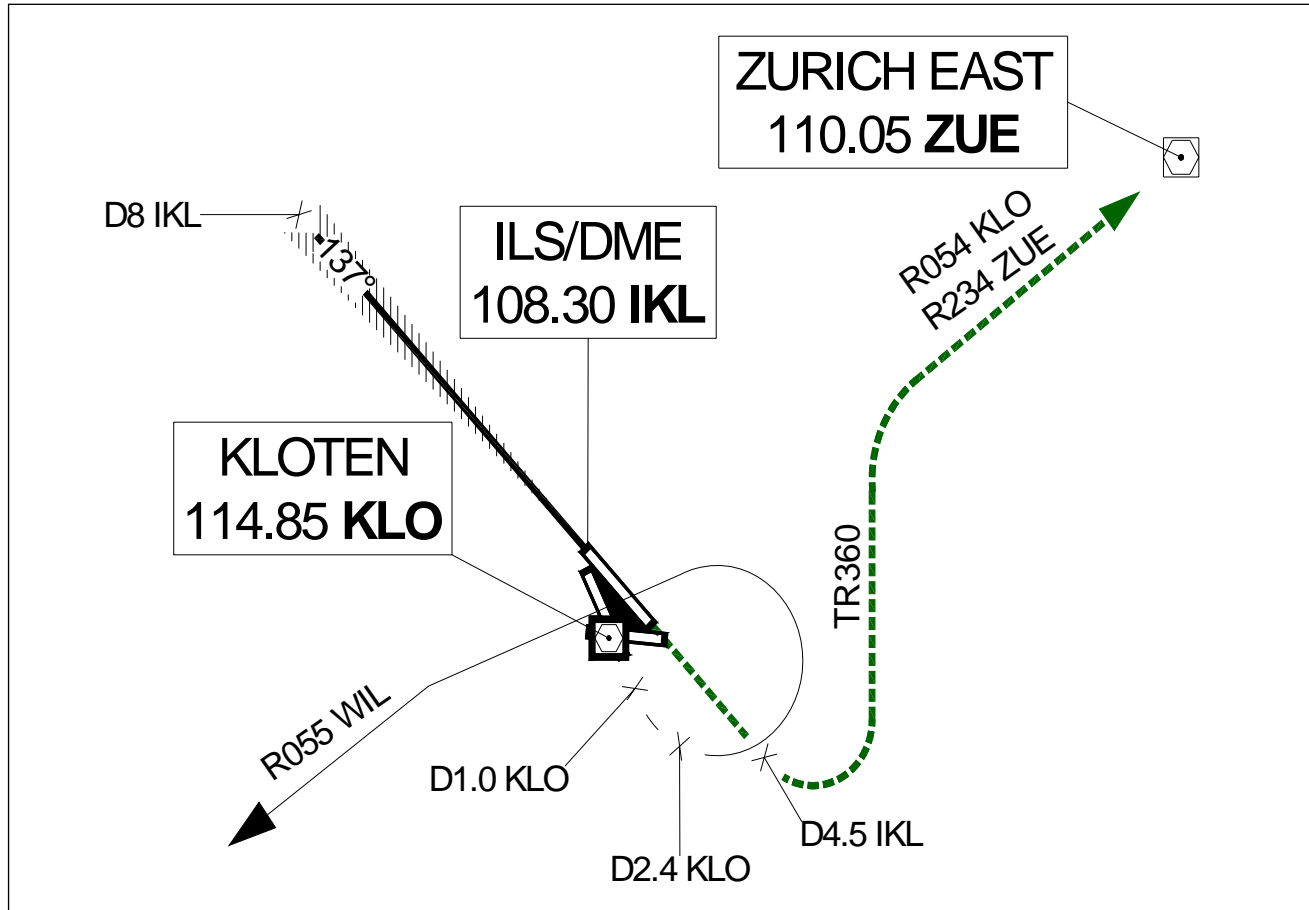


Objective

The (wake) turbulent road from unknown to standard

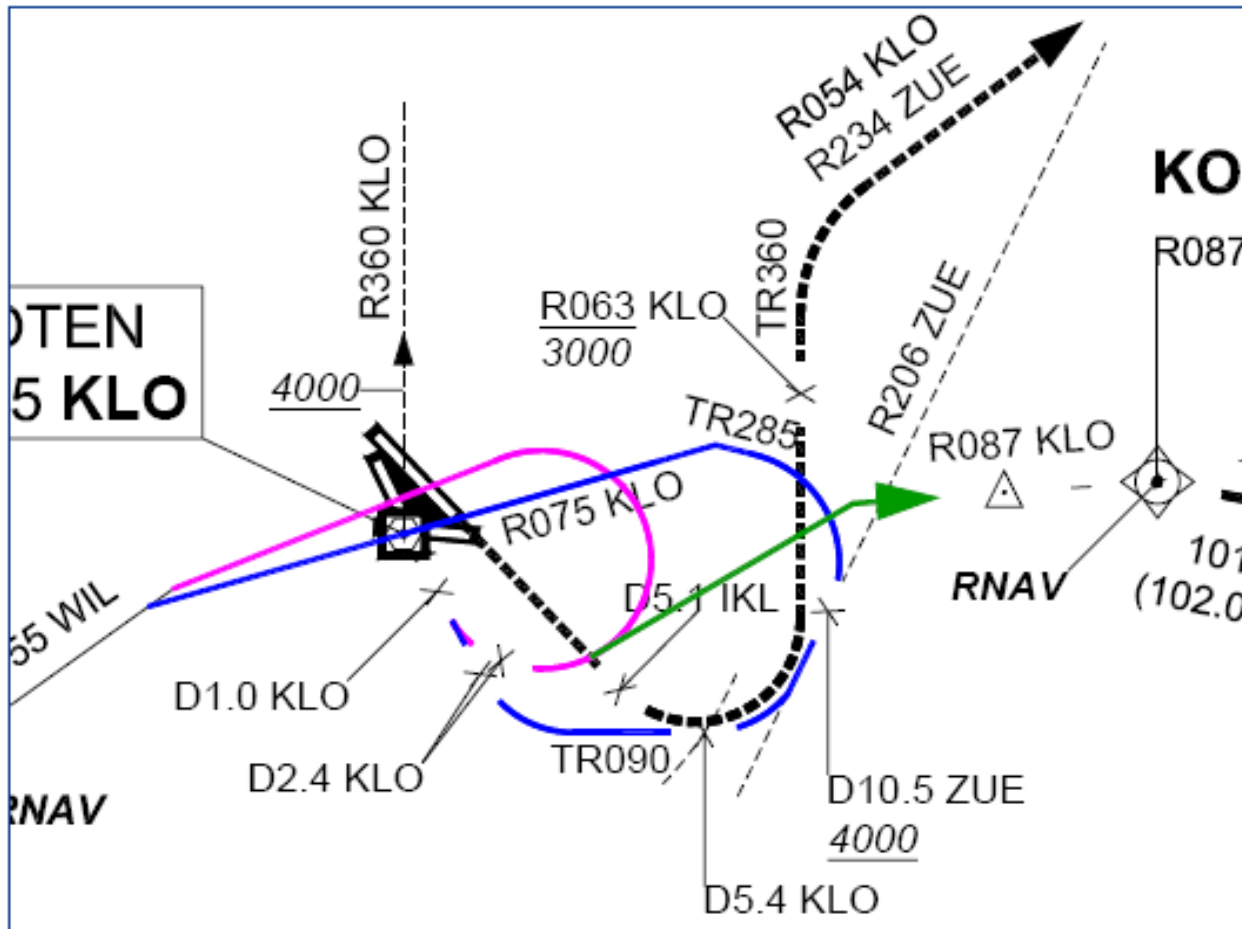


The initial situation



**Cut-off point at
6NM THR
RWY14**

The proposed solution - WLT



Prescribed Cut-Off
points for west/east
departures
12/8 NM

ICAO is the law.

Constraints

- Compliance with **ICAO SARPS/PANS** – scattered, not direct and/or not applicable
- RWY **axes** form **17°** angle
- Nominal paths do not diverge immediately after take-off and missed approach by required 30°, only 17° than cross = **segregated RWY** ops
- **MVA** 5000 Ft
- WTS needs to be applied as the nominal **paths cross** after departure

- **Wake Turbulence Separation;**

Separation to be applied (ICAO P-ATM) 1

- **5.7 SEPARATION OF DEPARTING AIRCRAFT FROM ARRIVING AIRCRAFT**

- 5.7.1 Except as otherwise prescribed by the appropriate ATS authority, the following separation shall be applied **when take-off** clearance is **based** on the position of an **arriving** aircraft:
 - 5.7.1.2 If an arriving aircraft is making a straight-in* approach, a departing aircraft may take off:
 - 2) before the arriving aircraft crosses a designated fix on the approach track; the **location of such fix to be determined by the appropriate ATS authority after consultation with the operators.**

