Wake Vortex Research in the USA (WakeNet-USA)

Steve Lang, FAA
Wake Turbulence Program Manager

Wayne Bryant, NASA
Airspace Systems Program Airportal Project Co-Principal Investigator

June 2006
FAA initiatives can not be completed without a revision of the separation standards (*FAA Research and Development Advisory Committee, Subcommittee on Separation Standards*)

<table>
<thead>
<tr>
<th>Critical Standard*</th>
<th>Controlling Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceanic</td>
<td>Nav/Altimeter Accuracy</td>
</tr>
<tr>
<td>Enroute</td>
<td>Radar resolution/Altimeter Accuracy</td>
</tr>
<tr>
<td>Landing</td>
<td>Blunder/ Wake/Runway Occupancy</td>
</tr>
<tr>
<td>Successive Departures</td>
<td>Nav Accuracy/Radar resolution/ Wake</td>
</tr>
<tr>
<td>Simultaneous Departures</td>
<td>Radar resolution/Wake</td>
</tr>
<tr>
<td>Departure/Arrival</td>
<td>Nav Accuracy/Radar resolution/ Wake</td>
</tr>
</tbody>
</table>

*Standards that have the greatest impact on system capacity*
FAA REDAC Separation Standards Working Group Finding

• Wake vortex avoidance is a limiting factor in defining separation standards in the terminal area
• Wake vortex avoidance could become a limiting factor in reducing separation standards in en route airspace
FAA/NASA Wake Vortex Research

Wake Vortex Research Goal

• Enable an increase in terminal area capacity at an agreed-upon level of safety for the National Airspace System through new standards for wake vortex operations (modify FAA wake vortex separation standards)

Develop the Field Test Data and Analyses to:

• Safely Change the FAA Definitions for WV Separations Standards

• Provide the Systems Engineering Data Necessary to support an FAA Joint Resource Council Investment (JRC-2B level) for a Full Scale Development of an Aircraft Wake Vortex Avoidance System
The US Wake program uses a Phased Approach to Reduce Risk

- **ATC Data Driven Procedural Changes** *(Near-Term Solutions)*
  - FAA led Phase I program with NASA support for data analysis. NASA is using FAA collected data for Initial CONOPS Development, Initial Safety Analysis, and Wake Predictor Evolution for Phase II and III concepts.

- **Weather Dependent Procedures** *(Mid-Term Solutions)* Concepts rely on Cross Wind Transport of Vortices *(Joint FAA/NASA)*
  - Phase II Departures; Phase II Arrivals
  - Both CSPR and Single Runway Operations

- **Operational Separation Based upon Safe Time Separation Predictions** *(NASA led – Far Term Solutions)*
  - Phase III Departures; Phase III Arrivals
  - Incorporates all dimensions of wake behavior – transport, sink, demise
  - Requires an agreed-upon level of safe wake encounter
FAA/NASA Integrated Research
“Creative Tension”

Corporate knowledge shared and maintained by both FAA and NASA
FAA/NASA Program Schedule

Timeline

Near-Term CSPR Procedures: SOIA, 2500 ft rule (FAA)

Mid-term: Wind-Dependent CSPR Departures/Arrivals (FAA/NASA)

Long-term: Active Wake Avoidance Solution (Primarily NASA)

International Coordination: European/FAA/NASA Action Plan/CREDOS
STL CSPR Waiver Proposal
(Phase I – Near Term)

Staggered CSPRs at STL
Proposed IMC ≥ 1.5-NM Grouped Arrivals

- 5 or 6-NM to Lead Aircraft in Next Group for Departures or After a Heavy/757

Within-Group Spacing is at least 1.5 NM

1300 Feet Separation

Stagger 3500 Feet

12L

12R
CSPR Departures
(Phase II – Mid Term)

STL Example

- Under current rules a Large departing 30L has to wait 3 minutes after Heavy departs 30R since it is considered an intersection takeoff.
- In this situation, the wake is obviously not a factor and no waiting should be required.
Single Runway DEPARTURES
(Phase II – Mid Term)

FRA/LHR Example

Under current rules a Large departing has to wait two minutes after Heavy departs.

