



## Procedural TBS (P-TBS) at EGLL

### *WakeNet-3 Europe Concepts Workshop*

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# Overview

- » Concept overview
  - » Concept challenges
    - » Initial benefits analysis
      - » Initial safety analysis activities
        - » Project Status

Research needs – some thoughts

*ANSP perspective*

# Concept Overview

- » Procedural-Time Based Separation (P-TBS) at Heathrow
  - » **Objective : landing rate resilience to headwind on approach**
- » Reduced Wake Separation on Final Approach
  - » Distance based, early benefit of TBS principles
- » 0.5NM reduction conditional on Met
  - » 10/15 Knots headwind – forecast & measured
  - » crosswind component considered
  - » excluded conditions (wind shear, storm, stratification etc)
- » NATS Procedures & Practices
  - » NATS Wake Turbulence Categories (J, H, UM, LM, S, L)
  - » Separation applied at 4DME



# Concept

- » Separation applied:
  - » Low altitude (IGE / NGE & OGE Boundary Layer)
  - » OGE established on glide path
  - » Option considering
    - » intercept heading
    - » not established on glide path
- » Met Measurement Options – short term assurance
  - » Runway Anemometer
  - » Wind profiling Lidar
  - » Mode-S derived wind data
- » Met Forecast Options – medium term assurance
  - » Statistical nowcast
  - » Numerical forecast

