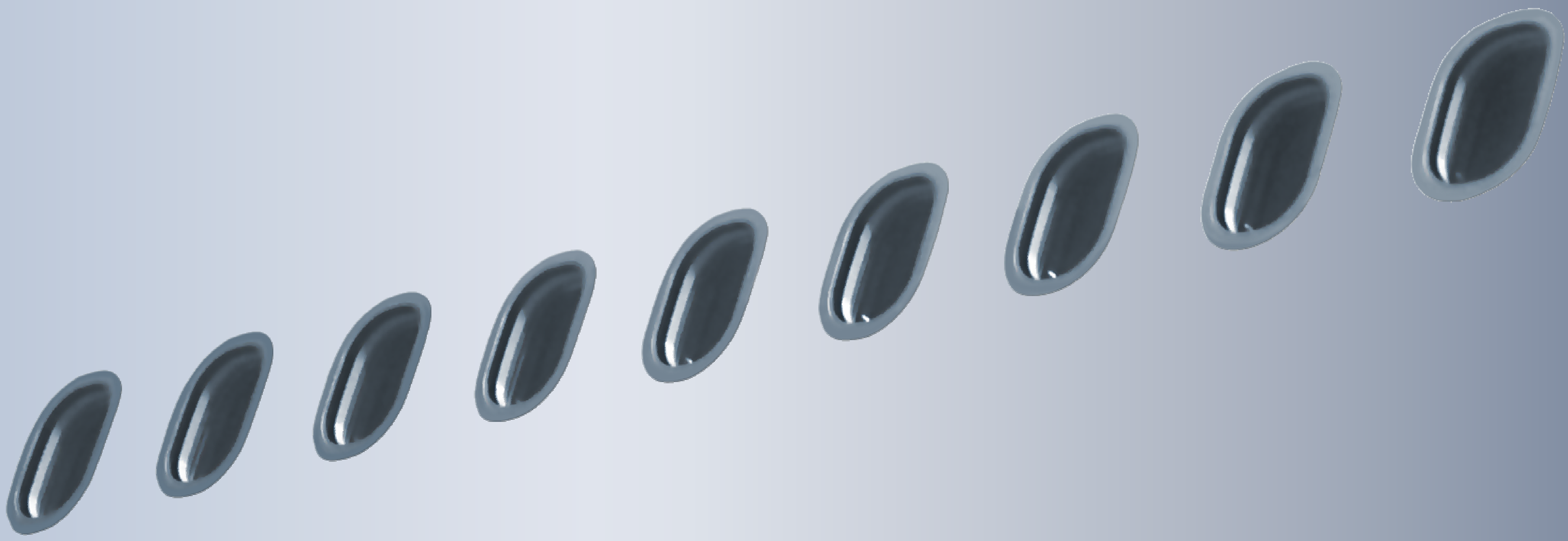

Airbus – Aircraft Energy management in descent phase using FMS

Airbus fleet performance

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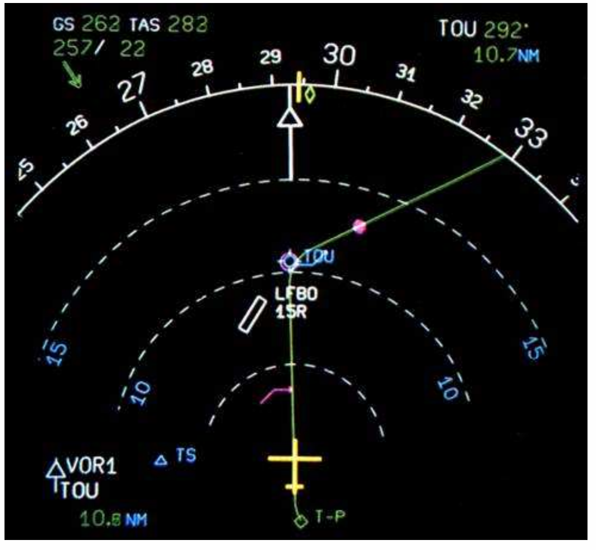
Introduction to descent operations

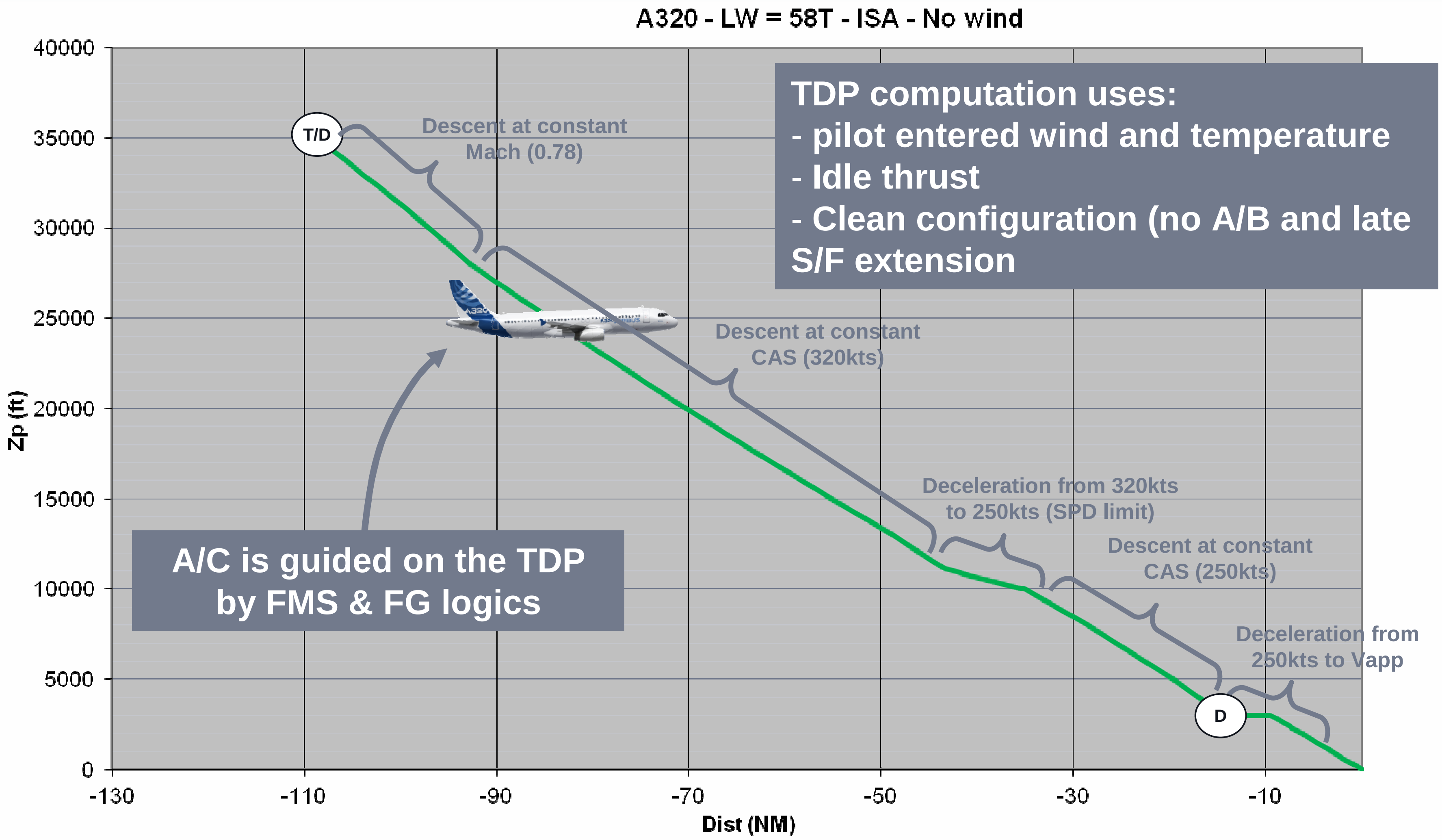
- In Airbus A/C, the FMS provides a **theoretical descent profile (TDP)** based on a Performance model (PDB) along the **lateral path** defined by a sequence of Waypoints provided by the Navigation Database (NDB). This flight path is used for:
  - **Top of Descent (ToD) display**
  - **Guidance during descent phase**
  - **Altitude and speed predictions**

