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AIC FRANCE
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SUBJECT : Deployment of CDO (continuous descent operations) on the French territory

1 INTRODUCTION

After a trial and assessment period, the DSNA (French Directorate for Air Navigation Services) would now like to deploy continuous descent operations all across the French territory.

When well performed by pilots, continuous descent reduces the effects of aircraft noise on the residential areas near airports and CO_2 emissions. Continuous descent approach performance indicators for the residential community (reduction of noise linked to the elimination of superfluous sound levels) are or shall soon be available for all large French airports. The gains in CO_2 shall be included in national greenhouse gas emission monitoring indicators.

The DSNA will use this AIC to provide a set of recommendations and procedures on how to create, deploy and use this type of operation at national level, in order to help airlines perform successful CDO. Both the applications of the internationally standardized general principles and the French choices for fields which are not yet standardized are described in this AIC.

2 DEFINITION

CDO (Continuous Descent Operations) is a flight technique which enables aircraft to have optimized flight profiles, either linked to instrument approach procedures and adapted airspace structures or air control techniques, by using reduced engine power and whenever possible, configurations limiting aerodynamic drag, in order to decrease the following:

- noise nuisance in the areas surrounding the aerodromes,
- emissions of gases into the atmosphere,
- consumption of aircraft fuel.

The above are reduced from the TOD (Top of Descent) at cruise level until the runway is reached.

3 SCOPE

Continuous descent approaches may be used in airspaces dedicated to both the ENR (end of cruise flight) phase for STAR (standard arrival) procedures and the TMA (terminal control area) phase for INA (initial approach) procedures.

They may be performed during both conventional and surface (RNAV) navigation. However, RNAV arrival and approach paths are now being developed whenever air traffic systems are assessed or improved. These RNAV paths are designed to reduce the distance travelled and allow optimized flight profiles on landing. They should make CDO more efficient.

4 CURRENT SITUATION OF PUBLICATIONS IN FRANCE

To date, several French international aerodromes have “Continuous Descent Approach” type procedures, which are now processed and published using the term “Continuous Descent Operations (CDO)”.

Given the complexity of airspaces and the difficulty that air traffic control units have in authorizing such procedures in order to maintain safety in busy traffic conditions, two types of publication have been adopted:

a) permanent documentation (AIP France), for procedures which are likely to be permanently authorized by the ATC,

b) temporary documentation (AIP SUP), for procedures being assessed in accordance with operational constraints.

At the time of publishing this AIC, Paris-Orly (LFPO) runway 06 and Strasbourg-Entzheim (LFST) runway 23 have permanent documentation.

Marseille-Provence (LFML) runway 31R, Paris-Charles-de-Gaulle (LFPG) runways 08L-08R-09L-09R, Toulouse-Blagnac (LFBO) runways 14L-14R-32L-32R, Lyon-Saint-Exupéry (LFLL) runways 18L-36R and Bordeaux-Mérignac (LFBD) runway 23 have temporary documentation.

International aerodromes such as Nice-Côte d'Azur (LFMN), Nantes-Atlantique (LFRS) and Bâle-Mulhouse (LFSB) are being studied.

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5 DESIGN AND DESCRIPTION OF A STANDARD PROCEDURE

5.1 Top of descent

A CDO likely to be performed both during the “ENR end of cruise flight” phase and the “STAR” arrival phase or the “INA” initial approach phase will begin in the flight phase commonly called “Top of Descent”.

This critical point of the CDO, which determines and guarantees compliance with the rest of the procedure until the subsequent flight phase, is determined by the FMS but may also be predefined and published or left to the initiative of the ATC.

In brief TOD can begin following one of these three options:

a) a point published in the procedure section (in particular STAR and INA);

b) on the initiative of the ATC;

c) on request from the crew.

5.2 Descent segments

The following phases are likely to be broken down into descent and deceleration segments until final approach phase (FNA) preparation, and are performed at variable gradients depending on the type of aircraft, its weight, speed, weather conditions and also the flight management imposed by the crew. Vertical profile construction rules per altitude band may nevertheless be designed.

