Dear Customers and Aviation Safety Colleagues,

Flight Safety has permanently improved from one aircraft generation to another and this trend continues. There are several factors that have led to these positive results, one of them being the flow of information between the key actors of the aviation community. Even though it is extremely difficult to quantify the benefit of information sharing, no one can dispute the positive effect it has.

To further develop this information sharing, we re-launch our safety magazine. This is the objective of this first issue of the Airbus Safety Magazine called “Safety First” (which replaces the previously named “Hangar Flying” magazine).

It is intended to issue this on a regular basis as a hard copy and we also intend to send it electronically.

This is not just a forum for Airbus to pass information to you. We want your participation. Send us articles that you think are worth increased knowledge and communications.

Yannick MALINGE
Vice President Flight Safety
NEWS

Are you on the distribution list?

If you are reading this you obviously have a copy of the magazine either in paper format or electronically. We need to make sure that our distribution list is up to date so please contact us to give us your details. Do not assume that you received it this once so you will get it next time! If you are an Airbus customer then contact us giving your name, title, company, address, phone and e-mail information and we will ensure that you regularly receive a paper and/or electronic copy of the safety magazine.

The plan is to issue a magazine on a regular basis but for those who have e-mail contacts some articles could be sent out in between the full magazine issues.

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Let us know what you think and do you have inputs?

As already said this magazine is a tool to help share information. Therefore we rely on your inputs. If you have ideas or desires for what is in the magazine please tell us. If you have information that we can share between us then please contact us. We are ready to discuss directly with you.

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Flight Safety Conference

Airbus’ annual flight safety conference was held in Toulouse from 11th to 14th October 2004, bringing the aircraft manufacturer and its customers together in a confidential forum that allows them to share experiences learned through in-service events.

Now in its eleventh year, the conference was also an opportunity for Airbus to raise awareness of general issues relating to the safe operation of its aircraft. This year’s conference is the largest to date with 135 representatives from 83 airlines. Alain Garcia, executive vice-president, Airbus engineering, opened the three-day safety conference for operators of all aircraft types.

As in previous years, a spirit of trust and openness prevailed throughout the conference, despite the sensitive nature of some of the topics being discussed. The open exchange of information by both airlines and Airbus has proved to be a significant contributor to safety enhancement.

Safety representatives from airlines who will be operating the A380 when it enters service in 2006 also received a special briefing related to the aircraft.

The questionnaires returned from the participants were very positive with 100% of the returns believing the conference objectives were achieved. There were comments on some points and these are being reviewed for next year’s conference.

One of the main concerns was the conference facilities. This point has been taken and as a result the date and venue for the next conference are confirmed:

LISBON, Portugal
17th to 20th October 2005

There will be more news on the conference in the next issue of the magazine.

Go-Arounds at Addis Ababa due VOR Reception Problems

By: Jean Daney
Director of Flight Safety
As reported by an Airbus Operator and reproduced with their permission

The following article was provided by the involved Airbus operator and has been reproduced with their agreement but has been de-identified. At the end of the article there is information on the Airbus policy concerning the use of GPS position for Terrain Awareness and Warning System (TAWS). This policy was issued in an OIT/FOT (ref: SE 999.0015/04/VHR dated 06 February 2004).

The same crew and aircraft had been scheduled to operate the flight from **** to Addis Ababa Bole Airport (HAAB) with a single en-route stop at****.

The first sector was operated without incident and, after disembarking passengers and refuelling, continued to HAAB. On arrival overhead the Addis Ababa VOR/DME (ADS 112.90 MHz), the flight was cleared to carry out a standard VOR/DME approach to runway 25L at Bole. Touchdown elevation at Bole was 7593’ amsl and the MDA for the procedure 8020’ amsl. There were no civilian radar facilities.