FMS full managed mode (lateral, vertical & speed)



The use of FMS full managed mode is strongly recommended to achieve an efficient CDO, but requires no ATC intervention

Introduction to descent operations

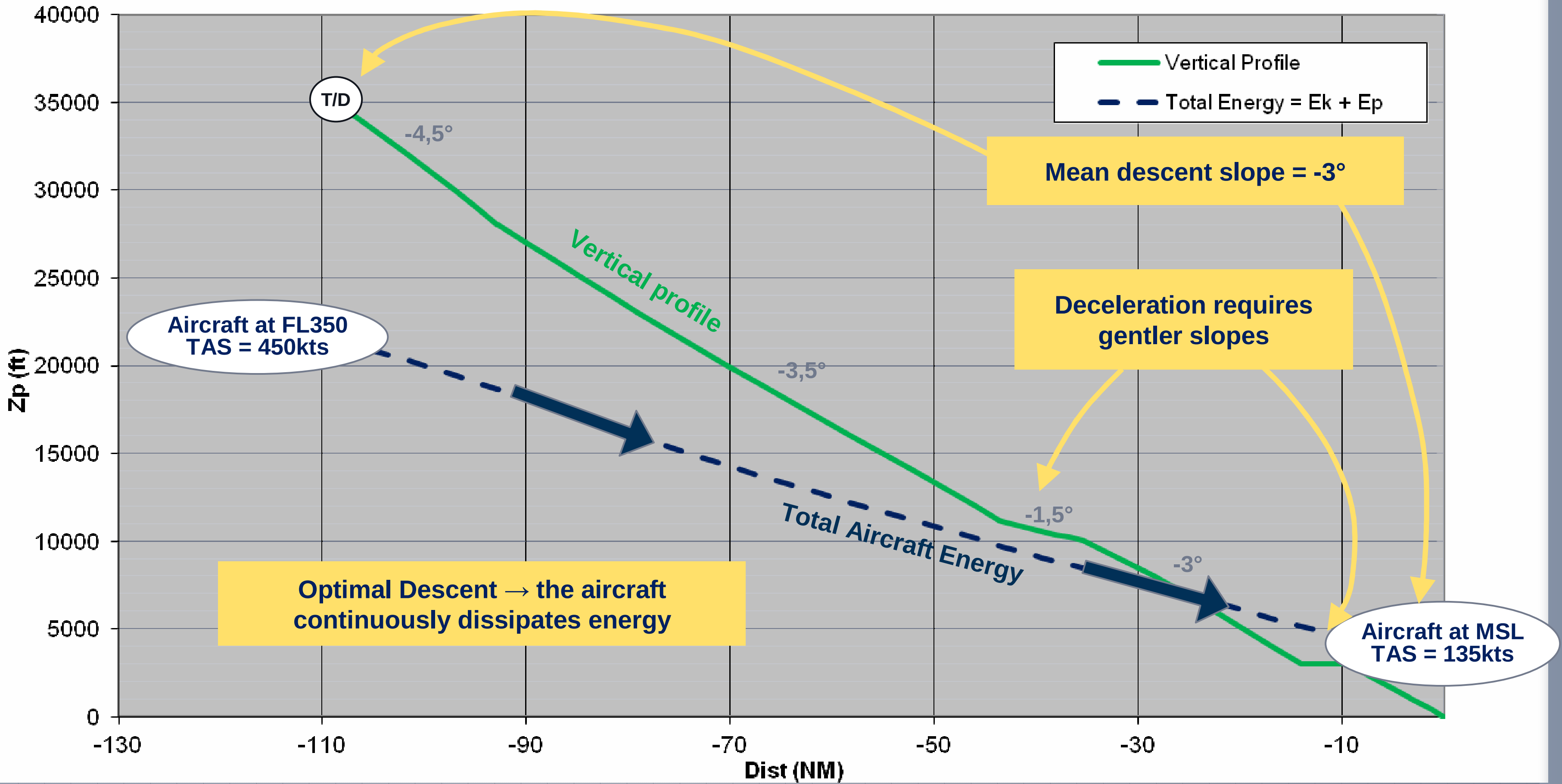


TDP computation uses:
- pilot entered wind and temperature
- Idle thrust
- Clean configuration (no A/B and late S/F extension

A/C is guided on the TDP by FMS & FG logics

Introduction to descent operations

- During descent, the A/C continuously loses Energy (kinetic energy + potential energy)
- Descent slope strongly depends on flying objective (maintain speed or deceleration)