Under certain wind conditions, like those depicted here, the wake is obviously not a factor and no waiting for mitigation should be required.
WakeNet-USA Purposes

• Coordinate, focus, and provide direction for US activities aimed at FAA/NASA Plan
• Collaborate with international partners working in the WV area through data and knowledge sharing
• Coordinate the development and modification of WV spacing standards across as broad a venue as possible
• Create a forum for the sharing of WV results from a broad spectrum of activities
WakeNet-USA Characteristics

• Government/Industry Working Group
• Involves program managers, solution providers, regulators, system users, international representatives, other benefactors
• No specific funding supports WakeNet-USA meeting activities other than wake program execution activities
• Meets every 6 months at a site provided by a WakeNet-USA member
# WakeNet-USA History

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Length of meeting/Number of attendees</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| March 2002 | Washington, DC                | ½ Day/10 People                      | • WV leaders discuss a means to focus on implementing RMP  
• Called “RMP Focus Group”                                                                                                           |
| May 2002   | NASA Ames, Moffett Field, CA  | ½ Day/25 People                      | • Continue discussing way of operating  
• Not enough time allowed to discuss topics                                                                                           |
| July 2002  | Boeing Commercial, Seattle, WA| 2 Days/30 People                     | • WV leaders/users/contributors discuss plans, progress, strategy  
• Focus on successfully executing joint RMP                                                                                          |
| August 2002|                               |                                      | • Initiated discussion with WakeNet2 Coordinator about forming parallel organizations across Atlantic with similar names             |
| October 2002| LMI, Washington, DC           | 2 Days/35 People                     | • ALPA and NATCA Began Participating  
• Developed 3-level organization: Executive, Key Stakeholder, General Membership  
• Began calling group “WakeNet-USA”                                                                                                    |
# WakeNet-USA History

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Length of meeting/Number of attendees</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2002</td>
<td></td>
<td></td>
<td>• WakeNet2 Coordinator supported idea of parallel wake vortex interest groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Selected names: WakeNet-USA &amp; WakeNet2-Europe</td>
</tr>
<tr>
<td>March 2003</td>
<td>St. Louis, MO</td>
<td>2 Days/50 People</td>
<td>• Participants include airline management reps</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• IFALPA presents wake policy</td>
</tr>
<tr>
<td>October 2003</td>
<td>United Airlines Training Center, Denver, CO</td>
<td>2 Days/48 People</td>
<td>• Status of each program phase presented to group and feedback requested on content/progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Eurocontrol presents European work</td>
</tr>
<tr>
<td>April 2004</td>
<td>New Orleans, LA</td>
<td>3 Days/28 People</td>
<td>• WakeNet-USA/WakeNet2-Europe Co-Sponsored specialist workshop on wake behavior In Ground Effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Determined that quality data sets to allow benchmarking three major wake predictors is necessary</td>
</tr>
<tr>
<td>April 2004</td>
<td>Boeing Commercial, Seattle Washington</td>
<td>2 Days/48 People</td>
<td>• Detailed discussions on multi-phase and European WV work presented</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Airlines, Safety Organizations discuss requirements for WV implementation</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Length of meeting/Number of attendees</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| October 2004 | Volpe National Transportation Center, Cambridge, MA | 2 Days/50 People | • Requirements from Boston Logan airport presented by airport authorities  
• US Concepts of Operations team presents findings |
| March 2005  | Boca Raton, FL            | 2 Days/50 People                      | • WakeNet2-Europe Coordinator presented status of WV research in Europe  
• Presentation give more detail Several European presentations given |
| October 2005 | Boeing Commercial, Seattle, WA | 2 Days/50 People | • Additional participation by Europeans includes Airbus, Eurocontrol |
| March 2006  | DFW Airport, Dallas, TX   | 2 Days/48 People                      | • European participation includes Eurocontrol, Airbus, NATS-UK  
• Panel on wake separation requirements conducted |
| April 2006  | Berlin, Germany           | 2 Days/22 People                      | • WakeNet-USA/WakeNet2-Europe Co-Sponsored specialist workshop on Wake Vortex Encounter Metrics  
• Established international working group to develop requirements and plan for accepted wake encounter def. |
Comments from our Customers

• United, Rocky Stone: “I’m happy that FAA and NASA are focused in getting an operational change.”

• UPS, Bob Hilb: “The joint FAA/NASA wake vortex plan is an exemplary case of how the agencies can effectively join forces to modernize the NAS.”

• Boeing Commercial, Paul Wagner: “Echo the comment by United-the program has operational focus. We need a success now and the 2500ft rule has the best chance of success in the near term.”
Concluding Remarks

• FAA and NASA are executing a joint wake turbulence program targeted at safely increasing capacity
• This partnership uses the strengths of the two organizations
• Significant international collaboration is involved (e.g., CREDOS Project…)
• WakeNet-USA was created to focus stakeholder interest on making the joint wake vortex plan successful
• WakeNet-USA is serving the purpose well.
  – Phase I results are expected September 2006
  – Phase II field tests are planned for November 2006
  – Phase III key issue on safe wake encounter is being addressed through newly formed working group