. The words spoken in haste, "750 traffic alert uh... go around, go around," may have created confusion in the minds of the crew as to why they were given the instruction. It was repeated by the controller, this time associated with the term "terrain alert" before being taken into account by the crew.

The repeated instruction to go around associated with the MSAW alert does not correspond to the phraseology as provided for in the regulations. It did however help put an end to an approach that did not include all the guarantees for a successful landing.

## 2.2 Aeronautical Publications and Practices of ATC services

The publication of the insert of the final approach point "on ATC instruction" was removed by the SNA-CE between the date of the event (see 1.17.3) and the publication of this report.

At the time of the event, the use of this insert extended to the non-precision approach without a glide slope was a circumstance liable to initiate a premature descent after radar vectoring at 3,000 ft, particularly since crews had not been informed beforehand of the stepdown fix scheduled by the controller, by the ATIS or on first contact, for example. For this reason, although the publication of the approach GOMET mentioned a possible change of FAP, this change was also systematic for the FAF, thus leading the crews to an FAF which was not provided in the navigation databases when in fact it was the essential criterion for initiating the descent. Although the crews generally seem to accommodate this fact, since no difficulty has been reported, the TC-TLE incident shows that a non-precision approach does not offer the same flexibility of use as a precision approach and that radar vectoring techniques should be adapted accordingly. The Nice approach agency, for example, has taken this difference into account (see 1.18.5).

This situation was particularly inappropriate in Lyon in that the «on ATC instruction» level was in fact systematically used at the end of radar vectoring, a strategy operationally equivalent to radar vectoring followed by a Z approach. The call-out on receiving the ATIS or on first contact, with the latter strategy, would have allowed the crews, including those arriving by GOMET, to prepare their approach according to current practice.

# 3 - CONCLUSION

## 3.1 Findings

- The crew possessed the licenses and ratings required to undertake the flight;
- There was no indication of any malfunction of the aircraft or of one of its systems;
- The glide slope of the ILS on runway 36R was down for maintenance, and was not emitting;
- The ATIS Y, received by the crew, indicated "loc 3 6 right approach";
- The AIS aeronautical publications provide for the procedure "ILS y [...] or LOC 36R", with an initial approach starting at GOMET serving an intermediate approach at 4,000 ft leading to an FAF located 10 NM from LSN. An insert provides that the FAP is located 6.9 Nm from LSN in case of clearance at 3,000 ft;
- The crew carried out its approach based on the Jeppesen procedure plate «ILS Y or LOC Y RWY 36 R» mentioning a level off at 4,000 ft associated with a FAF symbol and a level-off at 3,000 ft to be used on controller's instruction and without any FAF symbol;
- The practices of the air navigation services of the Lyon approach systematically consists of integrating, under radar vectoring, the intermediate approach at 3,000 ft;
- The height of the cloud base was close to the published minimum descent altitude;
- The crew did not follow the intercept heading for the 36R localizer given by the controller;
- The aircraft overshot the localizer, the crew received a new intercept heading followed by clearance to descend to 3,000 ft and a request, which they accepted, to accelerate to 200 kt;
- The aircraft began its final descent at 3,000 ft, shortly before 10 NM LSN;
- The whole of the final descent was made under the published approach path;
- An MSAW warning was generated in the control tower;
- The controller immediately informed the crew and ordered them to go around.
- The crew made a go around;
- The criteria for triggering the basic GPWS warnings were not met;
- The captain indicated he saw the runway and its lights shortly before reaching the minimum descent altitude.

### 3.2 Causes of the Serious Incident

The incident was due to:

- Misidentification of the stepdown fix by the crew and,
- Inadequate control of the final glide path by the crew.

The publication of two FAPs, one of which is to be used on instruction from the controller, including the fact that its use was extended to the non-precision approach, and the absence of information to the crew concerning the exact identification of the final approach procedure to use, constituted contributory factors.

## 4 - SAFETY RECOMMENDATIONS

Reminder: In accordance with the provisions of Article 17.3 of Regulation No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation in no case creates a presumption of fault or liability in an accident, serious incident or incident. The recipients of safety recommendations report to the authority in charge of safety investigations that have issued them, on the measures taken or being studied for their implementation, as provided for in Article 18 of the aforementioned regulation.

The investigation showed that the premature descent initiated by the crew was due to:

- the publication of two final approach points (FAP) in the approach chart used by the crew:
  - one at 4,000 ft, represented in the onboard navigation databases,
  - the other, at 3,000 ft, usable on instruction from the controller and absent from the databases ;
- the systematic use of radar vectoring for precision and non-precision approaches, for aircraft from GOMET and for others, to the intermediate stepdown fix at 3,000 ft.

In addition, the SNA procedures do not specify that crews should be informed, prior to the approach, of the exact identification of the final approach procedure currently in effect.