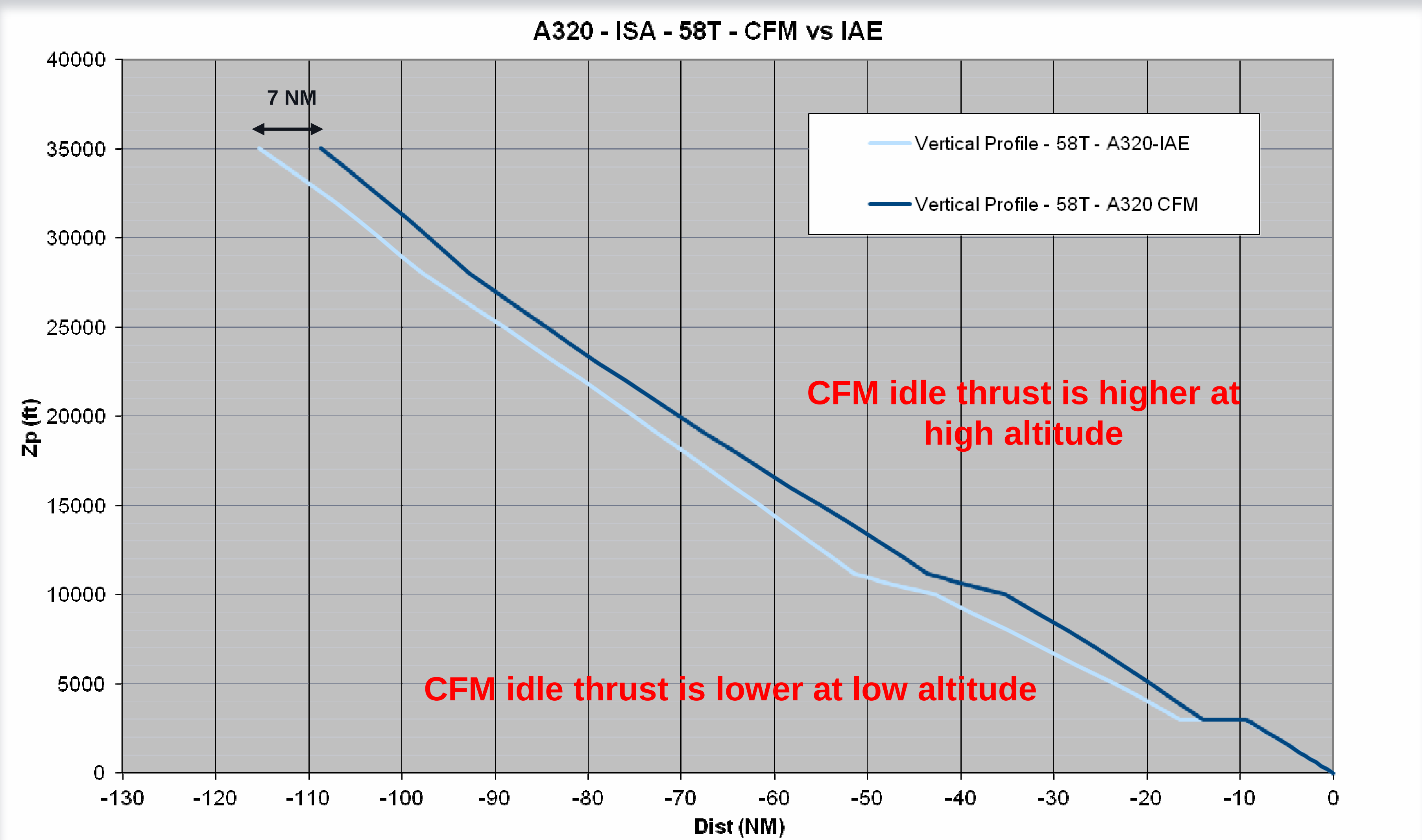
Optimum Descent profile sensibility

- Descent profile computation mainly depends on:
  - Aircraft type & Engine type
  - Landing weight
  - Descent speed law
  - Wind

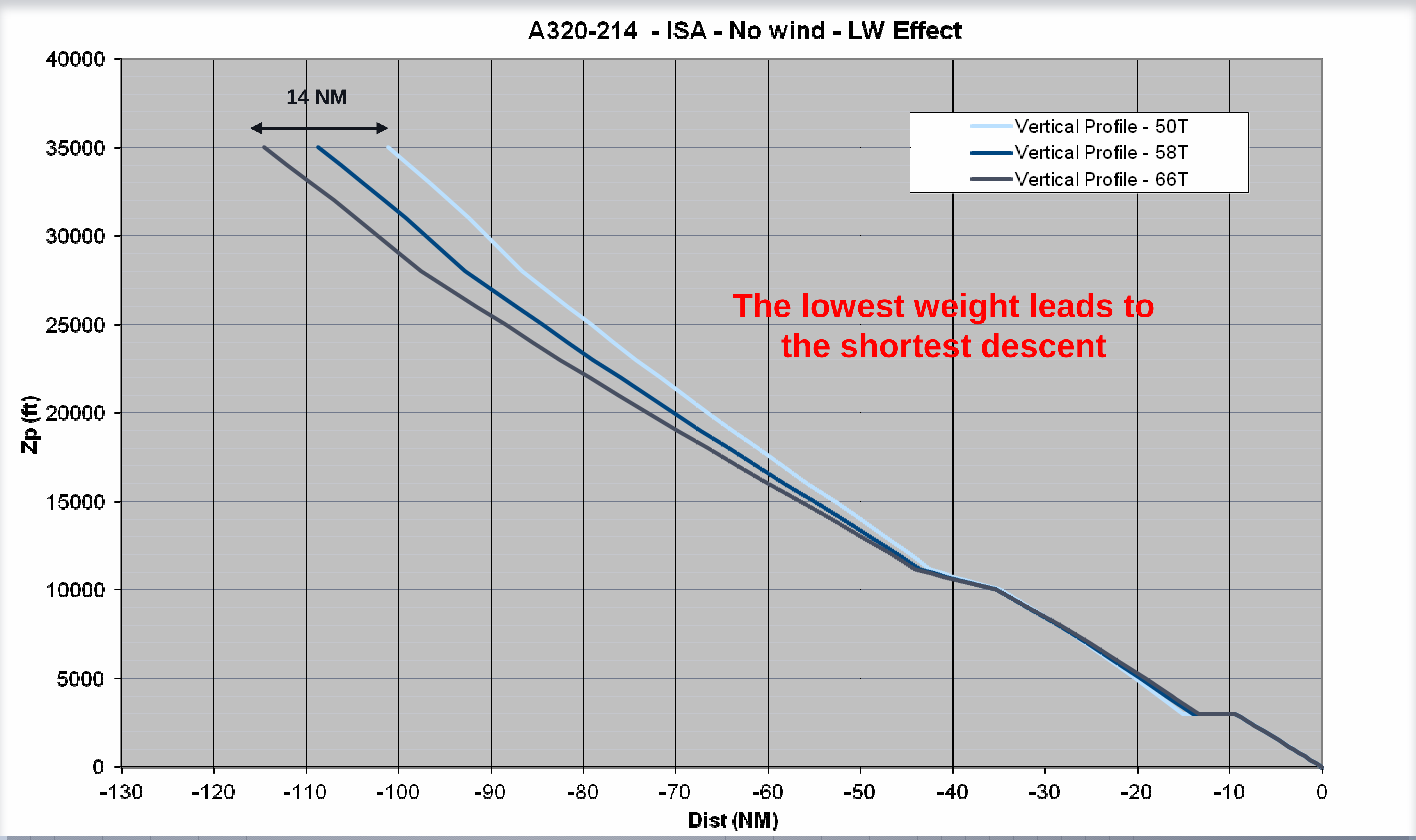
- This sensibility is taken into account by the FMS before descent phase (these conditions will impact the ToD position)

- Procedure design should allow the aircraft to adapt its descent to the current conditions