The VOR/DME indications had appeared normal up to the start of the procedure, but during the outbound leg, ADS 092’ radial, an unexpected large correction left was required to acquire the radial. After flying the ADS DME 13nm arc, a left turn was made to intercept the 249’ inbound QDM and descent from 11200’ amsl commenced in accordance with the procedure. The VOR radial started fluctuating during the descent and eventually the indications disappeared. With no adequate visual reference, a standard missed approach was flown from a minimum altitude of 8922’ amsl and the aircraft entered the hold over the ADS. Once in the hold and after confirming with Bole ATC that the VOR/DME was serviceable, the crew carried out a navigation accuracy check that appeared normal and elected to carry out a further approach. Once again, the VOR indication fluctuated during the inbound leg and another missed approach was flown from a minimum altitude of 8866’ amsl after which the aircraft diverted to Djibouti. A brief EGPWS “Terrain Ahead” warning occurred as the go-around was initiated.

After refuelling at Djibouti, the commander elected to use his discretion to extend the flying duty period and return to HAAB. On arrival at Bole, a daylight visual approach was flown to runway 25L and a successful landing made. It was noted during this approach that the VOR hearing information was in error up to 30° and that any attempt to fly the procedural inbound QDM would have displaced the aircraft to the North of the required track.

The commander filed an Air Safety Report (ASR) as required by the company in the event of any go-around. Normal company procedures also required an inspection of flight data from the Quick Access Recorder (QAR) as part of the follow up to any ASR and the company Flight Safety Manager carried this out.
The analysis revealed that at some point on both approaches the aircraft had passed over a ridge of high ground not normally encountered on the 25L approach. At the point at which the second go-around had been initiated the aircraft had passed over the ridge with a clearance of 55’ as shown by the radio altimeter recording. At no time were the crew aware of this close proximity to the ground.

A full company investigation into the circumstances of the incident continued independently of the official investigations initiated by the state authorities concerned and with the assistance of the Airbus Flight Safety Department. Following the outcome of the company investigation, the company has put in place measures to minimise the risk of similar incidents which include:

- HAAB to be treated as a Category ‘C’ airport,
- Operations to HAAB to be conducted by GPS equipped aircraft only,
- Approach to be discontinued if VOR indications differ from GPS derived FMGS indications by more than 5’,
- The MDA for the 25L VOR/DME procedure raised to 9380’ amsl (1790’ aal) in association with a minimum visibility of 5KM,
- Approach to be discontinued if no visual contact with the runway approach lights at ADS DME 5nm (RAP), (ie MAP is ADS SDME)

Note: The last two restrictions have since been relaxed as confidence in the “ADS” VOR/DME was regained. The airport authorities have also installed an ILS on this runway and a new DVOR/DME facility in the area since this incident took place.

The incident aircraft has also been fitted with a GPS engine in the ECFS computer as an interim measure, with a full GPS MMR upgrade scheduled for early 2005.

Navigational Considerations

All Airbus A320 aircraft are fitted with triple inertial Reference Systems (IRS). The navigation function is performed by the dual Flight Management & Guidance Computers using the outputs from the IRS and refining the combined IRS position with radio navigation aid or GPS satellite information. The involved aircraft is not fitted with GPS satellite navigation equipment and the position refinement is taken from ground radio navigation aids only, typically DME/DME, VOR/DME or VOR/VOR crossccts depending on local availability.

In the area of Addis Ababa the only suitable radio navigation aid was the “ADS” VOR/DME located between the two runways at Bole Airport at position N08 58.7 E038 47.9. It follows, therefore, that any error in the transmitted data from this VOR would result in a corresponding error in the computed FMGC position. Such errors could result from fault operation of the VOR/DME facility, radio frequency interference with the transmitted data or anomalous radiation caused by local terrain (sometimes referred to as “scalloping”).

The possibility of faulty airborne equipment had to be considered but this is unlikely as similar anomalous VOR indication behaviour was observed during a subsequent approach by another A320 fitted with a GPS. This latter occurrence was witnessed by the Flight Safety Manager.