Consequently, the BEA recommends that:

- **DGAC ensure that crews are informed with sufficient notice of the full identification of the final approach procedure to be followed; [Recommandation FRAN-2013-001]**

- **DGAC ensure that the DSNA identifies any non-precision approach charts with several final approach fixes (FAF) and removes this type of publication; [Recommandation FRAN-2013-002]**

- **DGAC clarify the "compendium of cartographic techniques" used by procedure designers by removing from non-precision approaches any of the following possibilities:**
  - The representation of an insert showing the position of an FAF on instruction from a controller;
  - the representation of several intermediate segments at different altitudes; **[Recommandation FRAN-2013-003]**

- **DGAC ensure that radar vectoring practices include the need to guide crews to a published altitude for the start of the final approach. [Recommandation FRAN-2013-004]**

# *List of Appendices*

**Appendix 1**

QAR parameters

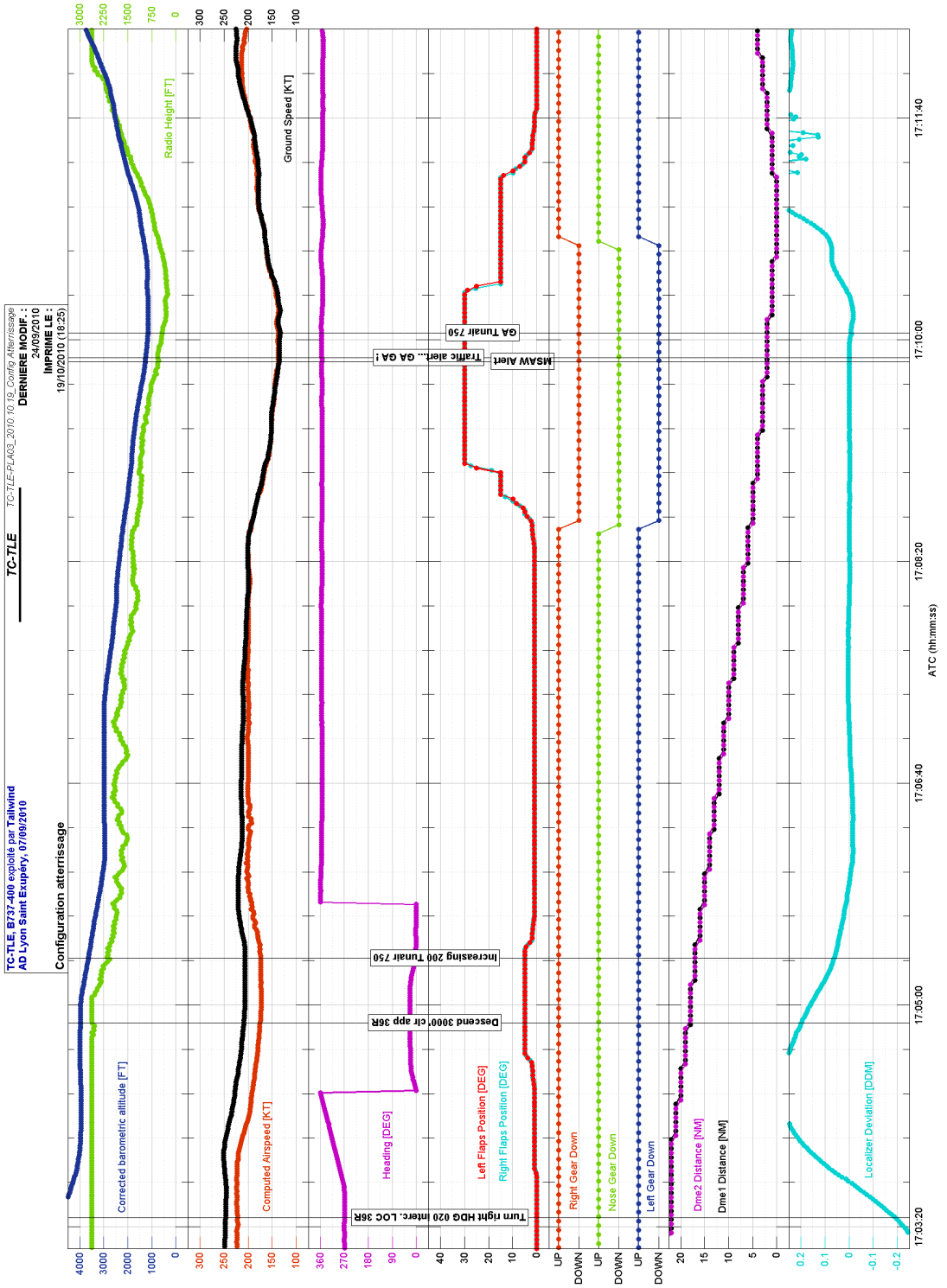
**Appendix 2**

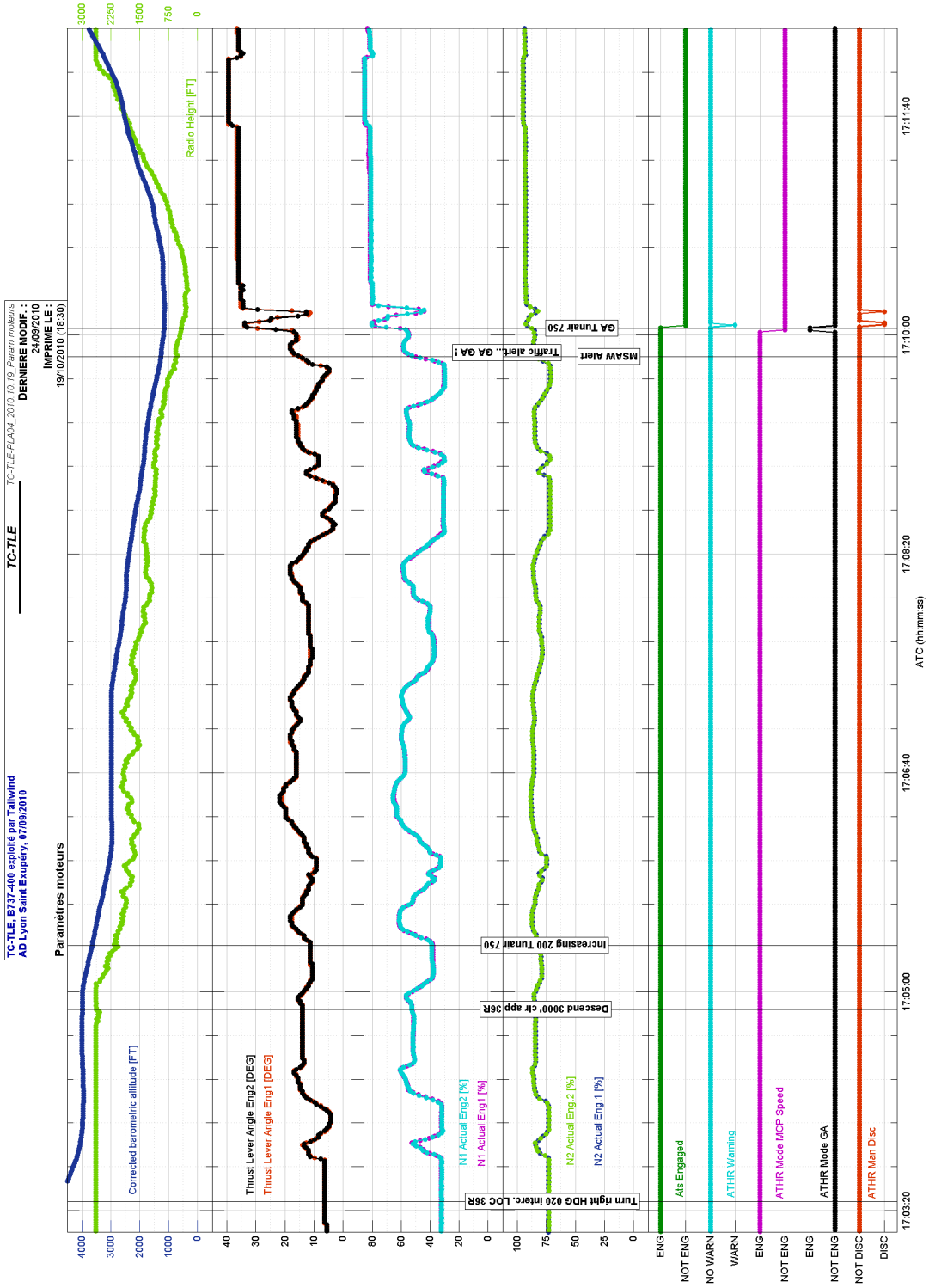
Approach charts

**Appendix 3**

Regulatory technical requirements for the design of approach procedures

# Appendix 1
# QAR parameters

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AD Lyon Saint Exupéry, 07/09/2010
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TC-TLE-PLA04_2010.10.19_Param moteurs
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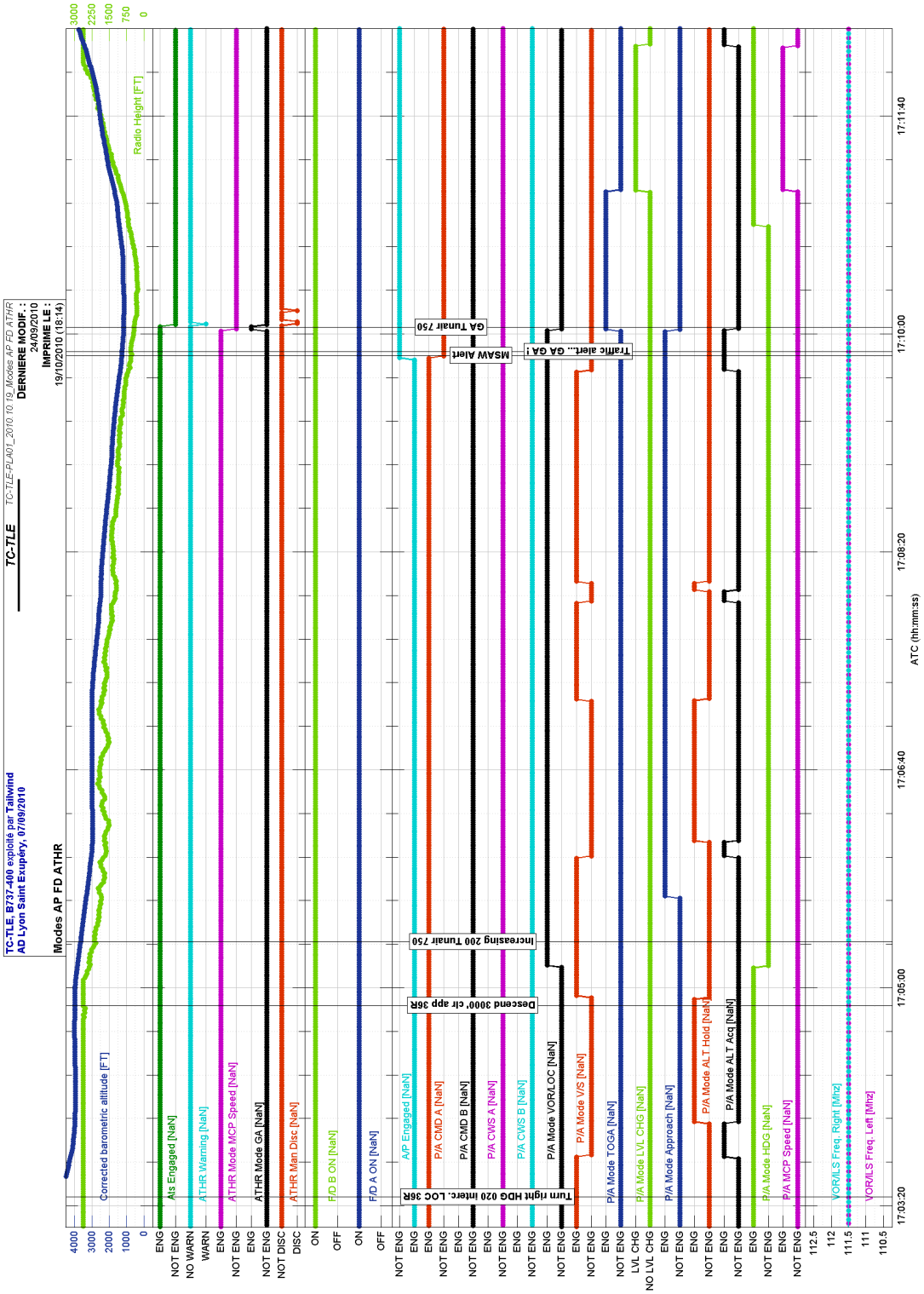
Radio Height [FT]
Thrust Lever Angle Eng2 [DEG]
Thrust Lever Angle Eng1 [DEG]
N1 Actual Eng2 [%]
N1 Actual Eng1 [%]
N2 Actual Eng.2 [%]
N2 Actual Eng.1 [%]
Ats Engaged
ATHR Warning
ATHR Mode MCP Speed
ATHR Mode GA
ATHR Man Disc
Turn right HDG 020 interc. LOC 36R
Descend 3000' clr app 36R
Increasing 200 Tunair 750
MSAW Alert
Traffic alert... GA GA !
GA Tunair 750
ATC (hh:mm:ss)