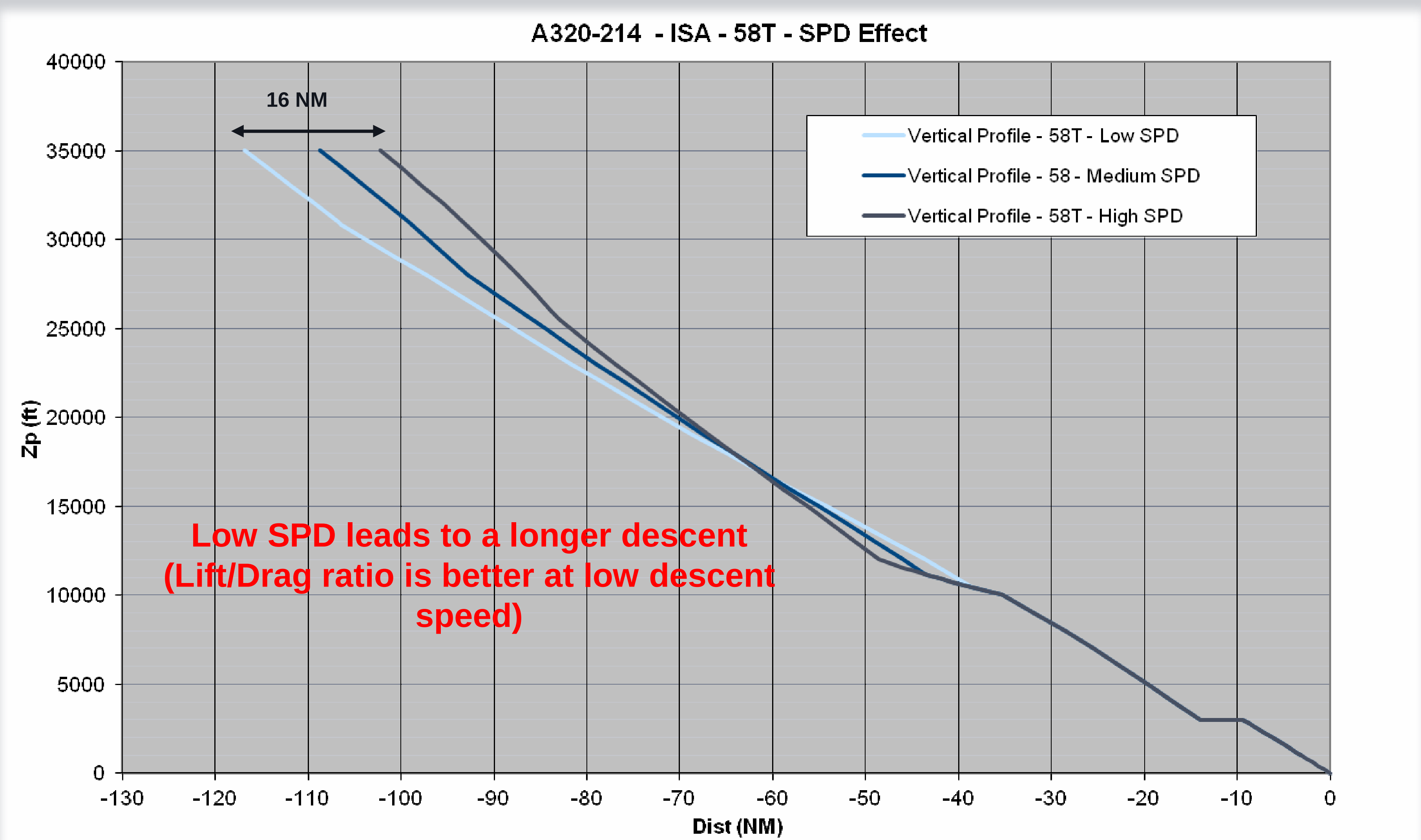
Optimum Descent profile sensibility: Engine type



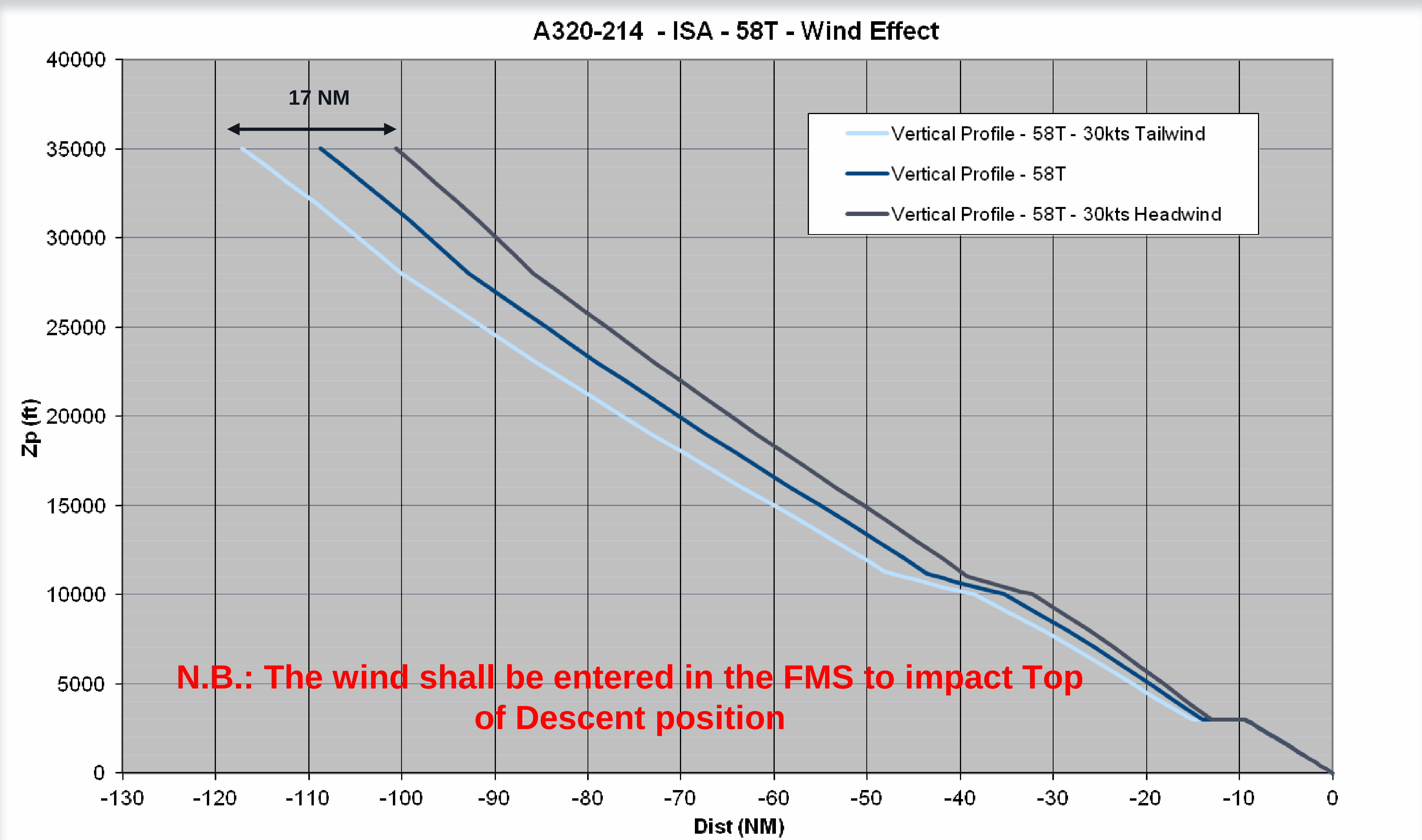
Optimum Descent profile sensibility: weight effect



