Ensuring increased runway throughput with advanced parallel runway operations and enhanced wake turbulence categories operations

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Runway Capacity Challenges and Throughput Enhancement Solutions

How could we enhance runway throughput in peak time?

Revision of separation standards

Separation function of weather conditions

Enhanced arrival procedures

ICAO PANS-ATM

RECAT-EU: 6 wake categories

RECAT-EU-PWS: pairwise separation

How could we enhance runway throughput in peak time?

Local separation optimisation

European Commission

ICAO ATMGE/24 – Runway Throughput Solutions and Wake RECAT

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CSPR Wake Independent Departure and Arrival Operations (WIDAO) at Paris-CDG

- In operations since 2011
- Maximum negative stagger offset of 600m between departures and landings for CSPR separated by 384m
- Safety assessment based on local wake, traffic and MET data
RECAT-EU Aircraft Categorisation

Clustering

Heavy

E145

B763

LOWER (CAT-C)

A346

UPPER (CAT-B)

A332

Light

LJ25

Medium

“Super”

A380
RECAT-EU Aircraft Categorisation

- B752
- B763
- A346
- A332
- A380

Clustered according to:
- CAT-B
- CAT-C
- LOWER (CAT-E)
- UPPER (CAT-D)

Classified into:
- "Super"
- Medium
- Light
RECAT Principles – Wake Generation

If this is safe…

… this can be reduced (due to over-conservatism)
RECAT Principles – Wake Resistance

If this is safe…

… this can be reduced (due to over-conservatism)
Separation based on a more efficient 6 wake category scheme (European Wake Re-categorisation - RECAT-EU)
Wake Turbulence Safety Risk Assessment

- Generator aircraft vortex decay
- Follower aircraft wake resistance

**WT Severity Metric**

- Measurements
- Modelling

100,000+ wake tracks at LHR and check with DXB

100+ hours flight test of wake encounters

900 flight sim runs of wake encounters
RECAT-EU proposal & safety case

Consultation Stakeholders

RECAT-EU final proposal & safety case
(endorsed by ECTL Agency Advisory Board)

EASA review

EASA decision

Local change safety case

NSA decision

NSA review

RECAT-EU scheme can be used by Member States as a basis to update current schemes
CDG as early RECAT-EU Implementer?

Peaks = one TakeOff every 50s / one Landing every 50s

Main ARR peak: up to 75ARR/h
Traffic Mix: 25% H / 75% M

24/7 operations with RECAT-EU distance minima started on March 22nd 2016 for arrival and departure aircraft at both Paris CDG and Le Bourget.
RECAT-EU CDG Deployment steps

- RECAT EU publication
- Technical changes (e.g. flight strip adaptations)
- ATCOs and Pilots familiarisation
- Safety case on local changes

⇒ human factors
⇒ safety arguments explained
CDG ATC considerations

- Big challenge to learn more separations
- Many letters confusing
- Resources in position, under pressure
- Difference between CDG and other airports
- Time to learn and integrate the change
- Pilot’s reaction?

- Airline involvement
  - Workshops with Flight Safety Officers
  - ROT
  - Communication
  - Support documentation
  - AIC

https://trainingzone.eurocontrol.int/clix/data/wbt/TRG/APT/APT-RECAT-EU/
ISA rating at the approach (APP) for the RECAT-EU and ICAO separation norms in DBS low wind operation (combined simulations)
Impact at CDG – New Separation Conformance

A330

A320

A380

A330

Pairs: B-D

June 2015 (27R) - 797 Pairs:

June 2016 (27R) - 1318 Pairs:

Pairs: A-B

June 2015 (27R) - 76 Pairs:

June 2016 (27R) - 141 Pairs:
Impact at CDG – Throughput Benefits

Same throughput with RECAT-EU but...

- Pre-RECAT-EU
- Post-RECAT-EU

Landing per hour measured on 30min sliding window:

ICAO separations - 30 peaks (more than 34 ac/h) in 2015 on 27R (Traffic mix: 15% Heavy and 1% A380)

RECAT separations - 29 peaks (more than 34 ac/h) in 2016 on 27R (Traffic mix: 27% Heavy and 3% A380)
Impact at CDG – Throughput Benefits

Applying original (PANS-ATM-based) separations with post-RECAT-EU traffic

Same throughput with RECAT-EU but...
Significant increase of Heavy and A380 in traffic mix
WVE reports vs. Altitude – Sep Norm – Go-arounds

1 year of RECAT-EU operations

In 2006, 10 reports

Wake Occurrence Analysis – A Collaborative Framework
- WVE reports collection
- FDM data
- ATC surveillance tracks data
- LIDAR

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RECAT-EU – Operational Benefits

- Greater flexibility to Controllers for managing traffic spacing;
- Resilience through rapid recovery from adverse conditions with a reduction of overall delay;
- Runway throughput improvement of 3 to 8% during peak periods at major airports;
- Future capacity gains with further evolution of traffic mix;
RECAT-EU: Next deployments?

- Operational trial (procedural) at Leipzig-Halle / EDDP and Munich APP

- Full deployment project ongoing (Enhanced TBS) at London Heathrow / EGLL (end 2017 / early 2018)

- Partial deployment project ongoing at Vienna Schwechat / LOWW (end 2017 / early 2018)
Separation defined per pair of aircraft types
(Pairwise separations – RECAT-EU-PWS)

Separations are adapted as a function of leader and follower aircraft type characteristics (RECAT-2)

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<tr>
<th>Safety Case under EASA review</th>
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RECAT-2 – Pair Wise Separations currently under EASA review
Separation based on time in place of distance (Time Based Separation - TBS)

Time Based Separation (TBS) permits the adaptation of separations to maintain runway throughput in strong headwind conditions

- Strong headwind increases time separation for constant distance applied
Separation based on time in place of distance (Time Based Separation - TBS)

Time Based Separation (TBS) permits the adaptation of separations to maintain runway throughput in strong headwind conditions

- Strong headwind increases time separation for constant distance applied
- Reduced separations support constant time between 2 landings in strong headwind conditions
- Wake behaviour verified with measurements

Safety Case under EASA review
TBS entails the use of separation delivery support tool for APP and TWR

**LORD – Leading Optimised Runway Delivery**

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**Only black Chevron is used by Approach controller**

**Red is provided if the buffer is too short**

Black Chevron: Compression buffer

Red chevron: Separation to be delivered
LORD integrates different solutions to assist ATCOs in the separation delivery task

Time separation = max ( [T1,T2,…,Tn] )

Mixed Mode Ops
CSPR Operations
RECAT-EU

RECAT Pairwise separation
Time Based Separation
Weather Dependant Separation

Enhanced Procedures
Runway Occupancy Time

LORD – Leading Optimised Runway Delivery
RECAT-PWS-TBS / RECAT-EU / LORD in real-time simulations

- At least 50% reduction of strong headwind related delay
- 10% increase in runway throughput during peak hours
- Reduces the number of pairs below separation minima
- Simple HMI ensures no increase in ATCO workload
Procedural TBS / REDSEP as Quick wins

- **Objective:**
  - To **safely** deliver part of runway throughput **benefits from TBS without significant modification of ATC tool**

- **2 concept versions:**
  1. Fixed reduction of distance-based separation minima **for wind above certain threshold level**
  2. Delivery of distance-based separation minima at a point located upstream the runway threshold, **for wind above certain threshold = “REDSEP”**

*Under deployment at Vienna*
Thank you for your attention

Our Wake Knowledge Hub:

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