TC-TLE, B737-400 exploité par Tailwind
AD Lyon Saint Exupéry, 07/09/2010
TC-TLE
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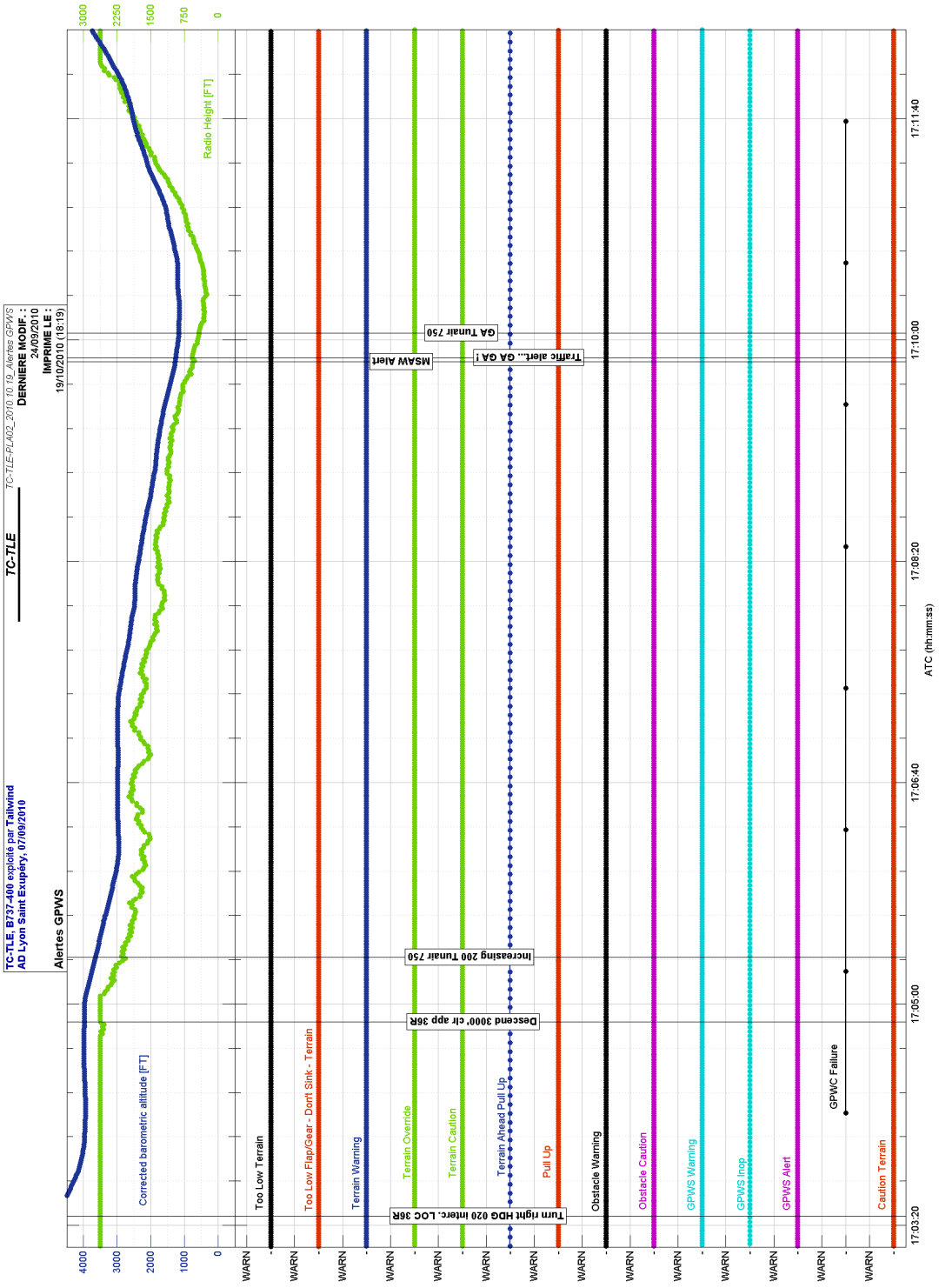
VOR/ILS Freq. Right [Mhz]
VOR/ILS Freq. Left [Mhz]
Turn right HDG 020 interc. LOC 36R
Descend 3000' clr app 36R
Increasing 200 Tunair 750
MSAW Alert
GA Tunair 750
Traffic alert... GA GA !
ATC (hh:mm:ss)