Optimum Descent profile sensibility: descent SPD



Optimum Descent profile sensibility: wind effect



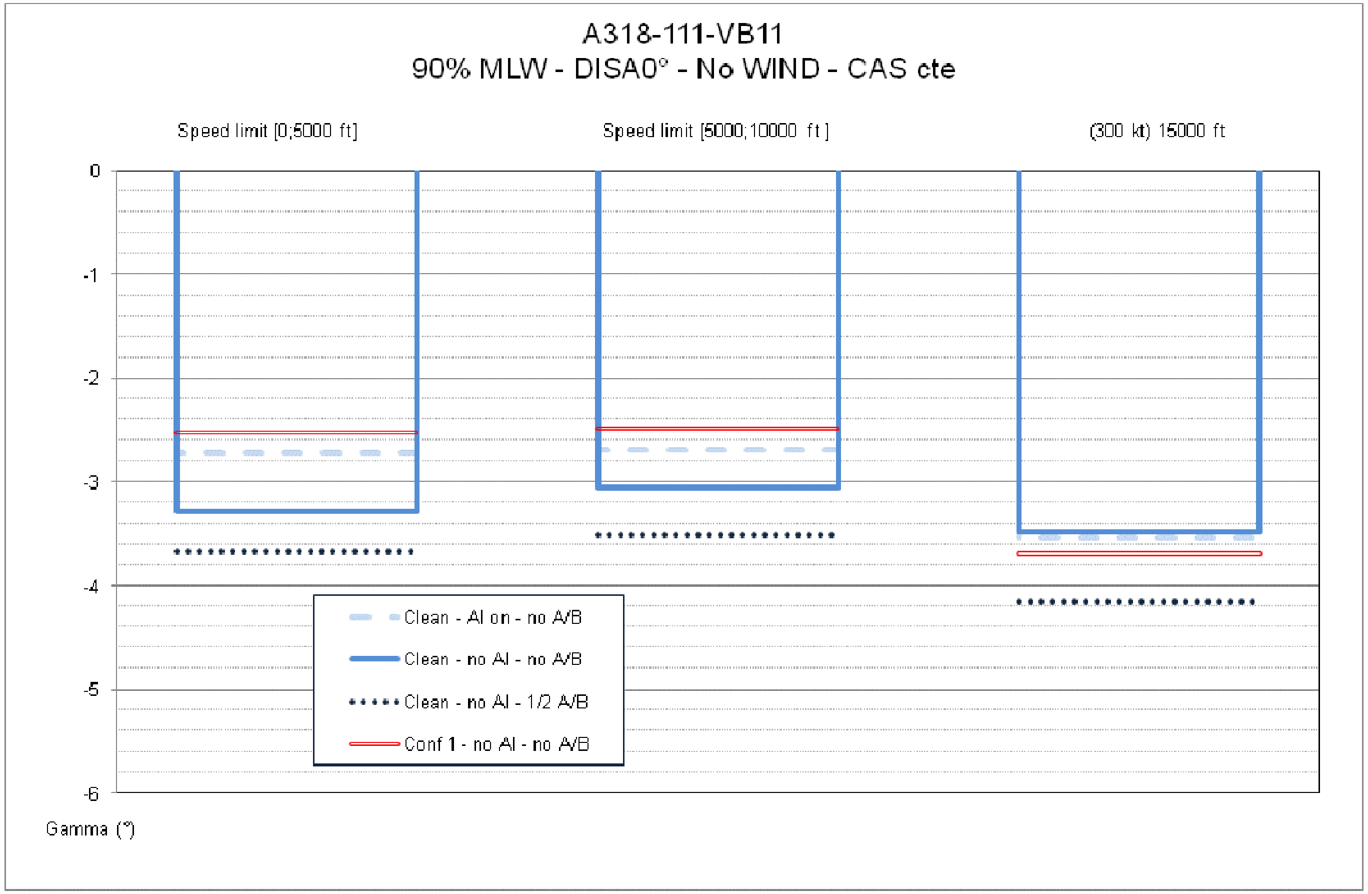
Recommendations for CDO procedure design

- Refer to the document **5.6.2_D03_Airborne Recommendations for CDA Procedure Design recommendations for CDO procedure design** provided by Airbus to SESAR project (WP5.6.2)
- Remind of the main recommendations:
  - "Window" ALT constraints shall be preferred compared to "AT"
  - Altitude constraints shall not impose a "too steep" flight path angle to the aircraft (too steep path required the use of Airbrake)
  - The average local wind shall be considered (10kts of tailwind shall decrease the limit slope by 0,1°)
  - A gentle slope (between -1° to -1,5°) shall be allow ed before glide slope interception
  - The transition altitude shall be preferably above FL100
  - Speed restrictions below 230kts and far from the FAF shall be avoided (this leads to early S/F extension)
  - The noise level can be reduced by using a SPD Limit at 230kts instead of 250kts

AIRBUS

Recommendations for CDO procedure design: limit slopes at constant CAS for the whole Airbus fleet

