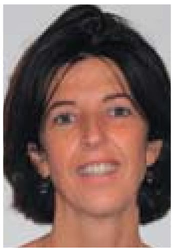
Near CFIT event during Non Precision Approach



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1 | Introduction

Today most of major incidents and accidents belong to one of the following categories:

- Controlled Flight Into Terrain (CFIT)
- Loss of control in flight
- Landing short
- Runway excursion

In particular CFIT events make up 45% of approach-and-landing accidents, that represent 55% of global accidents.
This article details a near CFIT event encountered on a single aisle aircraft as well as the associated lessons learned.
This event presents numerous classical components conducive to a CFIT and approach accident.

2 | Reported event

The following was reported to Airbus:
"This flight was uneventful until the approach phase that was a non precision approach performed in VMC conditions. Weather report indicated a partly cloudy sky with 10 miles visibility at destination, but, during the descent, ATC informed the crew about variable weather conditions due to banks of fog closing and opening the station.
On final approach, due to low visibility, the crew initiated a go-around and hit electrical lines. The crew then diverted to the scheduled alternate airport."

The investigation performed on site revealed that 25ft high electrical lines, located perpendicularly to the runway axis, at about 1100m from the runway threshold, were found sheared.
The aircraft was damaged subsequently to the impact with the electrical power lines. Damage was present all across the aircraft (fuselage, engine, wings) indicating that the aircraft impacted the lines head-on. Furthermore, some pieces of electrical lines were found in the area of the nose landing gear and it was concluded that the initial impact occurred at nose landing gear level.

The aircraft diverted and landed at the scheduled alternate airport. There were no passenger or crew injuries during this incident.

This article is mainly based on the analysis of the DFDR, which was provided to Airbus. Human factors aspects, in particular, will not be covered, due to lack of information.

3 | DFDR analysis

Note: for de-identification reasons altitudes are given in heights with reference to QFE.

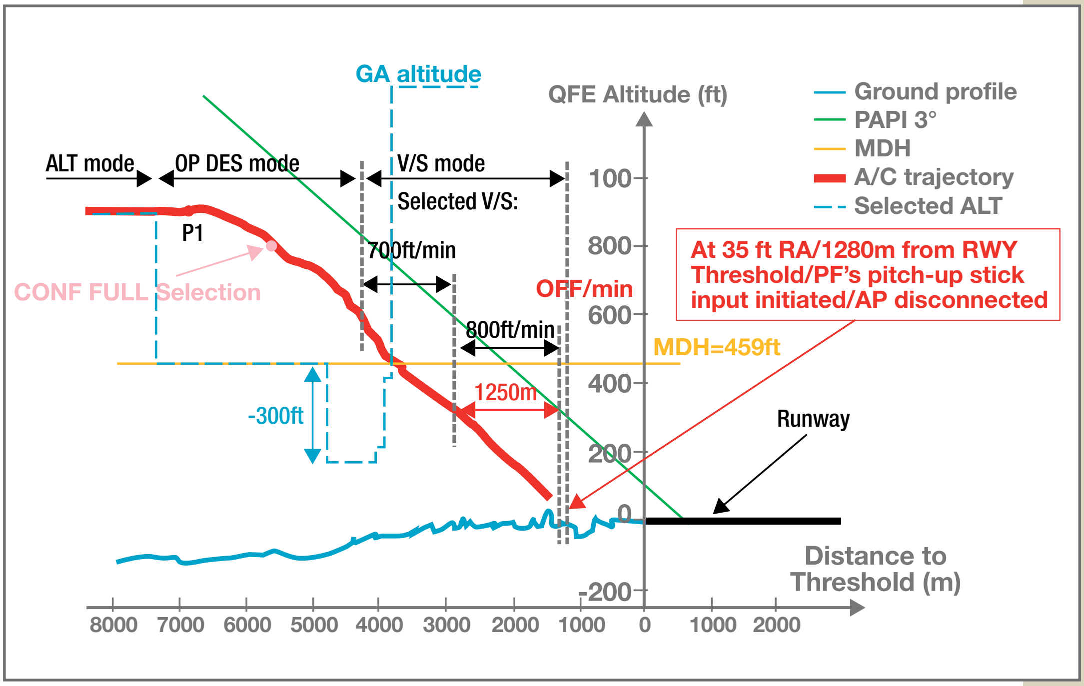
This was a step-down VOR-DME approach conducted in daylight, early in the morning, autopilot engaged.