The incident was discussed with the Director of the Air Operations and Navigational Aids Department (DONAD) and the Head of Safety Investigations of the Ethiopian CAA. The former stated that he was not aware of any other reports of problems with the ADS VOR but that an investigation would be carried out in response to this particular report. On the following day a verbal report was received that an examination of the VOR transmitter had revealed a 2” error in the radiation pattern and that an alternative transmitter was in service. Calibration of the alternative transmitter appeared to have been by pilot report from GPS equipped inbound aircraft and it was stated that the pattern was correct.

At a subsequent meeting with the Flight Safety Officer of Ethiopian Airways it was stated that there had been concerns from Ethiopian Airways pilots that the inbound leg of the 25L VOR/DME procedure was “taking aircraft too far north of the ideal track”. It was not clear whether these concerns had been relayed to the Ethiopian CAA, although it was stated that Ethiopian Airlines was putting pressure on the CAA too install an ILS for this runway prior to the rainy season that starts around July/August.

The following day, the company Flight Safety Manager was subsequently contacted by Bole ATC and advised that the ADS VOR had been taken out of service following a fault caused by the heavy rain that had occurred during that evening. The company flight for that day had already departed and was diverted to Khartoum. A further call from Bole ATC confirmed that the VOR was back in service and fully serviceable. The diverted flight arrived at HAAB with no reported problems.

Addis Ababa Bole International Airport (HAAB)

Bole Airport is located on the south western outskirts of the city of Addis Ababa, Ethiopia. The airport reference co-ordinates shown on the EAG Aerad chart are: N08 58.7 E038 47.9

Addis Ababa is situated on the Ethiopian plateau at an elevation of 7600’ amsl and is surrounded by areas of high ground rising to approximately 11000’ amsl.

The airport has been undergoing significant development in recent years and has recently seen the construction of a new terminal building and the new 07R/25L runway. The new runway lays parallel to and approximately 400m south of the original 07L/25R. The ADS VOR was moved to its current location south of the two runways during the development.

In current operations 07R/25L is used as the main runway with the old runway designated as taxiway “Foxtrot”. However, 07L/25R is still used as an active runway by local traffic.

The only instrument approach procedures currently available to the operator at the time were the VOR/DME procedures for 25L and 25R. Landings on runway 07R are achieved by carrying out the 25L VOR/DME procedure and breaking left for a visual circling approach to 07R. The Ethiopian CAA has promulgated a GPS/RNAV procedure for runway 07R and will shortly promulgate one for 25L. The involved operator does not currently hold an approval for GPS/RNAV approaches. Full ILS procedures for both 25L and 25R are now promulgated.

In addition to the ADS VOR, there were two MF locator beacons, ‘AB’ 333 KHz and ‘BL’ 352 KHz, situated on the original ILS approach path to 25R. There were no ILS procedures promulgated for the airport at the time, although the original 25R ILS localiser was believed to be still radiating on 110.3 MHz. New aids have now been installed as stated above.
Terrain Considerations

The airport is situated on a relatively flat plain at 7600’ AMSL. The level of the plain rises gradually to the east attaining an elevation of approximately 8500’ AMSL 15nm from the airport. There are significant high peaks around the airport as follows:

- 10535’ AMSL 010°/8nm
- 9646’ AMSL 025°/11nm from VOR/DME position
- 10167’ AMSL 120°/11.5nm
- 9200’ AMSL 230°/9nm

There is a significant ridge running approximately 135° from the first of the above peaks and running out into the plain at about 6nm from the VOR. This ridge is the one referred to in later sections of this report. A further ridge runs approximately 215° from the same peak towards the eastern outskirts of the city. This runs out into the plain approximately 3.5nm north of the airport.

Terrain information is provided for the crew by the following:

- EAG Aerad charts N1/N2 these show “safety contours” and Sector Safe Altitudes for the four prime sectors within 25nm of the aerodrome reference point. At Addis, the SSA for all sectors is shown as 13500’. No detailed terrain information is shown.
- EAG Aerad Terrain Chart A large scale chart showing the main features in a large area around Addis. No fine detail of terrain around the airport is shown.
- Military OMC Chart A 1:1000000 scale chart of the region

The involved aircraft is fitted with a Honeywell Enhanced Ground Proximity Warning System (EGPWS) with software to standard 428. The EGPWS computer has been removed from the aircraft and an attempt made to download event data from it. This was initially unsuccessful due to a fault condition at the time of removal. The unit was returned to the OEM who achieved a download in his workshop. During the subject approaches and go-arounds the crew heard only one EGPWS alert, a “Too Low Terrain” call just after initiation of the second go-around believed to have been triggered by the Terrain Clearance Floor mode 4 “Too Low Terrain” warning at about the same time.