Example of the steepest slope allowing a constant CAS descent



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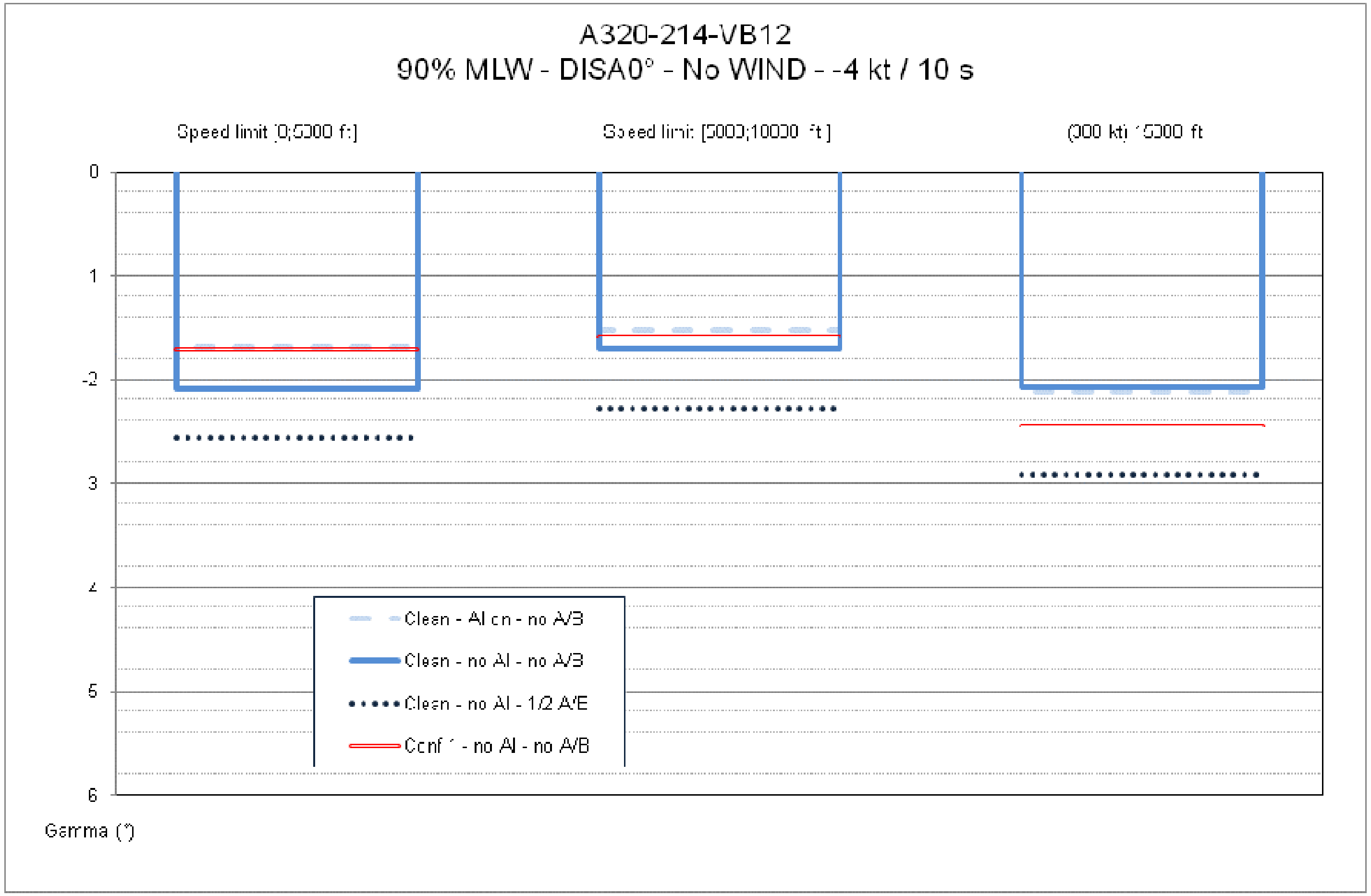
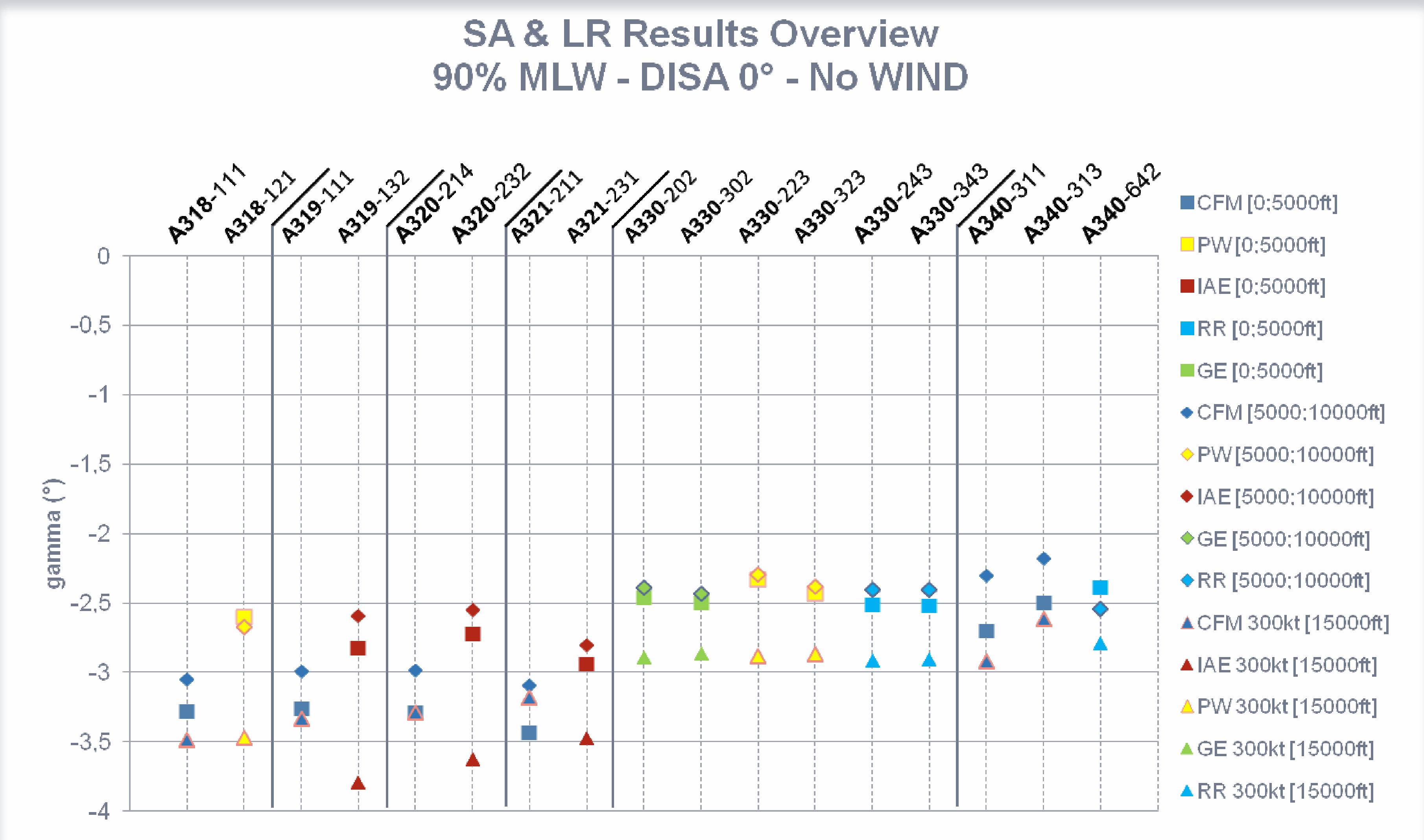
Recommendations for CDO procedure design: limit slopes allowing deceleration for the whole Airbus fleet

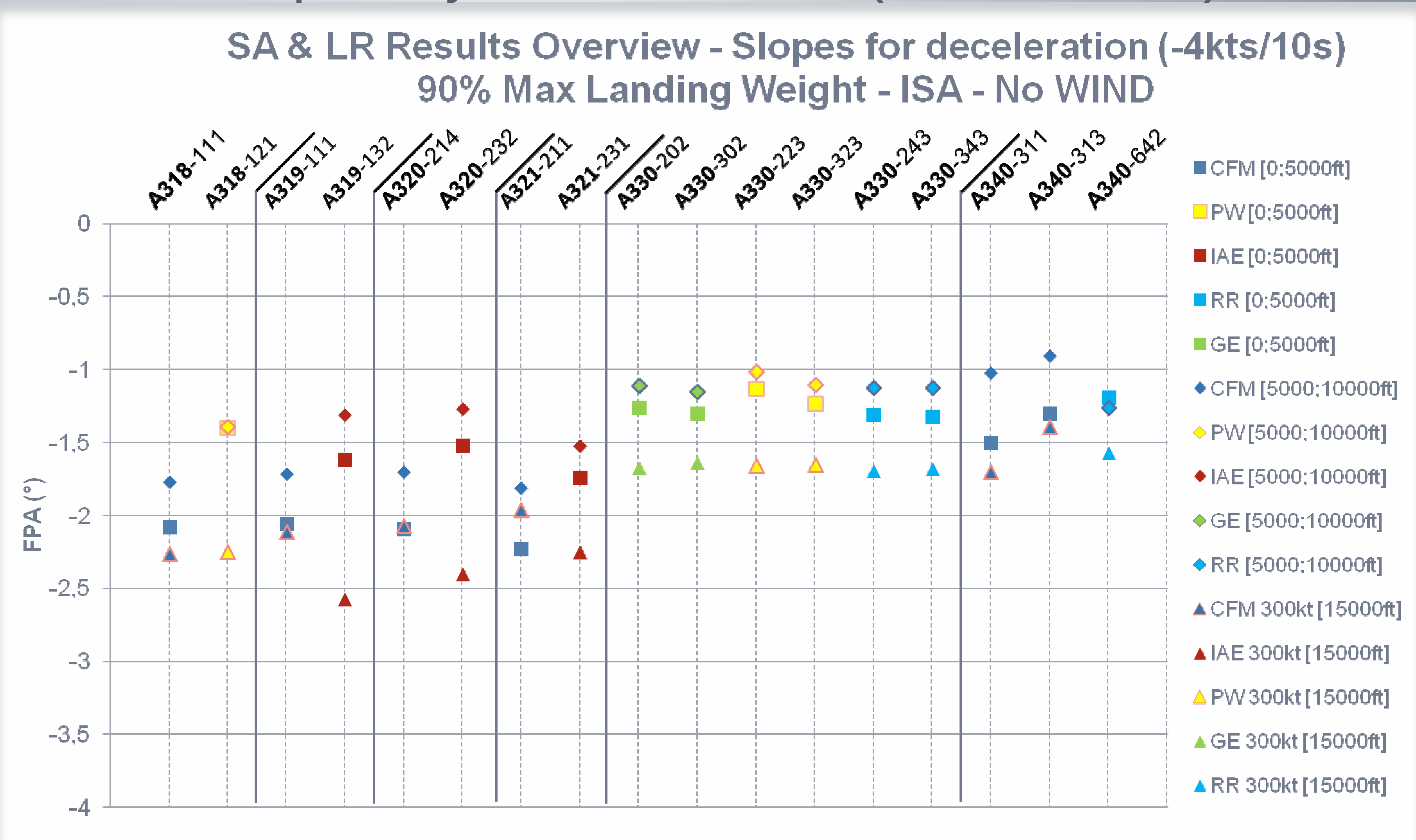
Example of the steepest slope allowing a deceleration rate of 4kts/10s