*for the purpose of the procedures to be applied analysis, NLR, FOCA and skyguide independently based their work on this assumption

Separation to be applied (ICAO P-ATM) 2

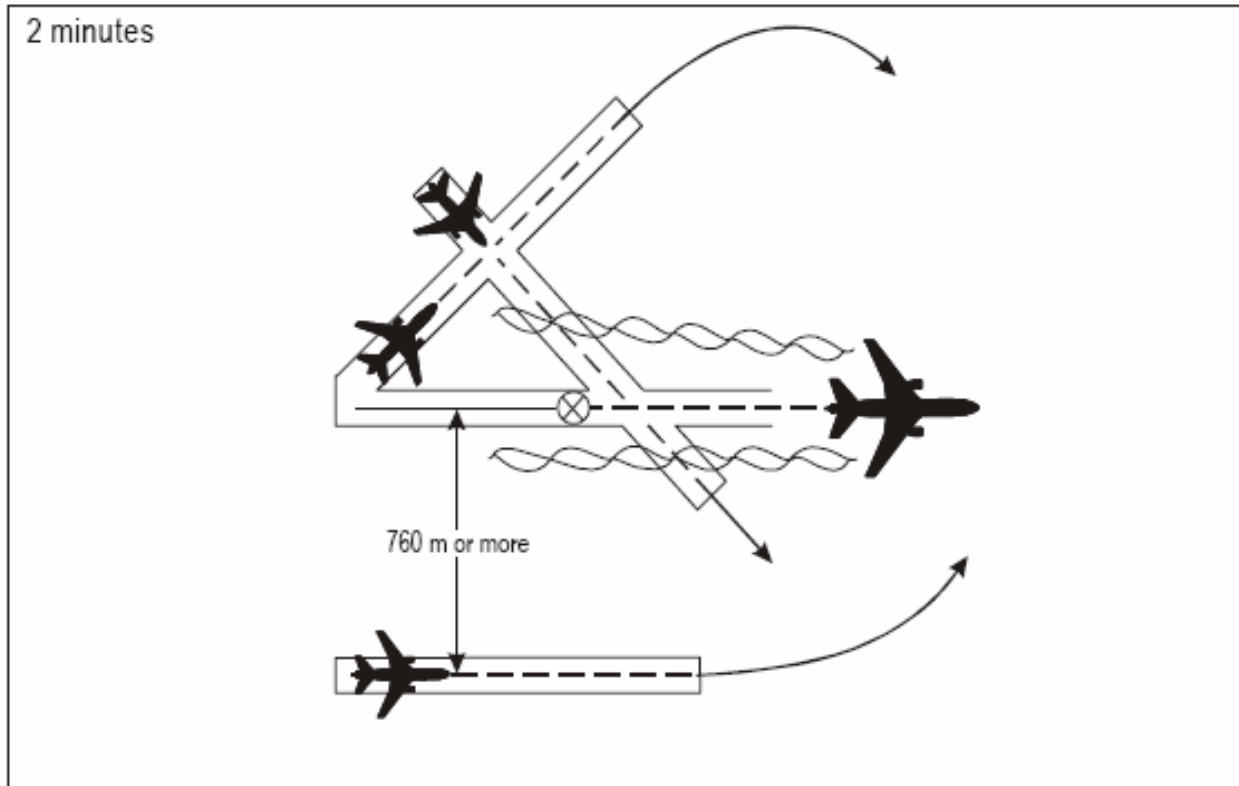
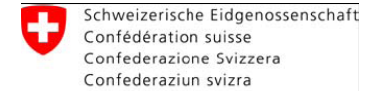


Figure 5-40. Two-minute wake turbulence separation for crossing aircraft (see 5.8.3.1 c) and d))