Terrain Profiles

The following approach and terrain profiles were derived using the data from the QAR. The pressure altitudes recorded have been corrected for a QNH of 1027 HPa for Figure 1 and 1029 HPa for Figures 2 & 3.

Aircraft Position

The only position information available from the QAR was the recorded FMGC latitude and longitude. Since the FMGC position was IRS position corrected by radio position and the only radio position was based on the suspect VOR/DME facility, no reliance can be placed on the accuracy of the recorded position information.

One point of interest was the behaviour of the recorded FMGC position immediately after each go-around. The standard missed approach procedure for the 25L VOR/DME approach states “Left (max 185kt) as soon as practicable onto ADS 193R to 13500 5910 then right to ADS states.” In Figures 2 & 3, the 13nm marker can be taken as 13D from the “ADS”, but other distances do not relate to DME as the aircraft was not flying towards the DME facility. The distances have been corrected to take account of the varying groundspeed during each approach.

Figure 3 shows the profiles for the second approach at HAAB. Here, the notable points are again the flat terrain between 15nm and 7.5nm and the high point at just over 5nm. The river valley is still apparent at 8nm, but has split into two. The terrain clearance at the point of go-around is 55’.
• During the outbound leg of the procedure, the VOR bearing information correlated with the GPS derived FMGC data on the Navigation Display (ND).
• As the aircraft turned left to intercept the 249°M track inbound to the VOR, the beam bar initially moved in as expected to near centre.
• As the wings were levelled on a heading that should have followed the correct track, the beam bar moved back out to the right and settled at about half to two thirds full scale deflection.
• The crew flew by visual reference to the runway using the GPS derived navigation data to follow the correct inbound track and the VOR indication remained steady at the deflection stated above.
• At about 3.5D, the beam bar quickly moved back to the central position.

Initially, as the procedure is commenced, the FMGC track and still track appear to be following the procedural 094°T track. The FMGC track then starts to deviate to the south and the aircraft is turned left to correct taking the still air track to the north of the required track. This correction brings the FMGC position slowly back to the required track, but the still air track is moving well north.

**Airbus Policy**

This Airbus policy is concerning the use of GPS position for TAWS operations. The TAWS is also known as EGPWS (Enhanced Ground Proximity Warning System) or T2CAS (Traffic and Terrain Collision Avoidance System).

The TAWS computer has an internally loaded terrain database and uses position information from the FMS. The FMS uses ADIRU position and radio position update. It can also use a GPS position source when available. The use of the GPS with multimode receivers (MMR) provides improved navigation and surveillance functions. Therefore Airbus strongly recommends the use of a GPS source in the global architecture of the TAWS system.

Airbus offers an upgrade package that includes installation of 2 multimode receivers (MMR) and 2 GPS antennas.

However, some aircraft configurations may need upgrade of other aircraft equipment to make full benefit of the MMR system. The Airbus upgrade recommendations are to provide the adequate information, but they are not. Improper maintenance or components failure are to be considered also.

Here we review the scope of the pre-flight F/CTL check, and demonstrate based on in-service examples, how topical it still is.

**1 Introduction**

As far as aeronautics systems are concerned, the pre-flight control systems (F/CTL) check has existed since before the first powered flight. It aims at ensuring that flight controls respond to the pilot inputs, i.e. with no jamming, or movement limitation, or stiffness, or delayed or inadequate response. It is thus a key factor in the safe operation of the aircraft.

The pre-flight F/CTL check has been made on a flight basis by pilots since they flew an airplane for the very first time.