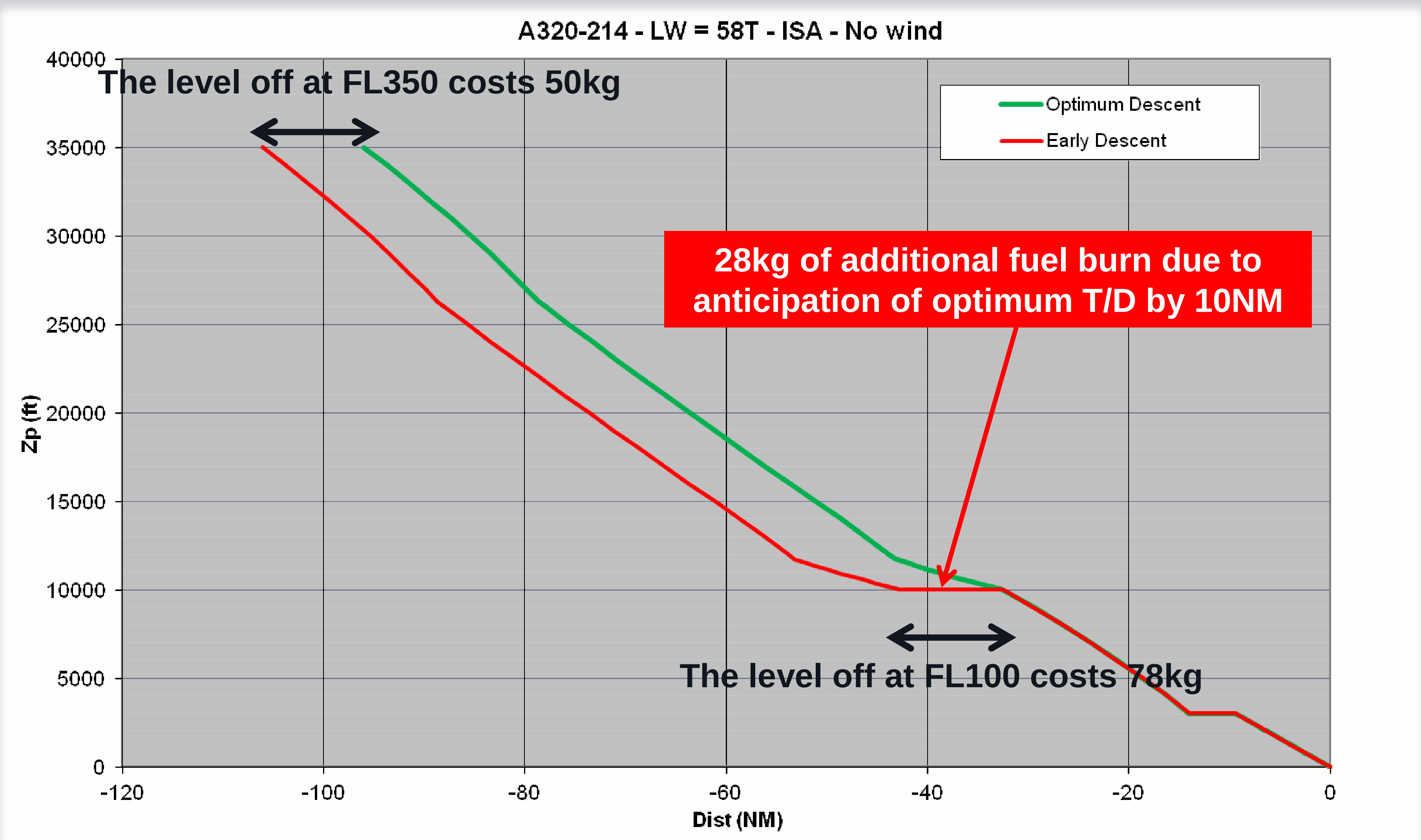
Recommendations for CDO procedure design: Descent capability of Airbus fleet (constant CAS)