Descent gradients with no particular constraint above FL100 may reach 4° (7%).

The first deceleration segment, most often when approaching FL100, has a lower gradient, around 2° (3.5%).

The subsequent segment (initial approach phase, INI) allowing aircraft to reach the landing phase (intermediate approach phase, INT and final approach phase, FNA) has a gradient close to 3° (5.2%).

The descent profile computed during the last 10 NM before the beginning of the final approach (FAF) may be reduced to 2° (3.5%) in normal conditions and must not exceed 3° (5.2%).

The difference in altitude created by the difference between the local runway QNH setting and the standard 1013 hPa setting must be taken into account, especially during a descent of a low flight level to an altitude over a short distance.

Example: In the least favorable case where QNH is 1040 hPa, the aircraft will have to descend an extra 756 feet (28 ft per hPa for a difference of 27 hPa in ISA), which means that the gradient needed to reach the final approach fix in good conditions must be higher.

The table below shows the possible variations of the gradient near interception level assuming that the aerodrome is at sea level and an interception level of 3000 feet, not taking wind gradients into account.

FL at WP or TOD	Altitude to lose to reach FNA level QNH 1013 hPa	Standard gradient	Distance traveled with standard gradient	Altitude to lose to reach FNA level QNH 1040 hPa	Corrected gradient – identical WP or TOD
FL100	7000 ft (2133m)	3° - 5.25%	40628 m (21.9 NM)	7756 ft (2364 m)	5.81 % - 3.35°
FL090	6000 ft (1828 m)	3° - 5.25%	34819 m (18.8 NM)	6756 ft (2059 m)	5.91 % - 3.40°
FL080	5000 ft (1524 m)	3° - 5.25%	29028 m (15.7 NM)	5756 ft (1754 m)	6.04% - 3.45°
FL070	4000 ft (1219 m)	3° - 5.25%	23219 m (12.5 NM)	4756 ft (1449 m)	6.24% - 3.55°
FL060	3000 ft (914 m)	3° - 5.25%	17409 m (9.4 NM)	3756 ft (1145 m)	6.57% - 3.75°
FL050	2000 ft (610m)	3° - 5.25%	11619 m (6.3 NM)	2756 ft (840 m)	7.23% - 4.15°

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Consequently, in order to ensure an optimized gradient less than or equal to 3°, it is advised to either move the reference waypoint (WP or TOD) back or to lower the level when it passes.

The last critical segment is the preparation of the final approach phase (FNA). This segment is relatively long and is not necessarily in relation with the intermediate approach phase (INT) with a minimum regulatory value of 30 seconds of flight at the given speed. In order to optimize this segment as much as possible and to reduce noise nuisance to a maximum, it must be performed with an optimum gradient close to 1° (1.7%) or less. This gradient also enables speed to be reduced at a rate of 20 to 30 kts/minute.

5.3 Published constraints

A CDO is optimized when there are no level or speed constraints, as this enables the FMGS horizontal and vertical path calculation and monitoring capabilities to be used fully.

The complexity of the air traffic systems around aerodromes nevertheless creates various constraints which may hamper the optimized vertical profile of a descent.

The ATC authorities must do their utmost to minimize the constraints or allow aircraft to pass in [low level – high level] windows compatible with the descent plans mentioned above.

Speed constraints should also be avoided, except those concerning flight safety, airspace management or compliance to procedures.

Finally, these published constraints must be respected by the FMS and the crew, unless otherwise instructed by the ATC.

5.4 Distance to runway (DTG, Distance To Go)

The optimization of the CDO procedure is improved by informing the crew of the distance to the runway:

- either at each significant waypoint of the published procedure, in particular during the initial approach phase (INA),
- or on the initiative of the ATC during a radar vectoring procedure performed before the final approach phase (FNA).

6 PROCEDURE IDENTIFICATION

Generally speaking, procedure identification meets the international recommendations and standards, as well as the national regulations in force.

