FDR Data: Enhancement to the NATS Wake Turbulence Database

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Introduction

› Time Based Separation (TBS) due to be applied at Heathrow in May 2015.

› TBS applied across all headwind conditions on final approach.

› TBS will rebalance Wake Turbulence Encounter (WTE) risk across different wind conditions.

› Operational monitoring of TBS requires comparison of WTE reporting rate for pre- and post-TBS implementation.
Wake Turbulence Database

▷ Voluntary UK WTE reporting scheme established in 1972.

▷ Used to understand operational conditions that result in a WTE and the effect of a WTE on an aircraft.

▷ Used to monitor the effectiveness of current separation minima and procedures.

▷ Indicates aircraft types that induce/susceptible to significantly higher WTE rates than others.

▷ All WTEs stored on NATS Wake Turbulence Encounter Database.

▷ **5813** WTEs reported to date (~240 per year).
NATS Wake Turbulence Encounter reporting process
Uses of database

- Heathrow
- TC Approach
- En-route
- Safety Monitoring Reports to ATC units
- Aircraft types
- Airlines
- Specific requests
- Introduction of new aircraft types/WT categories
- Pre- and post-operational concept analysis
- A380
- B748/B787
- RVSM
- TBS
Limitations of voluntary reporting scheme

- Voluntary scheme relies on pilot’s judgement recognising WTE.
- Relies on pilot cooperation completing reports.
- Expect that the more severe WTEs are reported.
- Subjective nature of reporting:
  - Pilot recall of event.
  - Interpretation of effect on aircraft.
- Missing reports/key information.
- Influenced by safety reporting culture.
Effect of pilot reporting culture

» Pilot reporting culture = Likelihood of pilot reporting a WTE.

» Wake Turbulence reporting scheme is voluntary reporting rate subject to variation.

» More difficult to quantify than effects from wind, aircraft trajectories, etc.

» Reporting culture linked to safety awareness campaigns launched when new operating procedures and aircraft types introduced.
Proposed enhancement to WTE reporting

› Flight Data Recorder (FDR) data to supplement pilot and ATC WTE reports.

› Can be used to objectively assess effect of WTE on aircraft.

› Letter requesting FDR data sent to airlines in January 2014.

› FDR data requested for 5 minutes before and after WTE.

› Data must include:
  – Time
  – Altitude
  – Roll angle

› Also useful:
  – Pitch
  – Speed
  – Wind conditions

› FDR data received from three airlines and promised from other airlines (subject to NDA, etc).
WTE detection from FDR data

- Baseleg to intercept
- Capture of localiser
- Encounter
- Pilot corrective action

Time (UTC)

Angle (°)

Altitude (ft)
WTE detection from FDR data

- Turn onto baseleg
- Baseleg to intercept
- Capture of localiser
Proposed use of FDR data for objective WTE assessment

- FDR data provides objective means for assessing the effect of WTE on the aircraft.
- Contains information about deviations to aircraft attitude and trajectory during WTE.
- Challenge to find appropriate and meaningful measure of effect on the aircraft.
- Must be easily derived from parameters in FDR data.
Proposed use of FDR data for objective WTE assessment

› Initial analysis will focus on comparing distributions of WTE roll-rate pre- and post-TBS implementation

› Propose to split data into altitude and wind bands (subject to FDR data sample size).

› Will split data into WTEs where:
  1. TBS distance separation ≥ DBS distance separation
  2. TBS distance separation < DBS distance separation

› Will provide indication of reporting culture effect.
Potential reporting scenarios following TBS implementation

Scenario 1

Probability of WTE remains the same, but percentage of reported WTEs increases.
Potential reporting scenarios following TBS implementation

Scenario 2

Probability of WTE increases, but percentage of reported WTEs remains the same.
Potential reporting scenarios following TBS implementation

Scenario 3

Probability of WTE increases and percentage of reported WTEs increases.
Conclusions

› Wake Turbulence Database important dataset for TBS operational monitoring.

› Data is subjective and dependent on pilot reporting behaviour.

› FDR data provides valuable objective viewpoint about effect of WTE on aircraft.

› Positive response from airlines.

› FDR data will be used in the comparative assessment of WTE induced roll-rate pre- and post-TBS implementation.

› Investigating suitability of other metrics easily derived from FDR data.
Questions?