TC-TLE, B737-400 exploité par Tailwind
AD Lyon Saint Exupéry, 07/09/2010
Alertes GPWS
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Radio Height [FT]
Too Low Terrain
Too Low Flap/Gear - Don't Sink - Terrain
Terrain Warning
Terrain Override
Terrain Caution
Terrain Ahead Pull Up
Pull Up
Obstacle Warning
Obstacle Caution
GPWS Warning
GPWS Inop
GPWS Alert
GPWC Failure
Caution Terrain
Turn right HDG 020 interc. LOC 36R
Descend 3000' clr app 36R
Increasing 200 Tunair 750
MSAW Alert
GA Tunair 750
Traffic alert... GA GA !
ATC (hh:mm:ss)

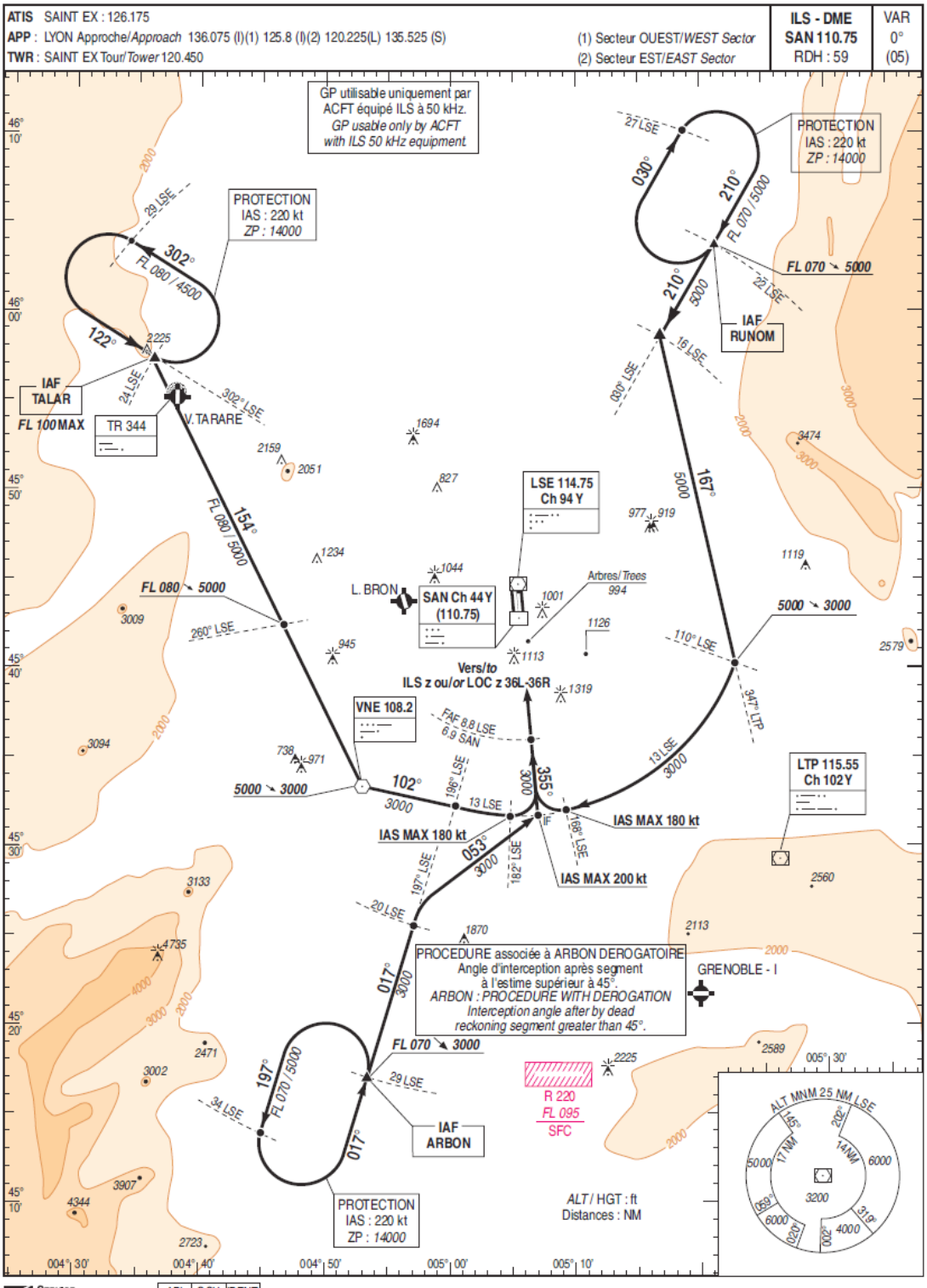
# Appendix 2
# Approach charts



**APPROCHE AUX INSTRUMENTS**
*Instrument approach*
CAT A B C D

LYON **SAINT EXUPERY**

*INA 1* ARBON/RUNOM/TALAR RWY 36L-36R



## APPROCHE AUX INSTRUMENTS
*Instrument approach*