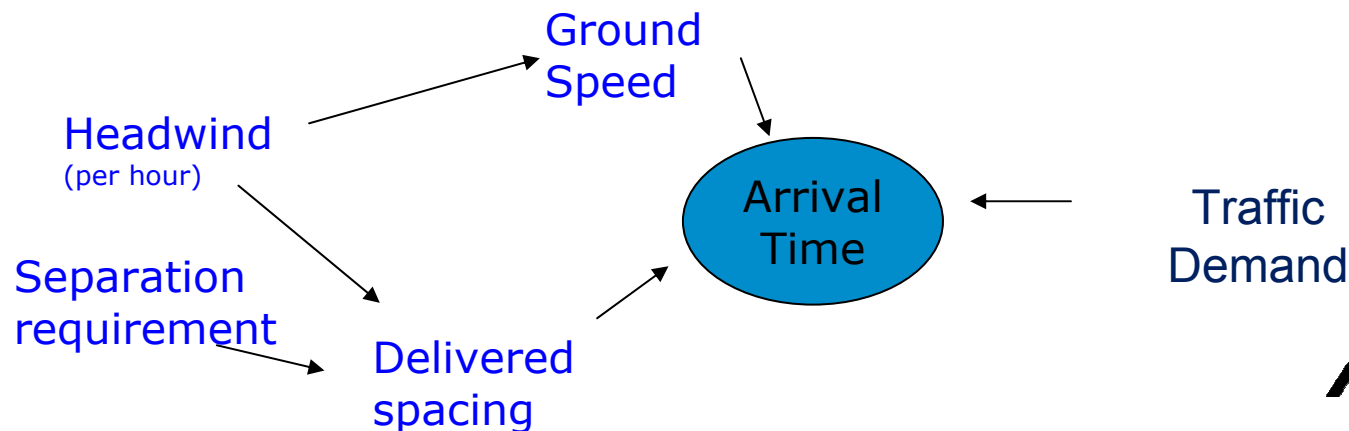


# Concept Challenges

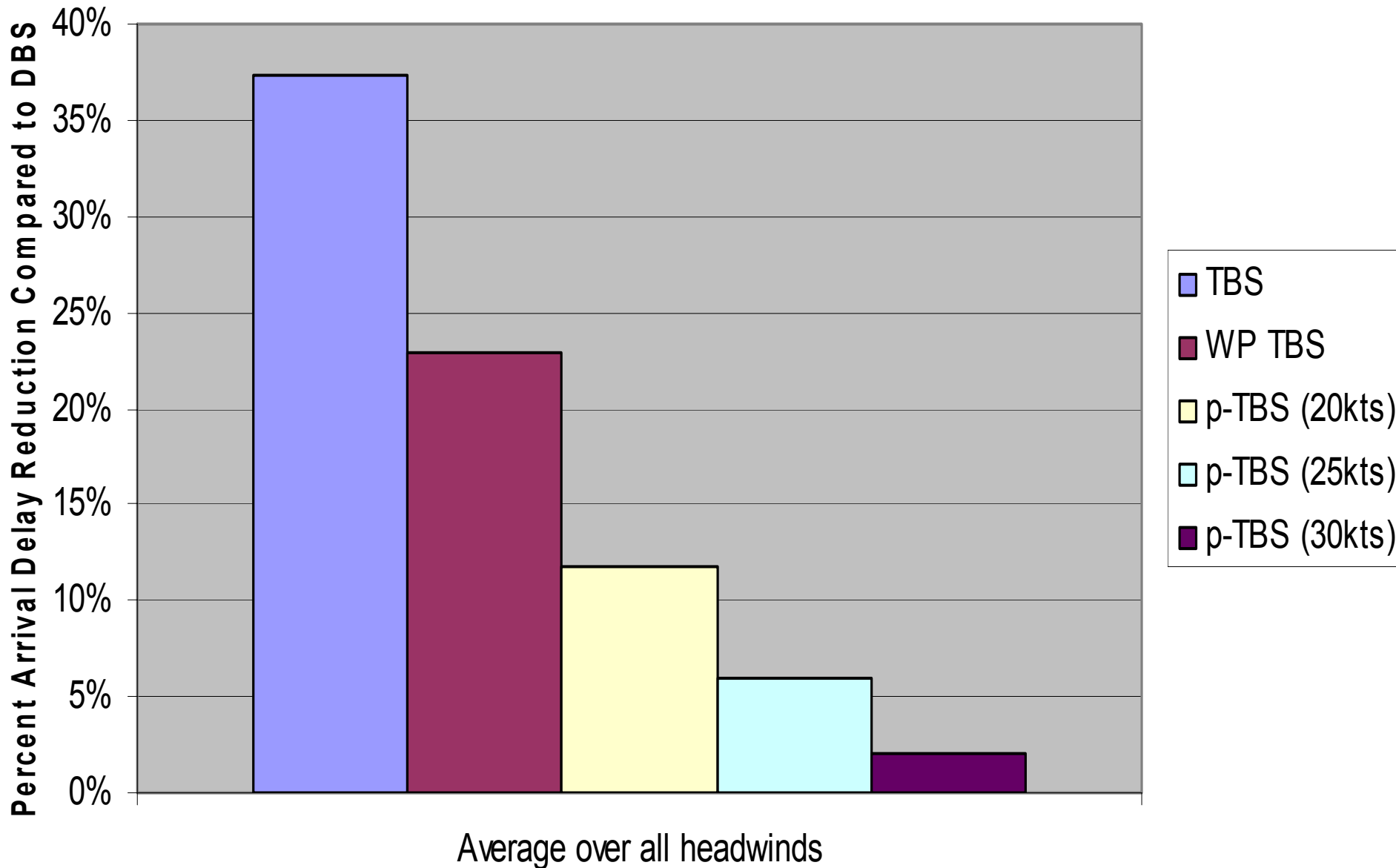
- » Relaying Complex Met data to Controllers
  - » Red / Amber / Green 'traffic light' system
- » Met capability accuracy & duration stability
  - » Accuracy to maximise operational benefit
  - » Duration to ensure sustained period of use
- » Transition into / out of procedure
  - » Across tower & terminal control operations
- » Relation to other concepts (e.g. 2.5NM)
  - » HF issues
- » Safety arguments & supporting analysis & evidence
  - » Wake encounter (Mid-Air & Runway collision risk)
  - » Tightly bound to concept options