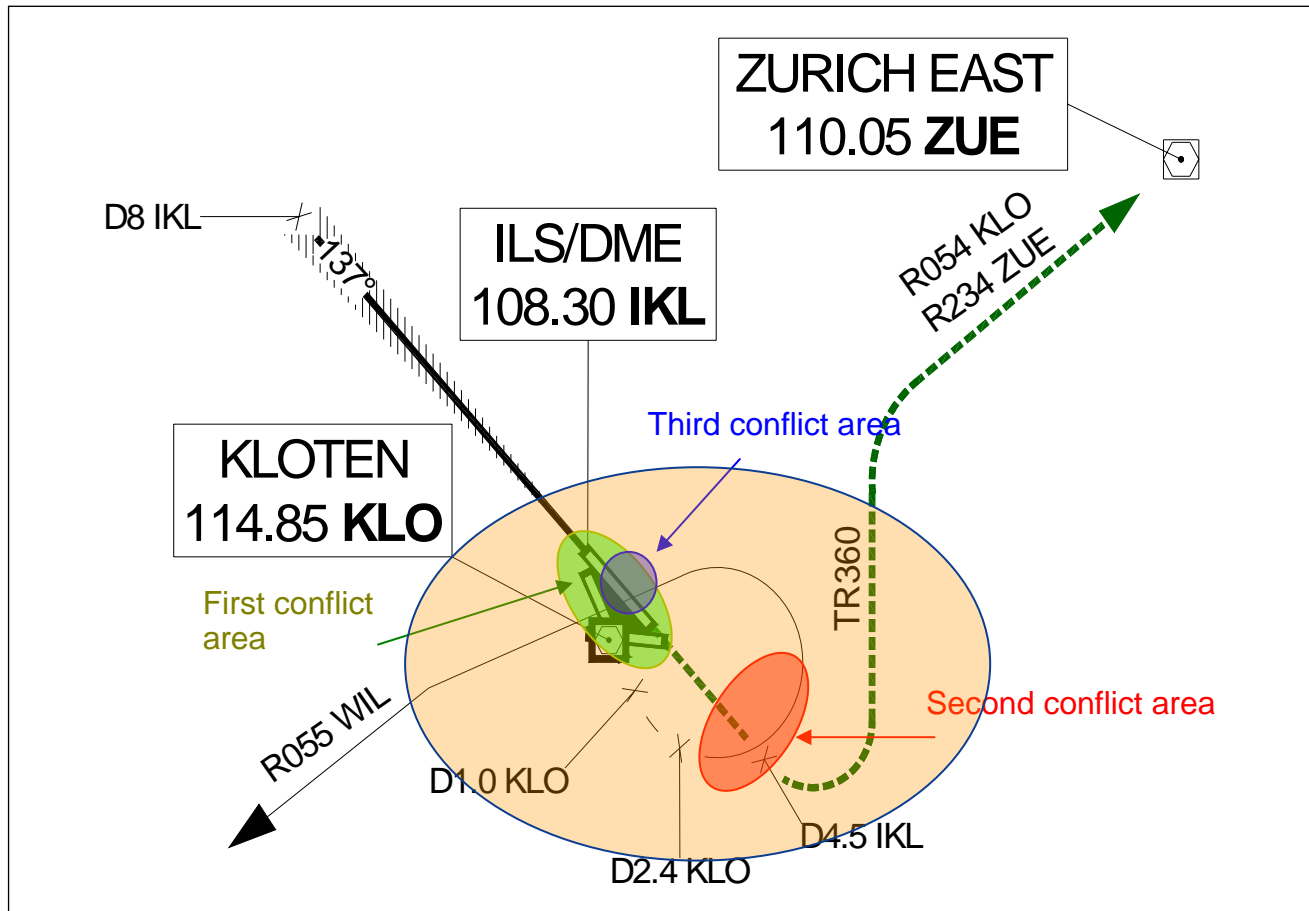
SEPAZ – SEPAration Zurich



- FOCA – Federal Office for Civil Aviation
 - Skyguide*
 - Major aircraft operator – Swiss* International Airlines
 - Airport Zurich operator Unique*
 - External - ATSI – Air Traffic Simulation Inc.
- * skyguide, Swiss & Unique both ops and safety staff