6.1. *Identification of the en-route procedure is based on the designation of the PDR and AWY.*
Example: *UT184 – G36*

6.2. *Identification of an arrival procedure must comply with the designation of a STAR.*
Example: *NARAK 6G*

6.3. *Identification of an INA initial approach procedure may be the designation of a STAR procedure or simply the designation of an IAF, initial approach fix.*
Example: (*INA) LAVGO 1A or LAVGO*

7 FUNCTIONAL DIAGRAM (STANDARD PROFILE)

The following diagram illustrates the vertical profile of such a procedure.

It contains:

- the various gradients enabling descents, speed decreases and preparation of ILS interception,
- the published monitoring constraints, like altitude windows or mandatory minimum levels, distance to the runway from each characteristic point.

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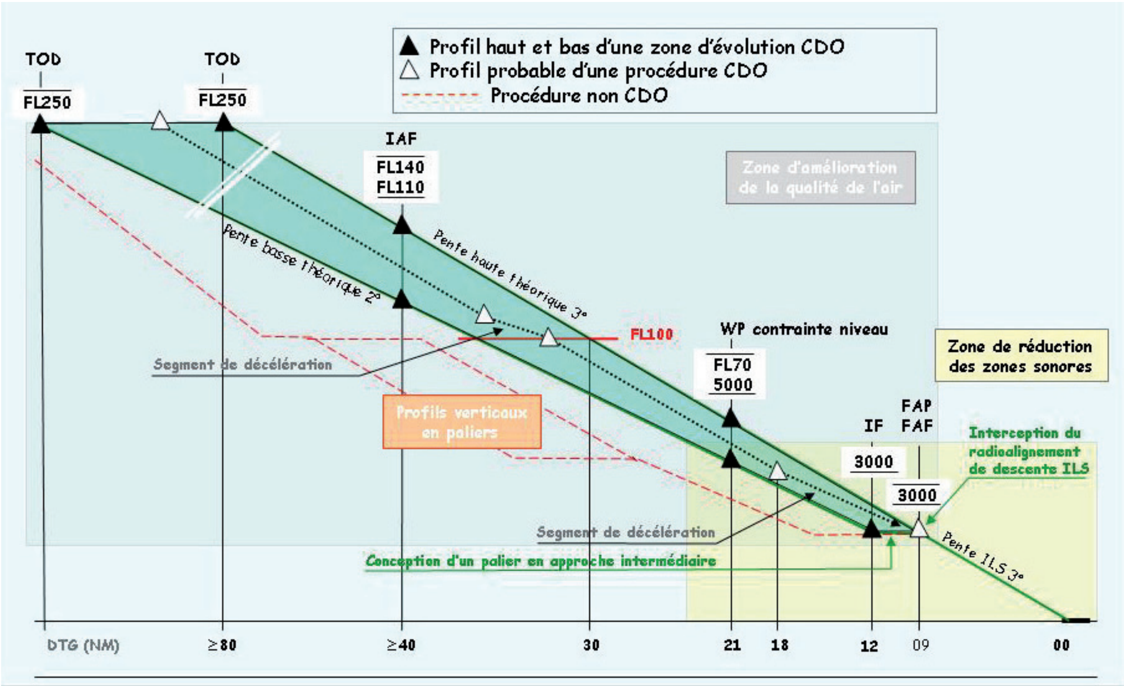

TRANSLATION FIGURE AIC CDO

Profil haut et bas d'une zone d'évolution CDO
High and low profile of a CDO operating zone

Profil probable d'une procédure CDO
Likely profile of a CDO procedure

Procédure non CDO
Non CDO procedure

Pente haute théorique
Theoretical high gradient

Contrainte niveau
Level constraint

Zone de réduction des nuisances sonores
Noise reduction zone

Interception du radioalignement de descente ILS
Interception of ILS glide path

Pente ILS
ILS gradient

Segment de décéleration
Deceleration segment

Conception d'un palier en approche intermédiaire
Creation of a level during intermediate approach

Profils verticaux en paliers
Vertical profiles in levels

Pente basse théorique
Theoretical low gradient

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8 MAPPING ASPECT

For a crew to optimize its descent profile, a CDO must be published like any other AIP procedure. It shall mention the following information:

- a warning specifying that this procedure is optimized for use during the CDO;
- distance to the runway at each waypoint (WP) of the procedure during the initial approach phase (INA),

and, if necessary:

- a clearly identified top of descent;
- level constraints;
- speed constraints.