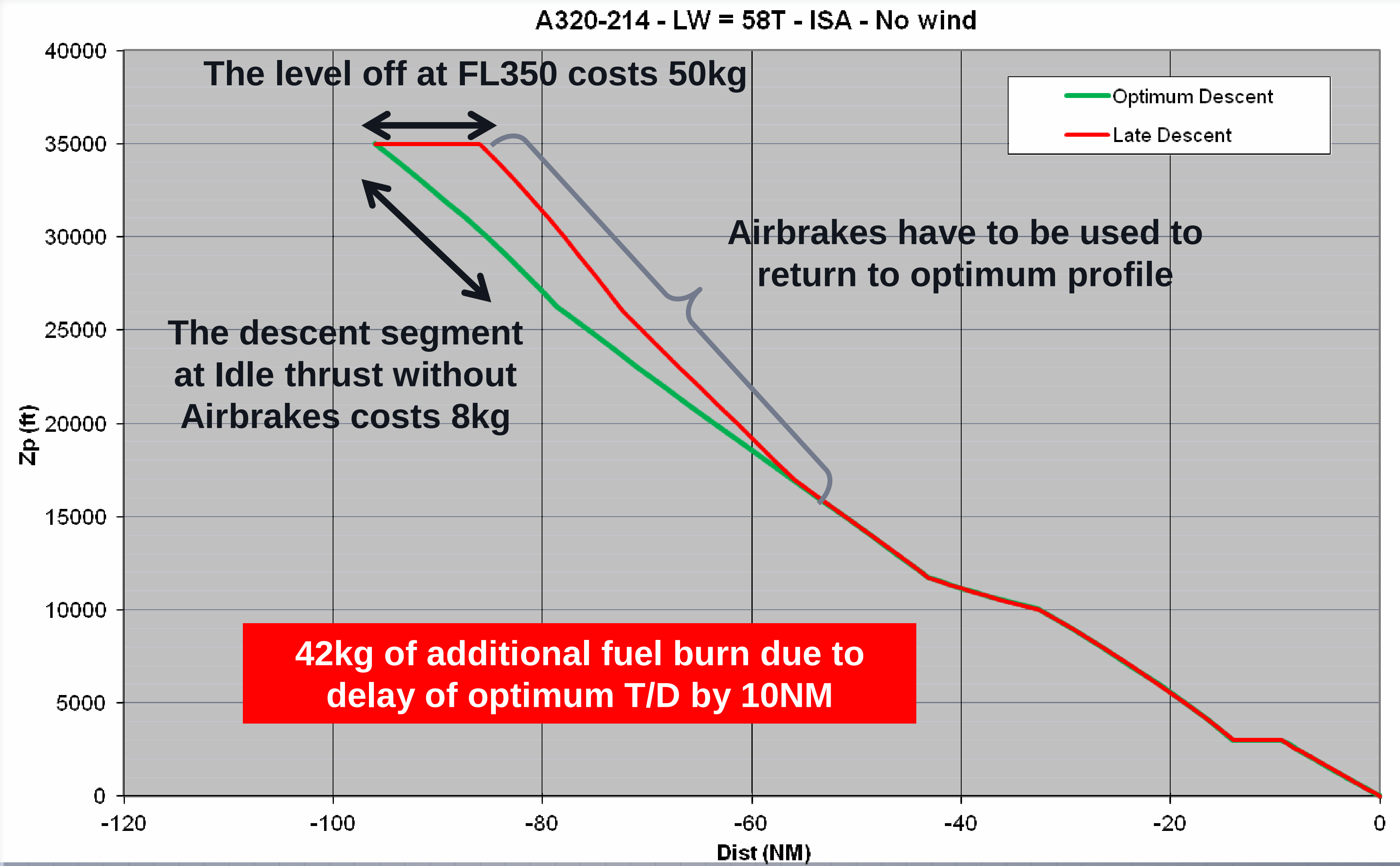
Recommendations for CDO procedure design: Descent capability of Airbus fleet (deceleration)



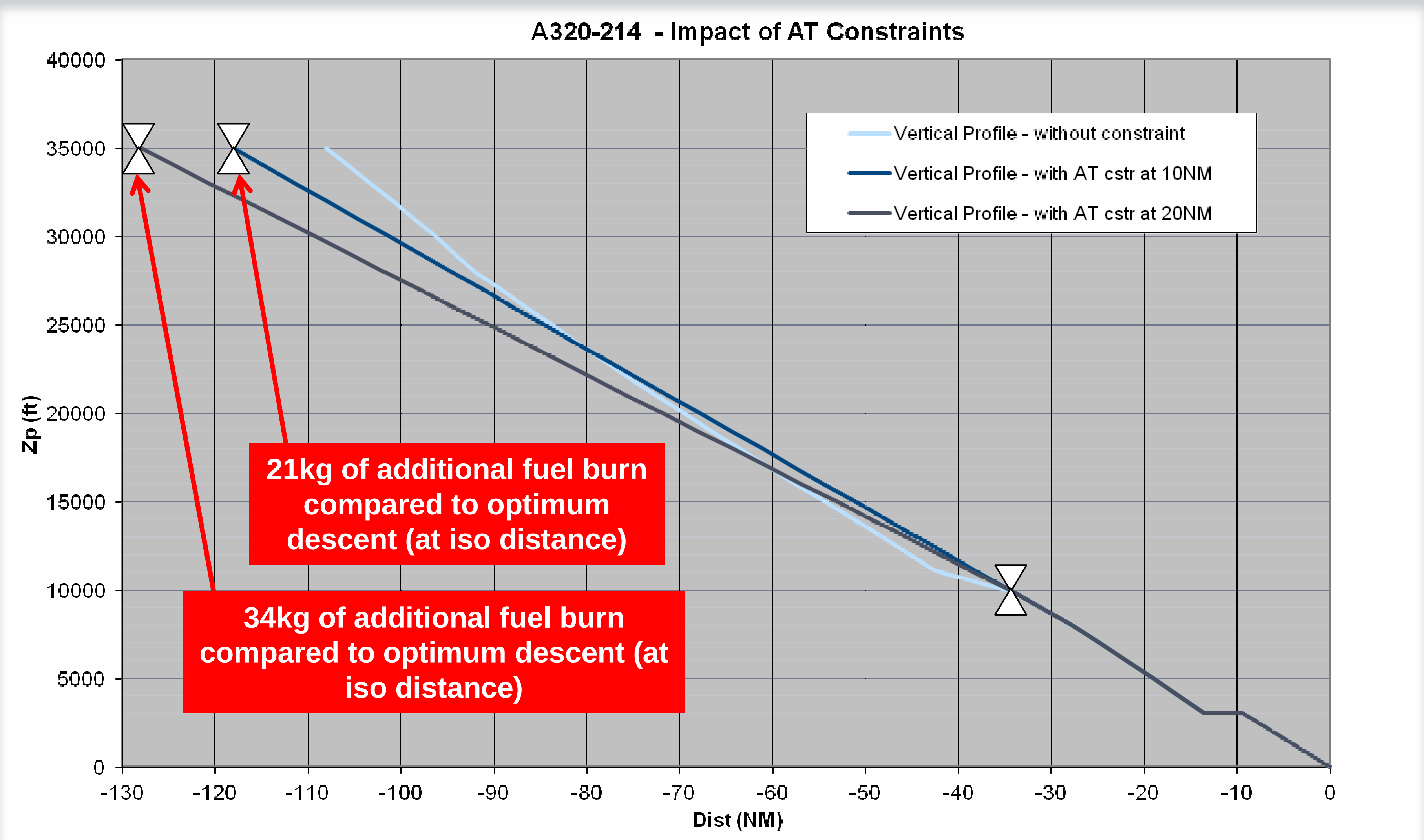
Fuel burn impact due to early descent



Fuel burn impact due to late descent



Fuel burn impact due to AT constraints



Conclusion about Aircraft capabilities in descent

- An **efficient descent** (regarding fuel & noise) consists in flying at **Idle thrust**, in **low drag configuration** → pilots should follow Top of Descent position based on aircraft type, atmospheric conditions and published procedure constraints

- **Steep slopes** in deceleration phase before G/S intersection (from IAF to FAF) is detrimental for:
  - **Fuel** and particularly **noise** efficiency (due to additive drag)
  - **Safety margins** (increased risk of over-energy, reduction of flight envelope)

- Approach procedures should allow (as far as possible) aircraft to fly a **gentle slope before FAF** in order to decelerate:
  - Limit slope for SA family: **-1,3°**
  - Limit slope for LR family: **-0,9°**

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