As a consequence, the approach was a succession of descent and level flight phases so that autopilot longitudinal modes were alternatively OP DES mode and ALT*/ALT modes, while the auto-thrust modes were respectively idle mode and speed mode (with speed managed by the FMS). The successive constraint altitudes were fully respected.
Shortly before over-flying the last altitude constraint "P1" (859ft QFE situated at 3.7NM from the runway threshold) the aircraft was in level flight at 860ft QFE. The minimum descent height was 459ft.

The figure here below presents the descent profile from "P1"

This sequence can be detailed as follows:

- Shortly before over-flying "P1", MDA altitude was selected on the FCU, and the OP DES longitudinal autopilot mode was selected so that a thrust reduction was progressively commanded to target idle thrust, while the autopilot mode maintained the speed target.
- At that stage the aircraft was in slats/flaps configuration 3, gear down, both flight directors engaged, autopilot N°2 engaged.



Descent profile

- For the whole approach the autopilot lateral mode remained in NAV mode.
- **At 800ft QFE, 3NM from runway threshold**, shortly after over-flying the last altitude constraint "P1" full slats/flaps configuration was selected.
- **At 680ft QFE, 2.6NM from runway threshold**, whereas the rate of descent was 1000ft/min, an altitude 300ft below MDA was selected on the FCU.
- **At 600ft QFE, 2.3NM from runway threshold**, while the current rate of descent was -1400ft/min, the crew selected the autopilot V/S mode with initially a selected V/S of -700ft/min. From that time auto-thrust was therefore engaged in speed mode. Target speed was Vapp (VLS +5kts).
- While descending **below MDA about 2.1 NM from runway threshold**, go-around altitude was selected on the FCU.
- **At 325ft QFE/ 1.54NM from runway threshold**, the crew selected a vertical speed of - 800ft/min.
- **At 47ft RA at about 0.72NM from runway threshold** the crew selected a vertical speed of 0ft/min.
- **At 35ft RA, at 0.70 NM from runway threshold**, the Pilot Flying applied 2/3 of full back stick input that disconnected immediately the autopilot.

Notes:

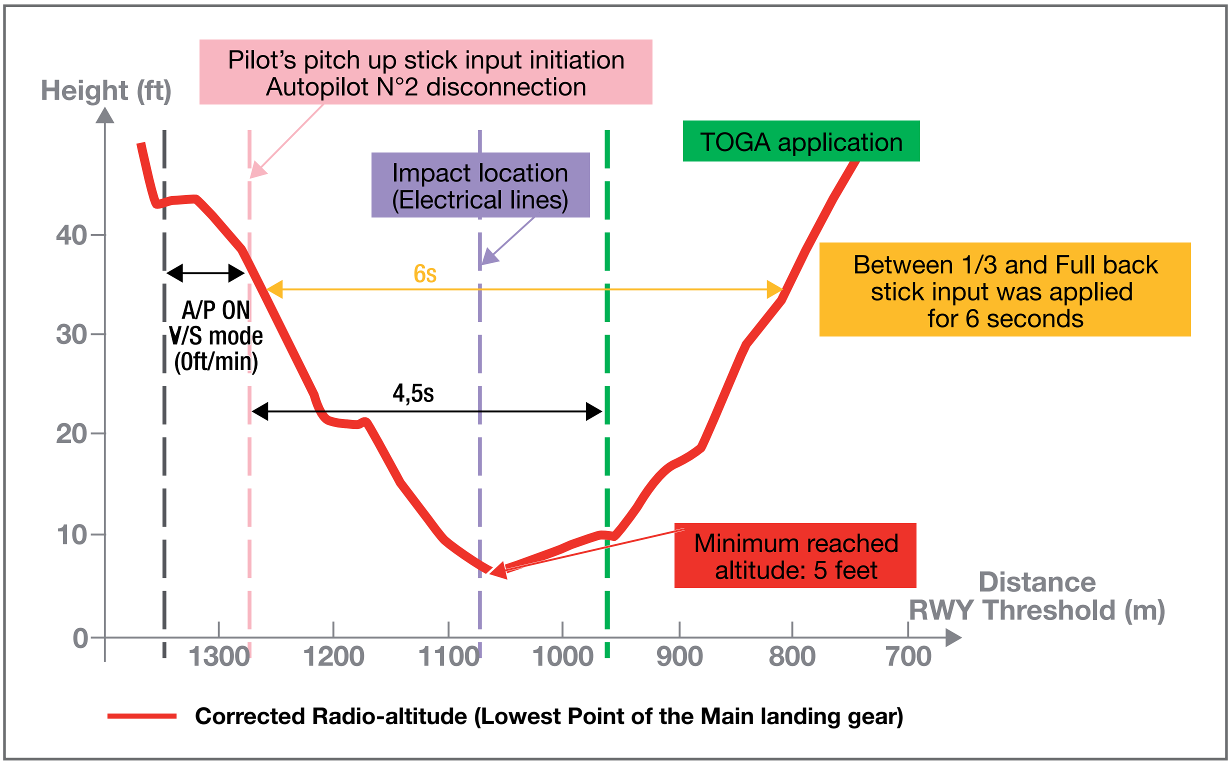
1/ As this approach was performed in GPS primary (In this case only GPS and IRS data are used for the aircraft position computation) the accuracy of the recorded aircraft position is very good.

2/ In managed guidance only (FINAL APP mode engaged) when the aircraft reaches MDA (MDH) –50ft or 400ft (if no MDA/MDH entered) the autopilot automatically disengages.

3/ As noticeable on the figure here above, from MDA altitude this final descent was performed on a 3° slope.

The figure here below presents a zoom on the pilot's take-over phase:

- The radio-altimeter parameters recorded in the DFDR (here plotted in red) indicate the distance between the lowest point of the main landing gear and the ground.
- The initial PF's pitch-up stick input was followed by permanent pitch-up stick input (between 1/3 and full back stick input) applied for 6 seconds, so that the aircraft stopped descending and started to climb.
- Minimum recorded altitude was 5ft RA reached at about 1100m from the runway threshold.
- The estimation of the impact location indicates that, at that moment, the aircraft impacted the electrical lines.
- At 10ft RA, 4.5 seconds after the initial PF's pitch-up stick input, thrust levers were moved forward to TOGA detent.
- 43 seconds after TOGA application, landing gears were selected up.
- 2 minutes after TOGA application, Slats/Flaps configuration 3 was selected.
- The aircraft diverted to the scheduled alternate airport.



Zoom on pilot's take-over phase

4 | Lessons learned

Following are the lessons to be learned from this near CFIT event:

4.1 Descent below MDA requests adequate visual references:

When conducting a non precision approach, it is recommended to apply the “Non Precision Approach” Standard Operating Procedures.
In particular, when the aircraft is properly established at MDA, the runway in sight must be confirmed by both PF/PNF, before disconnecting the autopilot and descending for a visual approach.

Furthermore, **if the required visual references are met at MDA but are lost at any time below MDA, a go-around procedure must be immediately applied.**

This is also highlighted in Chapter 7.3 (Acquisition of visual references) of the “Getting to Grips with...” ALAR brochure (Approach And Landing Accident Reduction).
This brochure can be downloaded from the Flight Operations Community at https://w3.airbus.com/.

4.2 Parameters monitoring

When conducting this particular approach, successive radio-altimeter callouts triggered below 200ft RA, while the aircraft was getting closer and closer to the ground, should have alerted the crew.

It is recommended as soon as the radio-altimeter is activated (at 2,500 feet AGL) to call out “radio altimeter alive”. The radio altimeter reading should then be included in the instrument scanning for the remainder of the approach. See Flight Operations Briefing Note “ Altimeter Setting – Use of Radio Altimeter.”
This FOBN can be downloaded from the Flight Operations Community at https://w3.airbus.com/.