Being so familiar with it, one may fall in the trap of routine and neglect the importance of it. One may also believe that the aircraft’s self-monitoring capabilities are sufficient to provide the adequate information, but they are not. Improper maintenance or components failure are to be considered also.

Here we review the scope of the pre-flight F/CTL check, and demonstrate based on in-service examples, how topical it still is.

**2 Scope of the F/CTL check**

An efficient F/CTL check ensures that the systems respond adequately:

1- In direction;
2- In amount of travel;
3- In return to neutral;
4- In feeling.

On any Airbus aircraft, the F/CTL check involves the elevators, ailerons, spoilers and rudder control systems. Not only the components activated with the control wheel, control column and pedals, but the whole system. Let us refer to figure 1 and take the rudder axis of an A310 as an example in order to illustrate this comment.

Consider now each of the 4 items we have mentioned and review which systems are involved. Consider now each of the 4 items we have mentioned and review which systems are involved.

- In direction;
- In amount of travel;
- Return to neutral;
- Feeling.

The majority of the components represented in figure 1 are involved:

- Obviously rudder pedals, mechanical linkage and servocorrols;
- Any inopportune rudder trim that would shift the rudder from neutral would be detected with criteria 3;
- Artificial Feel Mechanism with criteria 4;
- Detection of any offset from Yaw Damper system with criteria 3;
- Rudder Travel Limiting Systems with criteria 2.

We may come to similar conclusions on other axes, and/or other aircraft types. Not on fly-by-wire systems, it would be electrical wiring instead of mechanical linkage.

The F/CTL check is thus not limited to the relationship between the servocorrols, observed with the surface position indicators, and the controls at cockpit. The whole system is checked.
Take-off was performed with the shift first compensated by inputs on the pedals and then by the autopilot yaw actuator once autopilot was engaged. But the rudder moved sharply to the rudder trim position once the autopilot declutched and the aircraft experienced an unexpected and sudden bank.

Such an event is covered with criteria 3, rudder at neutral with controls (what includes rudder trim) at neutral. There was no warning triggered to the crew, but it could have been detected by carefully performing the existing Standard Operating Procedures (SOP) F/CTL Check.

3.2 Response in opposite direction

We will here discuss an in-flight turn back due to Inverted Roll Command experienced with an A320. The F/CTL check was performed with no anomalies noticed by the crew. At take-off, the Captain applied a lateral sidestick input to the right, but the aircraft banked to the left. The F/O took over, and successfully landed the aircraft. Upon troubleshooting, a maintenance error was found. A wiring inversion had been made between the transducer unit of Captain roll sidestick and ELAC 1, on both the COMMAND & MONITOR channel. With this double inversion, ELAC 1 was receiving consistent signals, and thus could not detect the anomaly and could not trigger a warning to the crew (Figure 3).

Figure 3: Cross connection of sidestick roll signals to F/CTL computer

3.3 Lack of response

Another example is an in-flight turn back due to reduced ability to turn left experienced just after taking off with an A320. Almost full left sidestick inputs were required in order to laterally control the aircraft. At 1500ft, ECAM warning “F/CTL SPLR FAULT” came up with all right hand roll spoilers shown inoperative.

During a previous maintenance task, R/H spoilers 2 to 5 were left in the maintenance position. After lift-off, they deployed to the zero hinge moment positions and would not respond to inputs. Preventive instructions have been added in AMM, and monitoring has been improved to trigger an ECAM warning in such condition. But it could also have been detected by carefully performing the existing SOP F/CTL Check (Figure 4).
4 Efficiency of the F/CTL check

Some events, including recent ones, have highlighted the importance of the F/CTL check. Indeed anomalies were detected which required correction before flight, when aircraft systems did not trigger any failure warning to the crew. Here after are some of them.

4.1 Lack of response
A few events of this kind have been experienced with aircraft of the A340 family. The crew detected during the pre-flight F/CTL check that one elevator was stuck down (Figure 5). The loss of the elevator control was not indicated to the crew by any warning.