## LYON SAINT EXUPERY

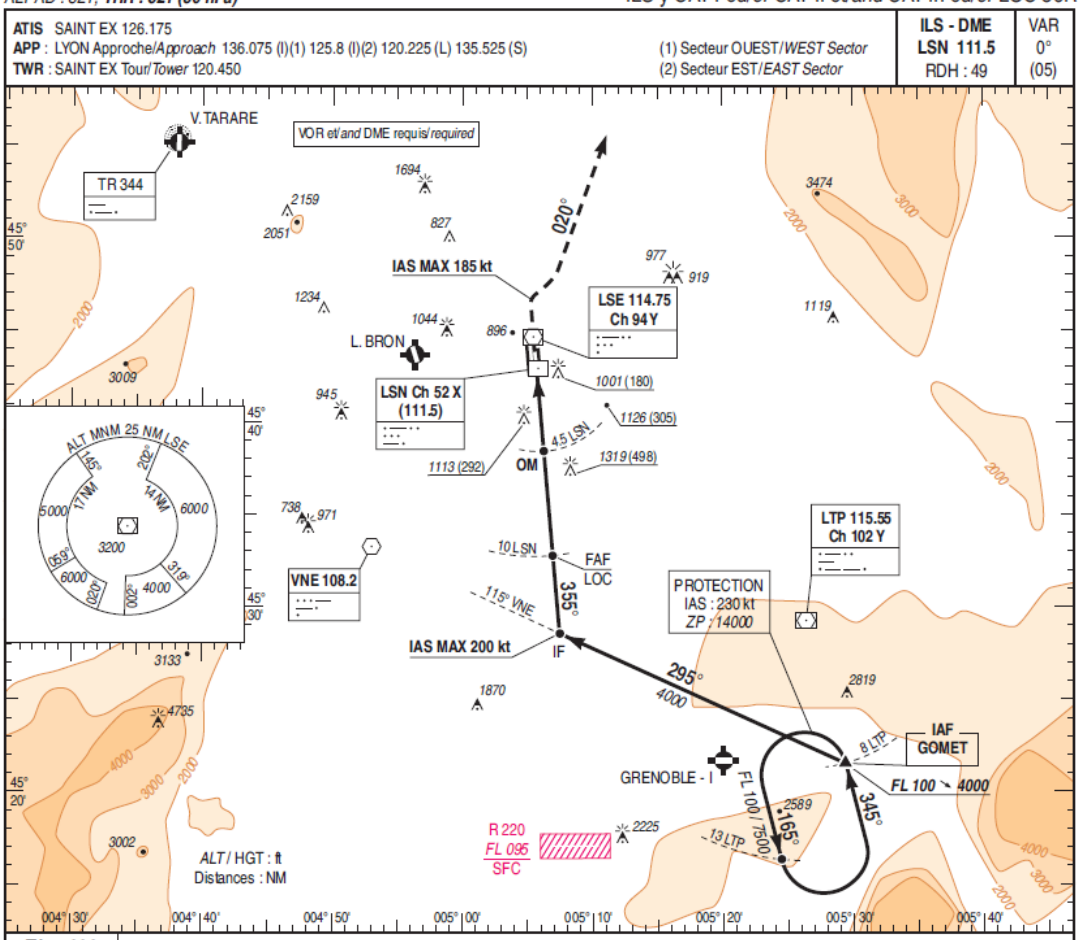
CAT A B C D
*ALT AD : 821,* ***THR : 821 (30 hPa)***

ILS y CAT I ou/*or* CAT II et/*and* CAT III ou/*or* LOC 36R

**ATIS** SAINT EX 126.175
**APP** : LYON Approche/*Approach* 136.075 (I)(1) 125.8 (I)(2) 120.225 (L) 135.525 (S)
**TWR** : SAINT EX Tour/*Tower* 120.450

(1) Secteur OUEST/*WEST Sector*
(2) Secteur EST/*EAST Sector*

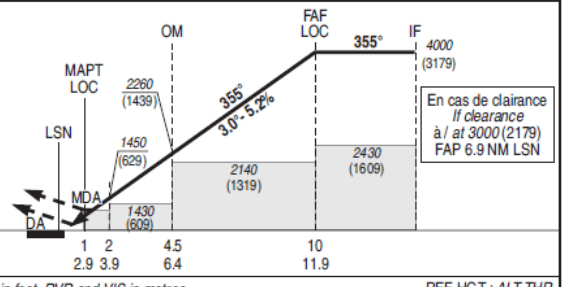
| ILS - DME | VAR |
|---|---|
| LSN 111.5 | 0° |
| RDH : 49 | (05) |




*TA : 5000*

API : Monter **dans l'axe**. A ***1200*** (379) tourner à **droite** (IAS MAX 185 kt) pour intercepter et suivre le **RDL 020° LSE** (RM 020°) en montée vers ***5000*** (4179). A **27 NM LSE** tourner à **droite** pour intégrer l'**attente RUNOM** à ***5000*** (4179).
Palier d'accélération non étudié.