4.3 Step-down Non Precision Approach:

For non precision approaches, Airbus recommends implementing the Constant Angle Non Precision Approach (CANPA) rather than the classical step-down non precision approach. Flying a constant-angle approach profile will reduce the risk of CFIT. Indeed it will provide a more stabilized flight path, will reduce the workload during this critical flight phase and will minimize the risk of error in step-down distances/altitudes and the need for a level off at the MDA (MDH). This technique is detailed in the chapter 7.2 (Flying Constant-Angle Non Precision Approaches) of the “Getting to Grips with...” ALAR brochure (Approach And Landing Accident Reduction).

4.4 No EGPWS alert was triggered during the flight phase where the aircraft was getting very close to the ground:

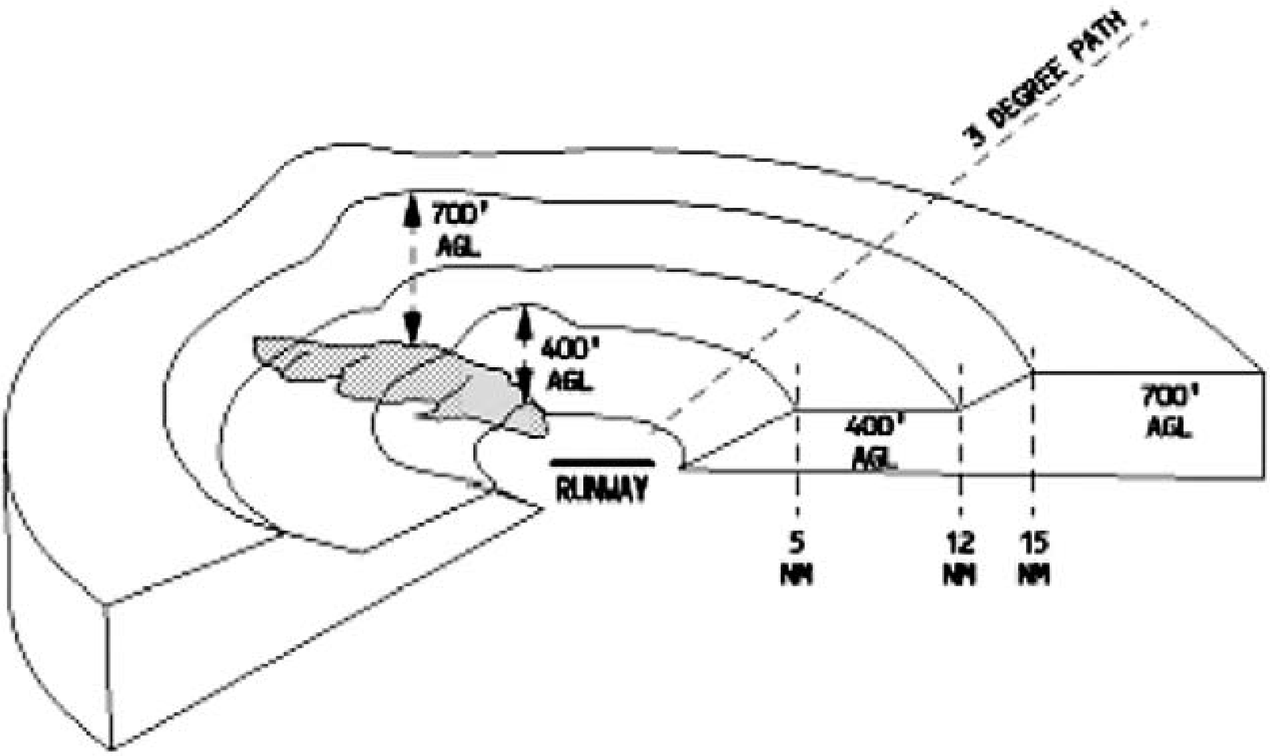
As the aircraft was in landing configuration (full slats/flaps, gear down…) no GPWS (Ground Proximity Warning System) basic modes could have been triggered, but as the aircraft was fitted with an E(enhanced)GPWS, the EGPWS mode “Terrain Clearance Floor (TCF) ” could have been triggered. Indeed, the TCF function uses a Terrain Clearance Floor envelope (see drawing here below) stored in the EGPWS database for each runway for which terrain data exists, and warns in case of premature descent below this floor, regardless of the aircraft configuration.
If the aircraft descends below this floor a “TOO LOW TERRAIN” aural warning sounds. In case of such alert, it is recommended by the Standard Operating Procedures (SOPs) either to adjust the flight path (In daylight with terrain and obstacles clearly in sight) or to initiate an immediate go-around (during night or IMC conditions).