These events resulted from failure of the servos in damping mode failed. Investigating these events has allowed definition of modifications to both the servos and the F/CTL computers in order to prevent similar events. Appropriate ECAM warnings are triggered for crew annunciation. For these events, detection was ensured by carefully performing the existing SOP F/CTL Check only.

Additional information about these events is available with:
- OIT/ FOT Ref. SE 999.0149/03 dated 17 December 2003 entitled “ATA 27 – elevator dropped down – Cracked mode selector valve transducer at servos in damping position”;
- OIT Ref. SE 999.0066/04/BB Rev. 01 dated 11 June 2004 and FOT Ref. STL 999.0061/04 dated 10 June 04 entitled “ATA 27 – Right elevator stuck down in full pitch down position caused by double failure.”

4.2 Limited deflection
One last example is an event of undue rudder travel limitation on ground.

The Rudder Travel Limitation Unit (RTLU) had failed closed in the high-speed configuration. The ECAM warning “F/CTL TRAVEL LIM FAULT” dedicated to the monitoring of the RTLU position was not displayed.

Indeed, at that time, FCSC which is the computer that controls the RTLU and PTLU did not monitor their behaviour during phases when they are not electrically supplied and thus not supposed to move. However the RTIL system failed and RTLU closed during such a phase of no monitoring on ground. Monitoring has since been reviewed.

The failure was thus detected only by performing the existing SOP F/CTL Check, and the right decision to return to the gate could be taken.

5 Completion of the F/CTL check

All of the above-mentioned events have confirmed that the crew properly performing Flight Control Checks remains the last safety net. However, training feedback and line observations have revealed that the F/CTL checks were not always performed properly because:
- Checks were routinely performed;
- The PF moved the sidestick too quickly and the PNF had insufficient time to efficiently perform the checks;
- The PNF may be out of the monitoring loop.

SOP F/CTL checks have been reviewed with a reinforcement of the role of the PNF who now calls out the results of his/her visual check of each of the PF’s sidestick/rudder pedal stops inputs. This allows the PNF to still closely monitor the correct sense, full deflection and return to neutral of all surfaces as previously recommended, and in addition:
- Avoids the PNF from being influenced by the PF callouts
- Ensures that the PNF efficiently checks all surface motions
- Obliges the PF to pause the sidestick/rudder pedals at each stop
- Allows the PF to detect a failure, if callout is not in line with the PF’s input.

The failure was thus detected only by performing the existing SOP F/CTL Check, and the right decision to return to the gate could be taken.
The in-flight thrust reverser deployment is one of the most feared situations by all pilots. It has always been under the extensive scrutiny of both the engines and airframe manufacturers as well as by the Airworthiness Authorities. This particular attention was even reinforced after the tragic accident which occurred on Lauda Air B767 flight NG004 in May 1991. This has led to the implementation of additional modifications to further decrease the probability of occurrence of such event.

Despite all protective measures in place, the event described hereafter occurred in March 2004 on an A320 aircraft equipped with IAE V2500-A1 engines.

**Sequence of events:**
- While the aircraft was on a transit check for a scheduled flight, airline’s maintenance found an hydraulic leak from the engine N°1 inboard lower thrust reverser actuator.
- Airline’s maintenance deactivated the reverser for an aircraft dispatch under M.E.L.
- In climb phase, approximately 15 nm from the departing airport, engine N°1 reverser got deployed.
- As per check-list, engine N°1 was shutdown by the crew.
- Crew then made a safe precautionary landing back to departing airport.

**Findings:**
- Upon landing, the engine N°1 reverser was found almost fully deployed.
- The thrust reverser sleeve locking pins (2) were not found, while the lock-out assembly was intact.
- After opening the fan cowl, both locking actuators were found lock wired in the unlock position. The HCU was properly deactivated.

**6 Conclusion**
In comparison with conventional aircraft, “Fly by wire” architecture provides an additional flight controls systems monitoring in order to ensure flight controls availability and safe aircraft operation.

Airbus’ priority is to continuously meet these objectives, if possible, via monitoring enhancements. However, EFCS monitoring features cannot possibly detect all failure cases.