# Initial Benefits Analysis

- » Business case: Preliminary benefit analysis
  - » Up to 12% overall annual delay recovery
  - » Landing rate improvement ~3 per hour compared to current
  - » *Considers separation & operational spacing performance*
  - » *Uses Mode-S derived met information at 4DME*
- » *Relative delay benefit compared:*
  - » *Current DBS operational baseline*
  - » *Procedural-TBS (wind condition specified at 4DME: 20-30 Knots)*
  - » *'Full' Tools Supported TBS concept : Wake separation only*
  - » *'Full' Tools Supported TBS concept : all aircraft*



# Modelled Arrival Delay Reduction Under TBS



# Wake Encounter Safety Analysis

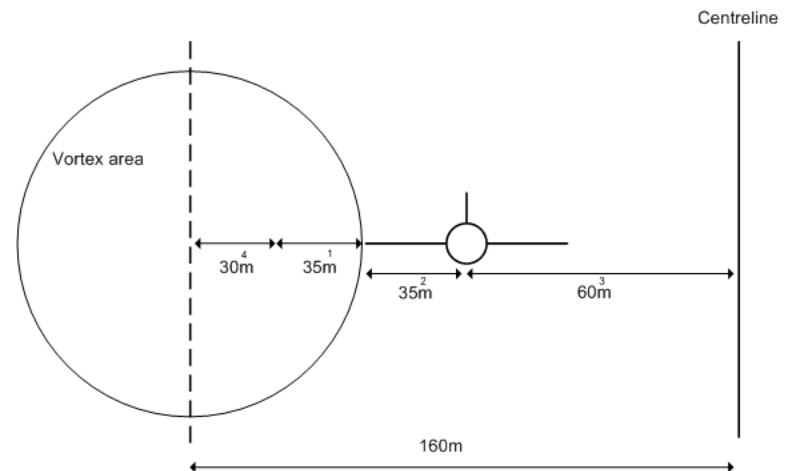
- » Wake Encounter Risk assessment:
  - » Comparative
    - » Low altitude (IGE / NGE & OGE Boundary Layer)
    - » OGE established on glide path
    - » Option considering intercept heading & not established
    - » Missed approach
  - » LIDAR data collection (IGE/NGE + OGE)
  - » Reported Wake Encounters
  - » Modelled Wake Encounter Risk
- » Additionally considers:
  - » Elevated wake encounter in encroachment scenario
  - » Analysis of outlying cases
    - » unfavourable wake strength / persistence / transport