The problem



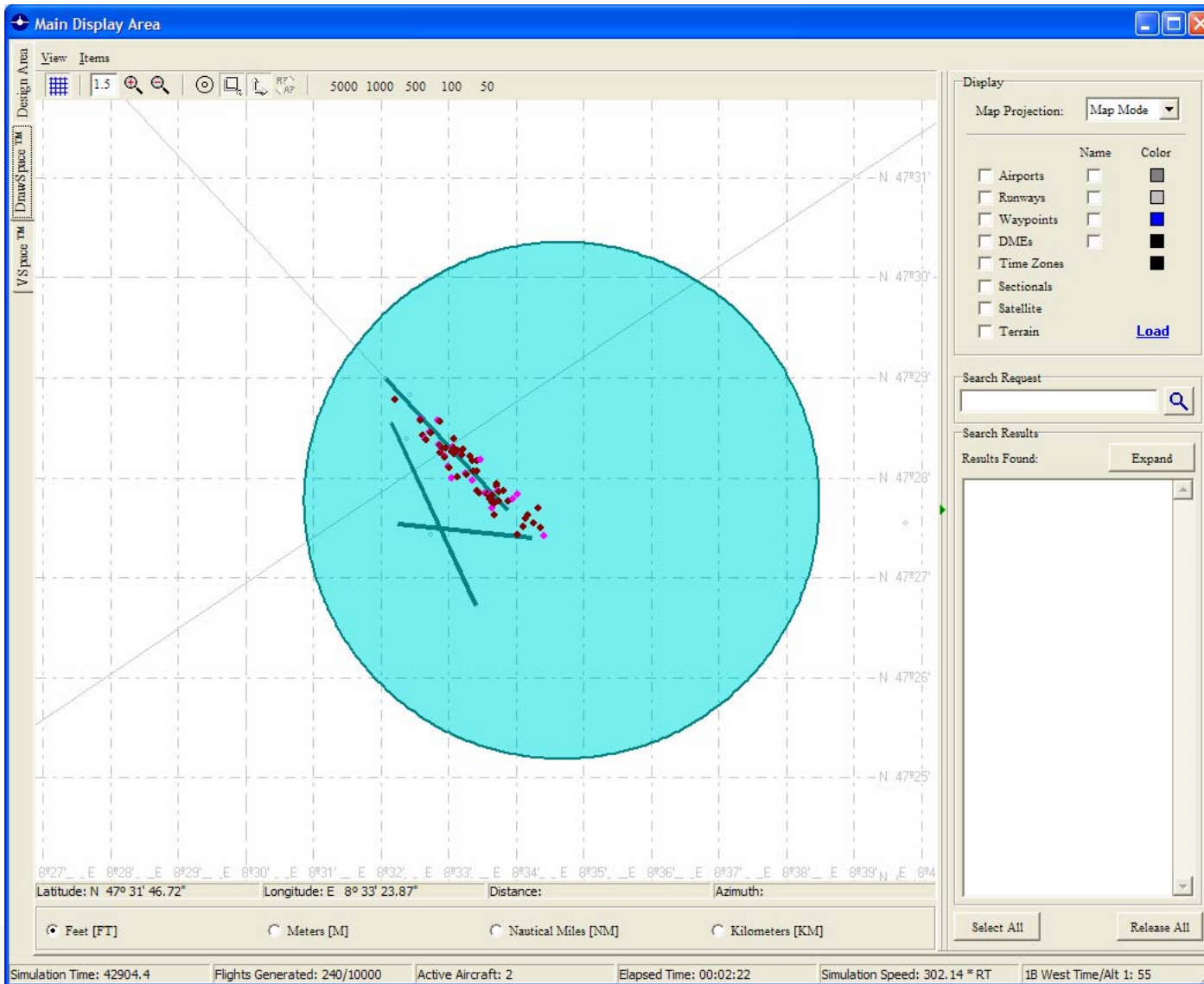
One big WT dependence area

Expert Analysis

Simulation

- Real life radar tracks apx 50.000 chosen from 150.000 available
- Real life fleet mix
- AeroSim-Pro uses NASA's APA 3.2 – AVOSS Predicting Algorithm (strength and position of WV in and out of ground effect) based:
 - Aircraft weight
 - Aircraft wing span
 - Aircraft true air speed
 - Air density
 - Wind profile with altitude
 - EDR profile with altitude (Eddy Dissipation Rate)
 - Temperature profile with altitude
- FAA performed thousands of piloted simulation runs of missed approaches on a wide range of flight simulators with hundreds of current airline pilots at all levels of seniority and experience participating in the tests to obtain empirical statistical data of piloting techniques and aircraft performance