A comprehensive flight controls integrity check relies on the crew’s accurate completion of pre-flight control checks.

The new SOP procedure increases the efficiency of the F/CTL checks, in association with the F/CTL monitoring systems: The PF and PNF are definitively in the monitoring loop.

The key message Airbus would like to convey is: **TAKE YOUR TIME PROPER F/CTL CHECKS = SAFER FLIGHT**

Note: The F/CTL checks have been discussed during the 11th Flight Safety Conference held in Toulouse in September 2004. CD’s of this conference may be requested to the Nuria Soler, nuria.soler@airbus.com.
Flight data analysis:

GMT: 14.16.30 A/C takes off TLA are set to TOGA position - EPR reach 1.4 A/THR engages
GMT: 14.17.30 A/P 1 is engagedAltitude is 1,700 ft AGL, TLA are set to CLB
GMT: 14.18.30 SLAT/FLAP conf clean is selected
GMT: 14.20.22 ENG 1 thrust suddenly drops down
ALT is about 6500 ft AGL – CAS = 250kts
The aircraft was in a left commanded turn. The roll angle was decreasing from around 10° with a rate of 2°/sec.
EPR actual, EPR command and EPR target decrease from 1.24 to 1.0 in 10 seconds (auto-idle logic activated due to a reverse deployment beyond 10%) A/THR disengages
Concurrently, VRTG decreases to 0.99g. Roll rate which was about 2°/sec (aircraft was in left turn) reduces to 0.4°/sec ; LATG increases to 0.05g. Rudder moves from 0 to -3DA (right input)
GMT: 14.20.32 ENG 1 TLA increases
When Engine 1 reaches Idle, crew moves TLA1 up to 31DA, ENG1 intends to follow TLA1 position (short thrust increase) but continues to decrease down to Idle (auto-idle logic)
GMT: 14.20.45 ENG 1 TLA decreases
Crew elects to retard TLA1 to Idle and increases TLA2 to 35DA (MCT)
GMT: 14.21.25 Aircraft levels off Altitude is 8000ft ; CAS increases to 282kts (maximum reached during this flight)
GMT: 14.21.59 ENG1 shut down Main ENG1 parameters start to toggle, NCD parameters
GMT: 14.22.27 Auto thrust is reactivated
GMT: 14.42.25 Crew performs a manual single engine landing

Due to the combination of having:
- The HCU deactivated (leading to no hydraulic power to the actuators)
- And the actuators not locked
- And the lock-out bolts not properly installed on the translating sleeves,

the translating sleeves were not locked and were free to move under aerodynamic loads.

Maintenance actions analysis:
- The HCU deactivation was done properly following the AMM procedure:
  • "A. Deactivation of the Thrust Reverser HCU" procedure.
- The following AMM procedure steps were not performed, because it was not possible to do so while the thrust reverser actuators were locked in the unlocked position:
  • "B. Manually move the translating sleeves to the fully retracted position" 
  • "C. Lock the Left and the Right Translating sleeves"
- Finally the last AMM procedure step was not done.
  • "D. Put the locking actuators in the locked position"

Operational aspect analysis:

Prior to engine start, the ECAM warning “ENGX REVERSE UNLOCKED” was annunciated.

According to information received, maintenance personnel cancelled the “ENGX REVERSE UNLOCKED” message through the “EMER/CAN” button.

Upon engine start, the “ENGX REVERSE UNLOCKED” warning was then displayed under cancelled cautions, while the ECAM showed "REV" Amber in EPR gauge and “STS” indication.

However, the aircraft was dispatched with the thrust reverser unlocked and free to move under aerodynamic forces.

Less than 4 minutes after take-off, the engine N°1 auto-idle was activated. It activates once there is more than 10% opening of the reverser, and brings down the TRA to idle based on the initial TRA position. This reverser opening detection also triggered the Auto thrust disconnection. The Auto re-stow which is also normally triggered was not effective since there was no hydraulic power due to the proper de-activation of the HCU.