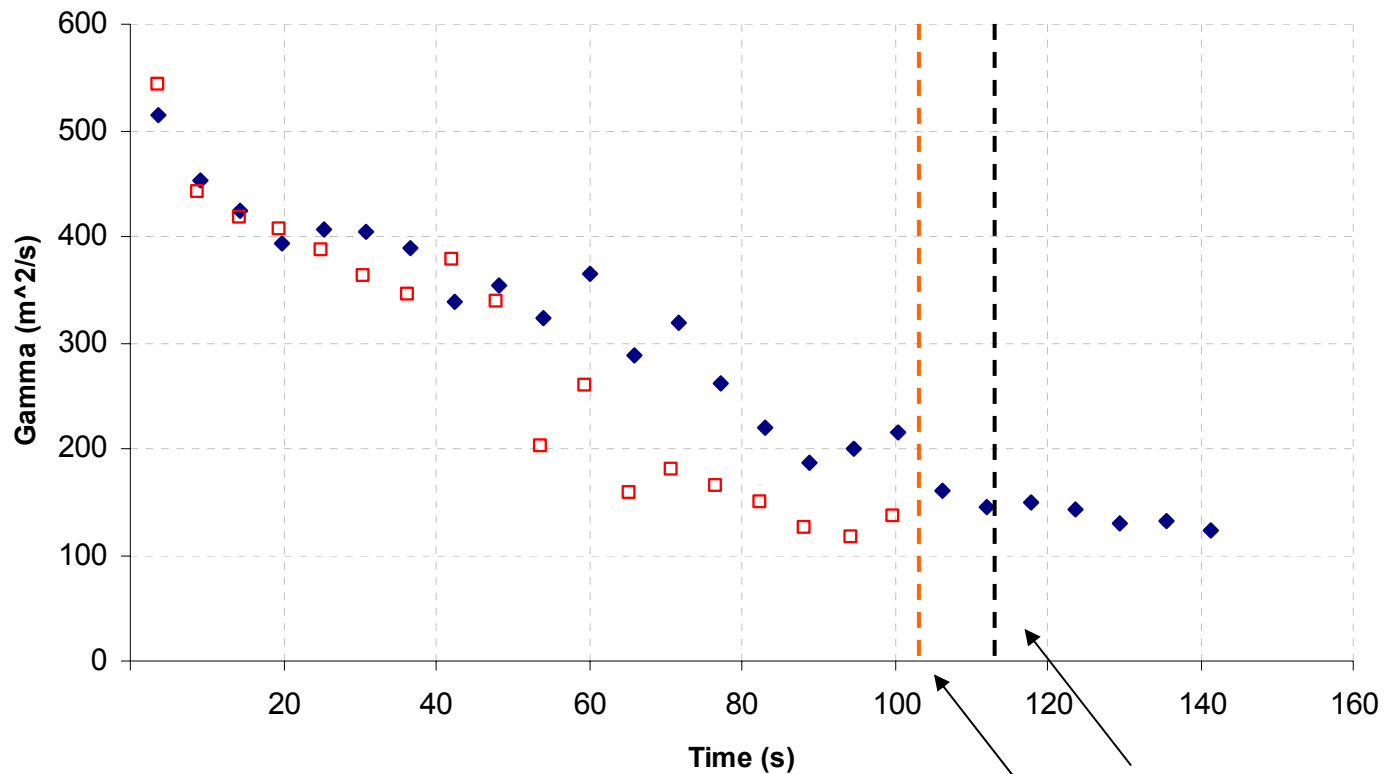
# LIDAR Analysis : method

- » Vortex circulation strength (over time)
  - *One factor influencing wake encounter*
  - *relation to current safety performance measures*
- » Probability of wake persistence
  - *~1200m from touchdown*
  - *all possible circulation strengths*
  - *'safety corridor' around ILS*