See Appendix 1: Example of initial approach section (INA) – Toulouse-Blagnac airport (LFBO)

9 PHRASEOLOGY

The procedures are usually encoded and stored in the FMS databases.

The identification of the aeronautical documentation procedure, the identification of the procedure in the database and the phraseology used by the ATC **must** be consistent.

Clear communication between the pilot and controller is essential to perform a CDO procedure safely.

Clearance outside constraints probably published on the various segments of the CDO procedure may be successively issued using the following phraseology:

- during the ENR (en route) phase via a waypoint (WP)
  - *Citron Air 1 2 3 – Proceed Route ESISI - NARAK*
    - *When (you are) ready, descend level 1 9 0 via NARAK*
    or Descend at own discretion – cleared level 1 9 0 via NARAK
    or Descend level 1 9 0 via NARAK
- during the arrival phase (STAR) via the initial approach fix (IAF)
  - *Citron Air 1 2 3 – Proceed NARAK 6G Arrival*
    - *When (you are) ready, descend level 1 1 0 via LAVGO*
    or Descend at own discretion – cleared level 1 1 0 via LAVGO
    or Descend level 1 1 0 via LAVGO
- during the initial approach phase (INA)
  - *Citron Air 1 2 3 – Proceed LAVGO Approach*
  - *Descend 3000 feet QNH 1 0 1 3 – ILS runway 3 2 right*

10 OPERATIONAL IMPLEMENTATION – ATC ACTION

When allowed by the density of the traffic inside the given airspace, the ATC will propose the available CDO procedures by default in order to encourage aircraft crew to perform them. The ATC applies the methods below. However, the real-time operational situation may lead it to take action in order to maintain flight safety.

10.1 During the performance of a published procedure

Clearance, based on the identification of ENR waypoints (PDR or AWY), of the arrival procedure (STAR) and the initial approach procedure (INA), either successively or on a segregated basis, allows a crew to perform such a procedure and enables:

a) the FMS to be used fully;

b) the choice of the vertical profile to be as flexible as possible;

c) the flight to be performed with no drag or power.

Any additional control instruction which introduces level constraints, a change in the rate of descent or speed is likely to disturb the management of this procedure optimized by the FMS. It should therefore be avoided except for safety requirements. Any shortening of the path (radar or GOTO) should also be avoided for the same reasons.

As regards the flight, the procedure should be performed, together with all the published constraints.

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10.2 During the performance of a radar vectoring or mixed procedure

Whenever possible, the controller should send the pilot information about the distance to the runway (DTG). The pilot will then be able to optimize his descent profile during the performance of the procedure.

11 FEEDBACK

This document has been discussed with manufacturers, airlines and operational staff. It may be improved during meetings organized by the DSNA with its clients, so that their needs may be better acknowledged.

12 REFERENCE TEXTS

- Resolution A33-7, Annex C: recommendations for a balanced approach to reduce the noise impact (ICAO);
- EU Directive 2002/30/EC (ECAC);
- First agreement committing all the air industry stakeholders (*Grenelle de l'environnement/MEEDDAT*, 28 January 2008) (Grenelle Environment Forum/French Ministry of Ecology, Sustainable Development and Energy);

- ICAO document 9931: CDO Manual
- ICAO doc 8168: PANS OPS Vol I and II
- ICAO doc 4444: PANS ATM

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APPROCHE AUX INSTRUMENTS
Instrument approach

L'utilisation de cette carte est réservée aux compagnies participant à l'évaluation CDO.
Use of this chart reserved to carriers participating to CDO assessment