As described in the Flight data analysis, there was very little changes on aircraft flight characteristics. Based on the flight parameters evolution it is assumed that the thrust reversers deployed slowly due to the aerodynamic forces (there was no hydraulic power due to HCU de-activation).

The aircraft maintained control with no upset throughout the event.

The engine was shut-down, then the Auto thrust was re-engage, and an IFTB was made followed by an uneventful single engine landing.

Per FCOM Standard Operating Procedure “cockpit preparation”, the ECAM control panel STS page must be checked to ensure that INOP SYS display is compatible with MEL.

In this case for ENGX REVERSE UNLOCKED, the MEL says “NO DISPATCH”.

Due to the combination of having:
- The HCU deactivated (leading to no hydraulic power to the actuators)
- And the actuators not locked
- And the lock-out bolts not properly installed on the translating sleeves,
Maintenance recommendations:

It is absolutely necessary to strictly follow all steps of the relevant AMM Thrust reverser de-activation procedure. Furthermore, only the required tooling must be used (appropriate locking pins, …)

Finally, “ENG X REVERSE UNLOCKED” warning should not be displayed following reverser deactivation.

Operational recommendations:

The “ENGX REVERSE UNLOCKED” and the “REV” Amber messages should not be present on ECAM following a proper thrust reverser deactivation. They are both NO DISPATCH warnings.

In addition, the “EMER/CANC” button should only be utilized to kill a permanent spurious warning.
Flight Safety Enhancement –
In Need of a Global Approach

Aviation safety, measured in terms of number of hull losses per departure, has reached a mature but stable level.

Any further enhancement of this achievement requires a systemic approach where the aircraft, the operations and the operating environment are considered globally.

Introducing the Flight Operations Briefing Notes Concept

The Flight Operations Briefing Notes have been designed to allow an eye-opening and self-correcting accident-prevention strategy.

The initial set of Approach-and-Landing Flight Operations Briefing Notes has been developed by Airbus in the frame of the Approach-and-Landing Accidents Reduction (ALAR) Task Force led by the Flight Safety Foundation (FSF).

The wide acceptance of the Approach-and-Landing Briefing Notes by the pilots’ community and the positive feedback received from customers have prompted Airbus to initiate the development of new sets of Briefing Notes, in order to cover the entire flight profile and address the main threats and hazards to flight operations safety.

Accident-prevention Strategy

To support this strategy, each Flight Operations Briefing Note:

- Presents the subject and its associated hazard to flight operations safety, using background information and statistical data;
- Emphasizes the applicable standards and best practices (e.g., standard operating procedures [SOPs], supplementary techniques, operational recommendations and training guidelines);
- Lists and discusses the operational and human factors that may cause flight crews to deviate from applicable standards;
  This section constitutes an eye-opener to assist the reader in assessing his/her own exposure;
- Provides or suggests company accident-prevention-strategies and/or personal lines-of-defense;

This section will assist the reader in identifying company or personal prevention strategies and/or corrective actions;

Flight operations briefing notes
A Tool For Flight Operations Safety Enhancement
Takeoff and departure operations (e.g.: Understanding takeoff speeds, Revisiting the stop or go decision, …),

En-route climb and cruise management (e.g.: Managing buffet margin, overspeed prevention / recovery, …),

Descent management (e.g.: Being prepared for go-around, …),

Approach techniques (e.g.: Flying stabilized approaches, …),

Landing techniques (e.g.: Preventing tail strike at landing, …),

Ground handling (e.g.: Preventing tail strike at landing, …),

Cabin operations (e.g.: Managing smoke issues in cabin, emergency evacuation, …).

The Flight Operations Briefing Notes are progressively released on the Safety Library room of the Airbus Safety First website: http://www.airbus.com/about/safetylibrary.asp

They should be also disseminated to customers once a year on CD-ROM and paper format.

Conclusion

Flight safety enhancement has been and will continue to be the result of technological developments.

However, 85 % of accidents today are operational events that involve human performance at every stage of the safety chain.
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