*Missed APCH : Climb* ***straight ahead***. *At* ***1200*** *(379) turn* ***right*** *(IAS MAX 185 kt) to intercept and follow* ***RDL 020° LSE*** *(MAG 020°) climbing up to* ***5000*** *(4179). At* ***27 NM LSE*** *turn* ***right*** *to join* ***RUNOM holding*** *at* ***5000*** *(4179).*
*Acceleration level not studied.*




MNM AD : distances verticales en pieds, RVR et VIS en mètres./*Vertical distances in feet, RVR and VIS in metres.* REF HGT : *ALT THR*

| CAT | ILS | | LOC OCH : 429 | | OCH ILS CAT 1 | OCH ILS CAT 2 | MVL / *Circling* | |
|---|---|---|---|---|---|---|---|---|
| | ***DA*** (H) | RVR | ***MDA*** (H) | RVR | | | ***MDA*** (H) | VIS |
| A | ***1020*** (200) | 550 | | 900 | 174 | 60 | ***1300*** (480) | 1500 |
| B | ***1020*** (200) | 550 | | 1000 | 185 | 72 | ***1410*** (590) | 1600 |
| C | ***1020*** (200) | 550 | ***1250*** (430) | 1000 | 196 | 87 | ***1570*** (750) | 2400 |
| D | ***1030*** (210) | 600 | | 1400 | 206 | 100* | ***1720*** (900) | 3600 |
| DL | ***1030*** (210) | 600 | - | - | 210 | 100* | - | - |

APP RWY 36R homologuée pour CAT 2 et 3 avec DA
* CAT 2 et 3: aéronefs de catégories D et DL : Vat < 161 kt

*APP RWY 36R homologated for CAT 2 and 3 with DA*
* *CAT 2 and 3: ACFT of categories D and DL : landing speed < 161 kt*

**DME LSN**

| NM | 6 | 5 | 4 | 3 | 2 |
|---|---|---|---|---|---|
| ***ALT*** (HGT) | ***2750*** (1929) | ***2430*** (1609) | ***2100*** (1279) | ***1780*** (959) | ***1450*** (629) |

| | | 70 kt | 85 kt | 100 kt | 115 kt | 130 kt | 160 kt | 185 kt |
|---|---|---|---|---|---|---|---|---|
| FAF - THR | 9.8 NM | 8 min 24 | 6 min 55 | 5 min 52 | 5 min 06 | 4 min 31 | 3 min 40 | 3 min 10 |
| VSP (ft/min) | | 370 | 450 | 525 | 605 | 685 | 845 | 975 |

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| API | OCH | IDENT | VSS |
|---|---|---|---|
| X | X | X | |

AMDT 10/09 **CHG :** IDENT, suppression LYS.

## Appendix 3
## Regulatory technical requirements for the design of approach procedures

# I – French Regulations

I-1. Minimum safe altitudes and identification of procedures

Significant changes concerning the establishment of procedures and the representation of instrument approach charts were made by Amendment No. 12 (effective November 25, 2004) of ICAO PANS-OPS (Doc 8168) and by Amendment 53 of ICAO Annex 4 (applicable on the same date), including:

- The representation of minimum safe altitudes on the profile view of IAC charts,

- changes to the rules for the identification of procedures.

These changes were incorporated into French regulations (Instruction 20754 DNA dated 12 October 1982, as amended), relevant aspects of which are summarized below.

Representation of minimum safe altitudes on the profile view

This representation, integrated on August 17, 2004 into French law, only applies to non-precision procedures with a final approach fix. In the case of ILS procedures, the corresponding localizer procedure, published on the same chart, is a non-precision approach and is therefore given this form of representation..

The minimum safe altitude on a final approach segment is derived from the altitude of the most penalizing obstacle located in areas associated with the segment. A MOC is added to the altitude of this obstacle. At the time when these minimum altitudes were calculated, the requisite MOC was 90 meters for a segment partially or wholly located over 6 nautical miles from the runway threshold and 75 meters for a segment located at a lesser distance.

Changes to the rules for the identification of procedures

This change stems from the standardisation of designation of procedures, to avoid ambiguity between charts, electronic displays in the cockpits and control clearances.

The identification of a procedure is primarily based on the navigation means which provides lateral guidance to the final approach.

The same approach chart may represent several approach procedures when the procedures for the intermediate approach segment, the final approach segment and missed approach segment are identical; in these cases the identification contains the names of all the types of radio-navigation assistance used for lateral guidance to the final approach, separated by the word “or.” (e.g. ILS or NDB RWY 35 L).

A letter-based index, in the reverse order of the alphabet, starting by the letter "z" is used if no distinction can be made between several procedures corresponding to the same runway by means of the type of radio navigation aid alone (e.g. VOR z RWY 26, VOR y RWY 26) and especially in the case, among others, where "intermediate + final + missed approach segments are identical but are published on several charts associated with different initial segments.