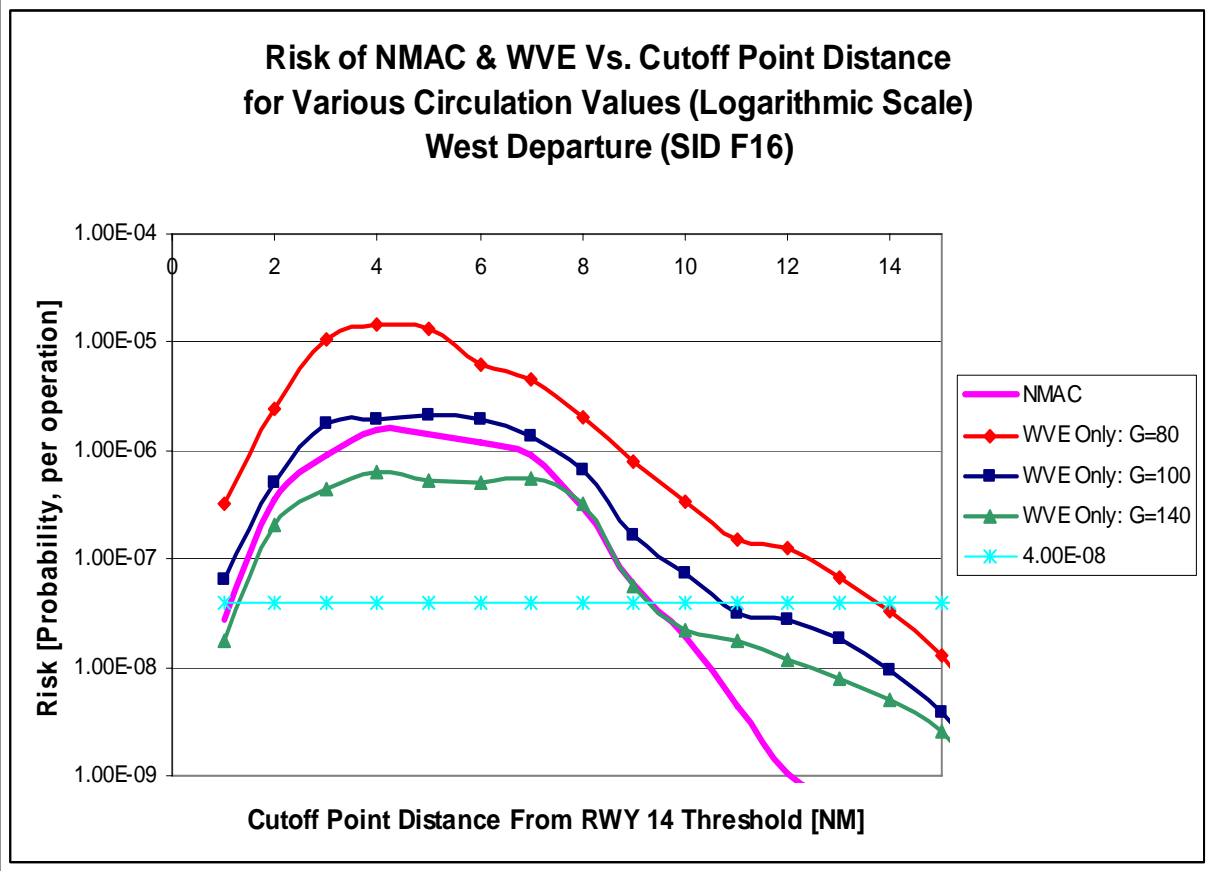
Pure ICAO compliance/non compliance



Using solely ICAO 2min/1000ft separation pushes "cut-off" points to 18NM for west departures.

Figure shows that departing as well as going around aircraft might encounter a wake (color coded)