TOULOUSE BLAGNAC

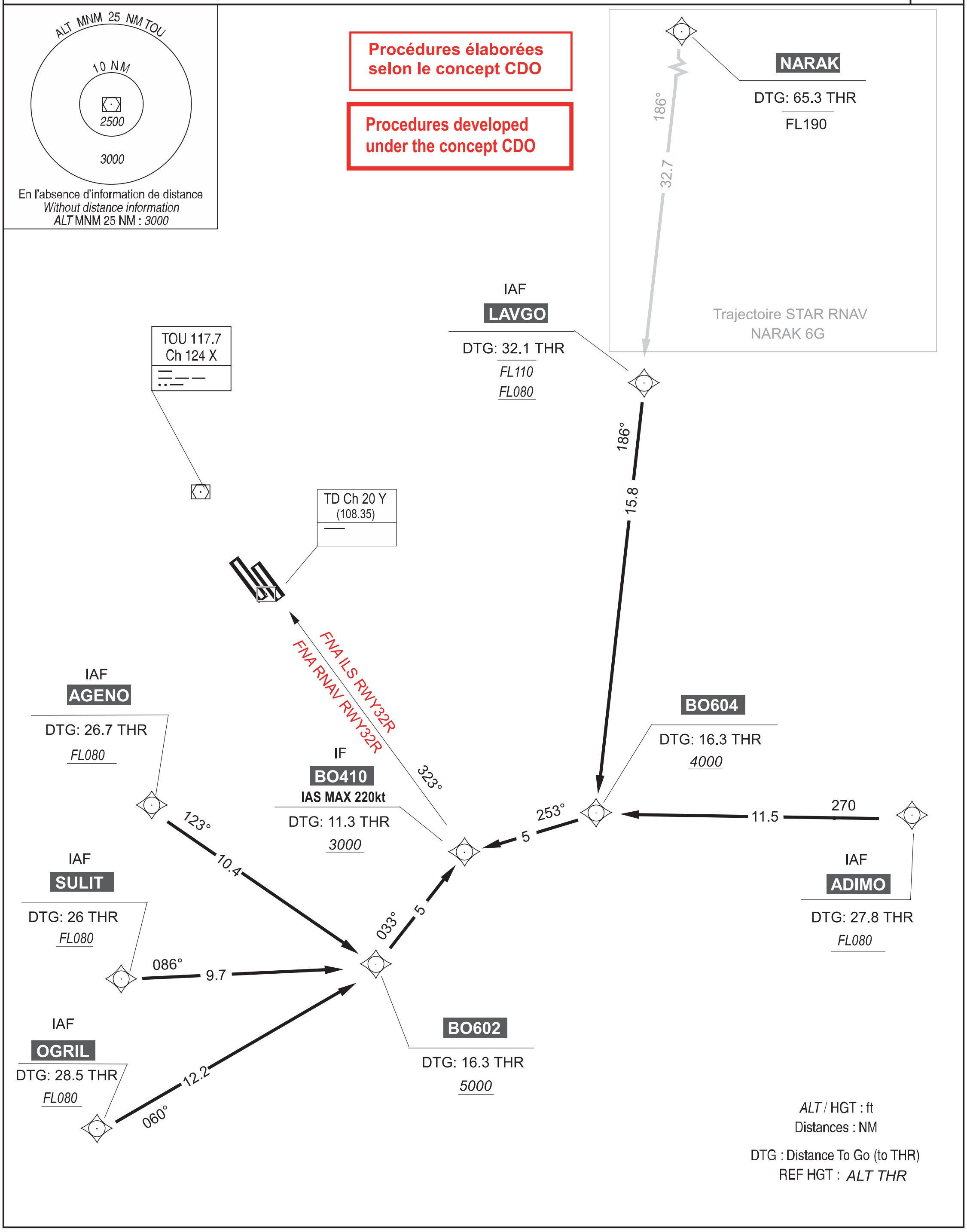
CAT A B C D

INA RNAV (GNSS) RWY32R

ATIS BLAGNAC : 123.125
APP : TOULOUSE Approche / *Approach* 129.3 (1) - 125.175 (2) - 124.975 (s)
BLAGNAC Approche / Approach 121.1
TWR : BLAGNAC Tour/*Tower* 118.1

(1) Secteur Est / East sector
(2) Secteur Ouest / West sector

VAR 0° (10)



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