I-2. Extracts from relevant technical requirements for the event

Certain specific technical requirements for an ILS approach and a non-precision approach are listed below:

The ILS procedure and the associated localizer procedure are published on the same chart. The minimum length of the intermediate segment must correspond to a flight time of 30 s at the initial approach speed scheduled according to the category of aircraft. The slope of this segment must be zero (instruction 20754 DNA, APP 2-11, 2.1.3).

In the case of a non-precision approach, the intermediate approach cannot be less than 30 seconds of flight. It can be constructed with a maximum slope of 5% subject to a stepdown of at least 1.5 nautical miles (aircraft categories C and D) after the descent (instruction 20754 DNA, APP 1-37, 1.5.3 and 1.5.6).

In both cases, when turning to the intermediate approach fix, the minimum length is also constrained by the construction and connection of the turning point areas and of the intermediate approach

Finally, constraints also apply to the construction of the initial approach. In particular, the slope retained must be less than 8% for a given segment, a potentially restrictive criterion for the study of a trajectory to leave GOMET at FL 100 and align with the final approach course at 3,000 or 4,000 feet, in view of the obstacles in the protection areas.

I-3. Graphic representations

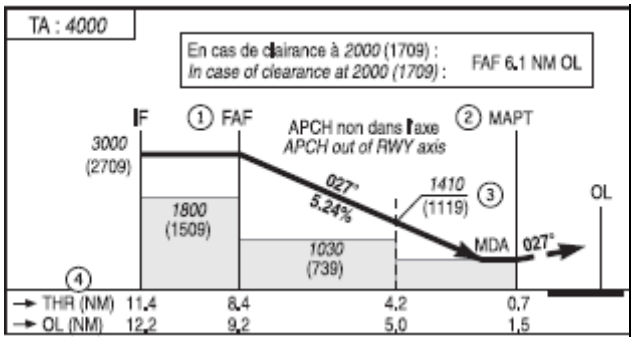
The possible graphic representations of the profile of an approach path, used by a procedure designer, are described in the "compendium of cartographic techniques" of the AIS (extracts dated June 23, 2088):

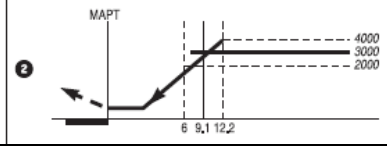
Si plusieurs procédures d'approche classique avec FAF sont représentées sur la même carte, les blocs grisés représentent les altitudes/hauteurs de franchissement d'obstacles les plus pénalisantes pour chaque segment. Si nécessaire, dupliquer les cartes pour représenter chacune des procédures avec ses altitudes/hauteurs de franchissement d'obstacles associées.

This paragraph mentions the possibility of publishing several non-precision approach procedures on the same chart

The following illustration shows a representation of an approach with a "principal" FAF and a FAF "in case of clearance"

Further on, the same document offers the following graphic possibility:




| | |
|---|---|
| En cas d'approches intermédiaires multiples pour une même procédure, l'approche nominale est en trait plein, les autres sont en tireté.<br>La position des différents FAP est rappelée en dessous ❷. |  |



## II – ICAO Texts

ICAO Annex 4 "Aeronautical Charts" (11th edition, July 2009) includes the following information :

- the identification of an approach procedure must be established in accordance with document PANS-OPS, Doc 8168, Volume II, Part I, Section 4, Chapter 9, which stipulates:

This paragraph describes the general aspects of instrument procedure naming. Specific aspects are covered in the appropriate chapters. A standardized naming convention is required to avoid ambiguity between charts, electronic cockpit displays and ATC clearances. This convention affects the following charting aspects:

9.5.2.3 *Multiple procedures.* A single approach chart may portray more than one approach procedure when the procedures for the intermediate, approach, final approach and missed approach segments are identical. If more than one approach procedure is depicted on the same chart, the title shall contain the names of all the types of navigation aids used for final approach lateral guidance, separated by the word "or". There shall be no more than three types of approach procedure on one chart. For example:

ILS or NDB Rwy 35L

9.5.2.3 *Multiple procedures.* A single approach chart may portray more than one approach procedure when the procedures for the intermediate, approach, final approach and missed approach segments are identical. If more than one approach procedure is depicted on the same chart, the title shall contain the names of all the types of navigation aids used for final approach lateral guidance, separated by the word "or". There shall be no more than three types of approach procedure on one chart. For example:

ILS or NDB Rwy 35L

- Paragraph 11.10.6.3 of Annex 4, which states the following for the profile view (see especially paragraphs b and d) of an instrument approach chart:

**2.4 Symbols**

2.4.1 Symbols used shall conform to those shown in Appendix 2 — ICAO Chart Symbols, except that where it is desired to show on an aeronautical chart special features or items of importance to civil aviation for which no ICAO symbol is at present provided, any appropriate symbol may be chosen for this purpose, provided that it does not cause confusion with any existing ICAO chart symbol or impair the legibility of the chart.

11.10.6.3 A profile shall be provided normally below the plan view showing the following data:

a) the aerodrome by a solid block at aerodrome elevation;

b) the profile of the approach procedure segments by an arrowed continuous line indicating the direction of flight;

c) the profile of the missed approach procedure segment by an arrowed broken line and a description of the procedure;

d) the profile of any additional procedure segment, other than those specified in b) and c), by an arrowed dotted line;

Appendix 2 of Annex 4 containing the graphical symbols for use does not give an example of an insert, as used in the French literature to define an FAF "on ATC instruction" or an example of additional intermediate approaches specified by arrowed dotted lines..

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