Simulation results

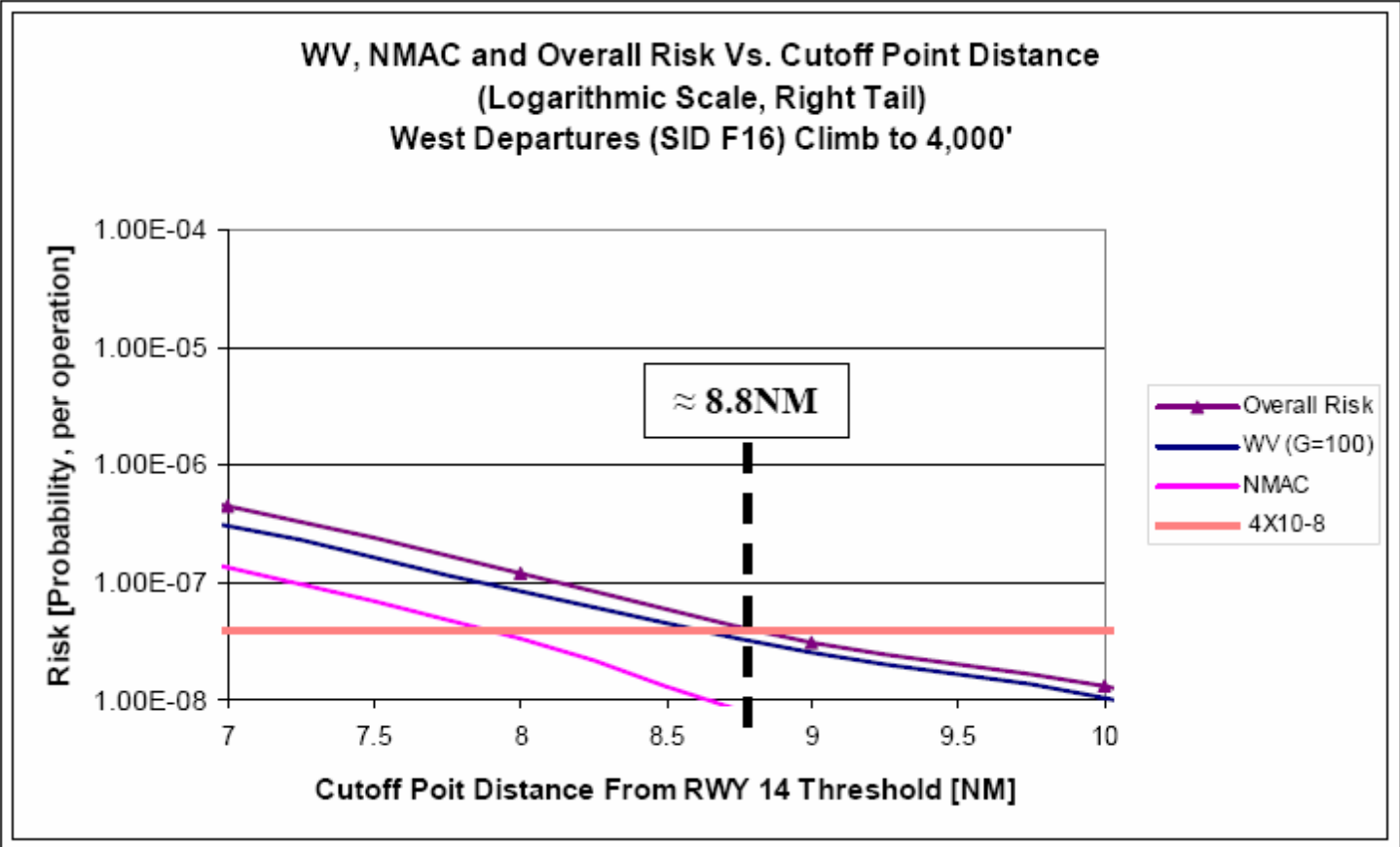


Circulation [m ² /Sec]	Cut-off West [NM]	Cut-off East [NM]
80	14	9.5
100	11	7.5
140	9	7 NMAC condition
ICAO	18	8

*NMAC-Near Mid-Air Collision – a bubble of 500 FT around the aircraft



MAA – 4000'



Study - Conservative Approach

Abstract

Due to lack of well established criterion for the determination of hazardous wake vortex encounters, a **conservative criterion** was used for this study.

The results indicate that the baseline operational scenarios evaluated, using the **existing** procedures and cutoff points **is safe** and that **additional improvement** can be made **while maintaining** the Target Level of Safety (**TLS**).

- No ATCO involvement
- Wind – omni-directional 10KTS = slow vortex decay while being transported in all directions
- (Relatively) High go-around = going around traffic being at relatively high altitudes when passing over the vicinity of the arriving runway threshold thus, increasing the probability of conflict with traffic departing west from RWY 16
- Ratio between wake encounter and catastrophic event = very conservative ratio of 10^{-2}

Summary 1

- Converging flight paths
- The single most restrictive factor is ...

- **Wake Vortex Encounter**



Summary 2

- **Quantified, proven and understood risks**
- **WTS standards accepted by the Regulator**
- **Implementation** of 8/11NM Cut-Off
- Possibilities:
 - MAA 4000ft
 - 0.3NM
 - New fleet mix
 - Low missed approach
 - VMC SIDs
 - Greater "vorticity"



Thank you for your attention



Questions?