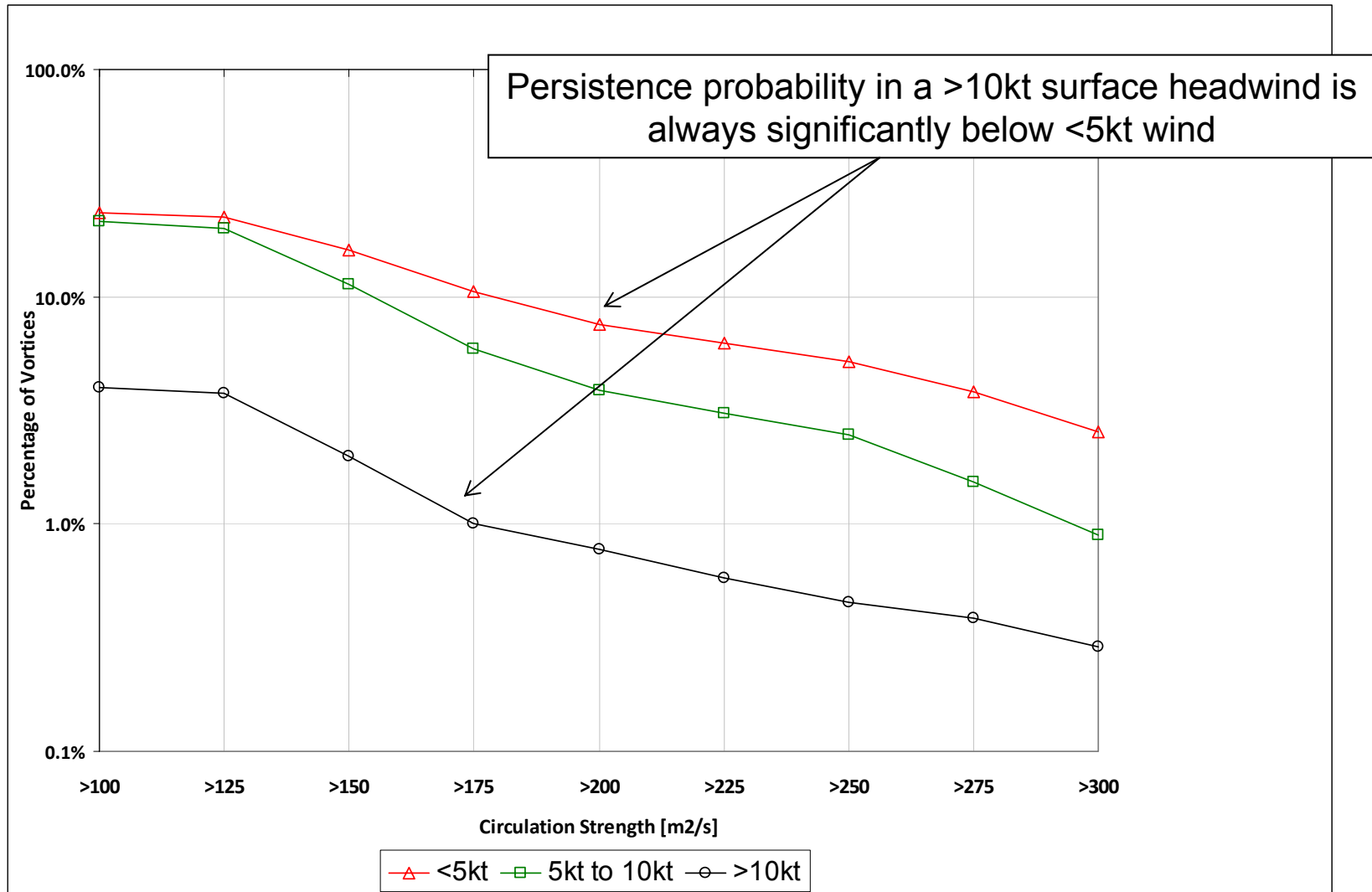
- » Analysed by surface headwind

# Pair-Wise Analysis

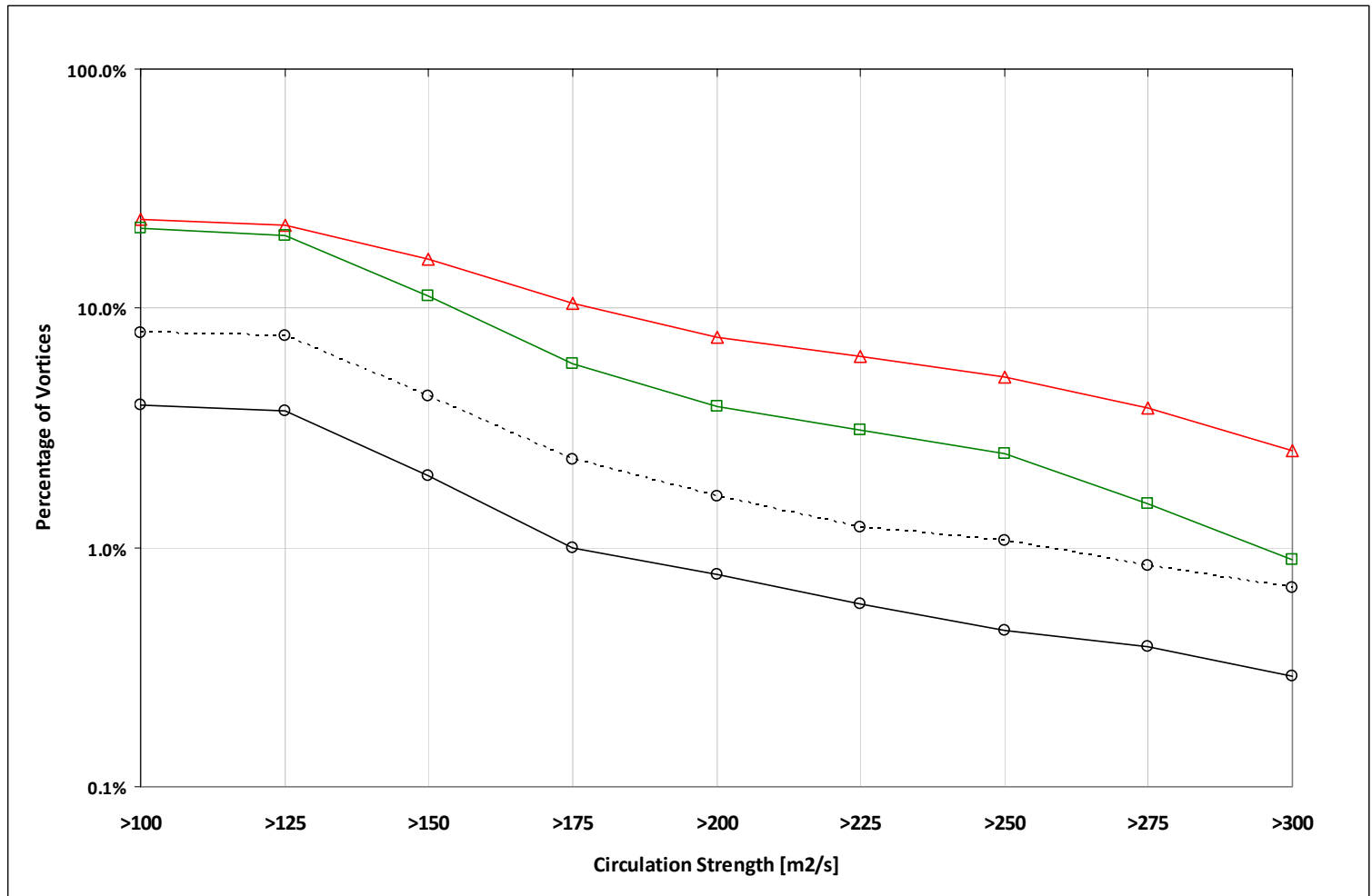


What circulation may potentially be encountered under P-TBS?

# DBS in different surface headwinds



# DBS / P-TBS (10Kts)



H-H Pairs

# Relative Wake Vortex Encounter Rate

Headwind	Freq of wind	Rate of Encounter
under 5kts	42%	1.00
5-10kts	37%	0.23
over 10kts	21%	0.03

EGLL Approach, <500ft

» A few reported encounters in vicinity of Lidar

# Analysis Considerations

## » Increased wake strength

- » Relation to current safety performance measures:
  - » Corresponding increased in reported wake ? Severity?

## » Risk associated with operational variation

- » is the escalation of wake risk greater?
- » encounter reporting

## » OGE and Intercept cases

- » Risk assessment above Boundary Layer and not on intercept



# Project Status

## » Feasibility and Options (Mar 11)

- » Concept definition
  - » User groups ongoing
- » Met capability evaluation
- » Wake encounter safety plan, safety arguments
- » Initial evaluation of wake risk against safety arguments
- » Business benefit / cost



# Research Needs – some thoughts

- » Coordinated view of safety arguments & risk to operations
- » Improved operational wake safety performance measures
  - » target level of safety
  - » relating theory to operational practice
  - » improved airport instrumentation (met) & aircraft data collection
- » Improved understanding of wake encounter risk
  - » *in relation to operational practices and procedures and variation*
- » Data sharing across different research organisations
- » Safety analysis using measured wake & met data



# Research Needs – some thoughts

- » *Validated* Wake models sufficient for regulator review
- » Utilising operational data to validate models
  - » Wake risk with typical met variation and operational variation
- » Understanding escalation of wake risk for exception cases
- » Continued wake vortex data collection
  - » Wake, Met, aircraft & pilot data



Questions?



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