But as shown on the sketch here below there is a progressive desensitization of this function when the aircraft approaches the runway. In particular, in a circle centered on the runway, a full desensitization exists i.e. no warning when the aircraft is very close to the runway.
With the EGPWS software version fitted on this particular aircraft, the Terrain Clearance Floor function had a higher desensitization zone than current EGPWS, so that no alert was given when the aircraft descended very close to the ground.
With the latest EGPWS software version (the aircraft was equipped with a GPS), an alert would have been triggered about 20s before impacting the electrical lines (at about 200ft QFE).

Upgrade to last EGPWS software standard (P/N 965-1676-002) for any Airbus aircraft type:
Please refer to OIT ref.
SE 999.0050/06/VHR dated 18 April 2006.
Please refer to last ref. SIL 34-080 revision

Note: The desensitization area depends on the FMS estimated position accuracy.
In particular this software release allows for the GPS position data to be used directly, resulting in much smaller estimated error values that allow for smaller desensitization areas.
This latest software version was revised to optimize the envelope profile and to reduce the minimum desensitization area to a circle with a radius of 0.25NM, whereas such radius was 1NM for the software version installed on the aircraft at the time of the event.
This results in significantly improved protection for "landing short" accidents.

This last, free of charge, EGPWS software version is available for any Airbus aircraft type since May 2006.



4.5 MDA and then an altitude lower than MDA were successively selected on the FCU during the final approach:

When performing non precision approaches, Airbus does not recommend MDA selection and even less so an altitude below MDA. Indeed, this may cause unwanted ALT* mode engagement and consequently approach destabilization at a critical stage of the approach. Therefore FCU altitude should be set at go-around altitude after over-flying the final approach fix (FAF).

5 Conclusion

Five main recommendations should be particularly highlighted:

- **To be go-around prepared and go-around minded**
  When performing an approach, even and because the go-around is not a frequent occurrence, it is of prime importance to always be go-around-prepared and go-around-minded. This will help in performing the go-around appropriately, in the optimal conditions and as per procedures.
  In particular the flight crew should have a clear view of excessive deviation and should be ready to interrupt the approach if:
  - Ceiling and visibility are below the required weather minimums
  - Criterias for stabilized approach are not achieved
  - Doubt exists about the aircraft position
  - There is confusion about the use of automation
  - The aircraft is destabilized below MDA
  - The visibility is lost below MDA
- **To adhere strictly to SOPs for Non Precision Approaches**
  In particular altitude/distance checks and respect of MDA are crucial when performing Non Precision Approaches.
- **To retrofit a GPS on aircraft not already equipped with this system**
  The installation of a GPS improves the efficiency of the EGPWS by providing a more accurate aircraft position to the system.
- **To upgrade the EGPWS software standard**
  The EGPWS software should be upgraded with the last version (free of charge for any Airbus aircraft type), which reduces the desensitization area.
- **Constant Angle Non Precision Approach**
  Airbus encourage the operators to work with their Authorities in order to translate step down Non Precision Approaches into Constant Angle Non precision Approaches.

Safety First

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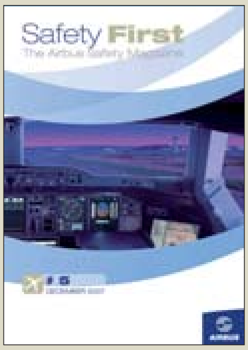

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