

Presented by

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Wake encounter severity metrics as input to monitoring requirement

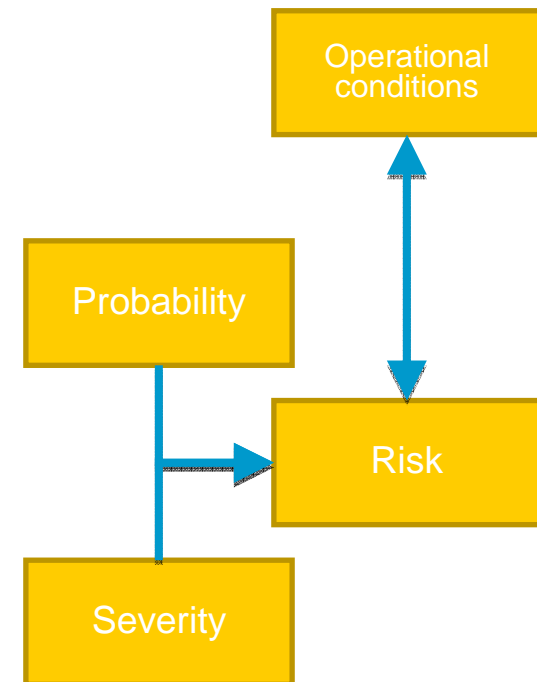
WN3-E Specific Workshop on
"Incident and accident monitoring and analysis"
NLR, Amsterdam, 18-NOV-2010

Wake Vortex Reporting Requirements

- Needs for Wake Encounter Incident Reporting
 - ▶ to identify critical and/or relevant operational conditions
 - ▶ to establish baseline safety levels
 - ▶ to monitor safety trends after implementation of new procedures or aircraft
 - ▶ to identify encounter events for advanced analysis of encounter effect on the aircraft

Wake Vortex Reporting Requirements

- Optimum output of monitoring / reporting
 - ▶ Full picture of operational circumstances
 - Including traffic situation, weather
 - ▶ Full coverage
 - All wake encounters reported
(But when is encounter reportable?)
 - ▶ Assessment of the encounter severity
 - Objective, standardized severity level



Wake Vortex Reporting Requirements

- Full picture of operational circumstances
 - ▶ Flight phase
 - Separation scheme applied
 - ▶ Generator aircraft situation: (with positive identification!)
 - Type, position, altitude, speed, weight, configuration
 - ▶ Follower aircraft situation:
 - Type, position, altitude, speed, weight, configuration
 - ▶ Meteorological situation:
 - Wind directions & speeds, turbulence, stratification

Wake Vortex Reporting Requirements

- Full coverage
 - ▶ All wake encounters reported
 - Positive identification of a wake encounter (and not something else)
 - Assured delivery / record

Wake Vortex Reporting Requirements

- Assessment of the encounter severity
 - ▶ Severity criteria / metrics
 - ▶ Objective
 - ▶ Standardized
 - ▶ As close as possible to relevant risk(s)
 - A good risk indicator?
 - The severity of a wake encounter is characterized by consequences (e.g. objective aircraft upset), not by cause (e.g. vortex circulation)
 - ▶ Continuous or at least 2 severity levels

Wake Vortex Reporting Requirements

- Which monitoring / reporting schemes are possible?
 - ▶ Pilot reporting
 - Voluntary / Mandatory
 - ▶ Reporting by / via ATC
 - Based on ad-hoc pilot info
 - Loss of separation
 - ▶ Automatic identification of WVE events
 - Real-time onboard the aircraft
 - Post flight data processing

Wake Vortex Reporting Requirements

- Capability of **Pilot reporting**

- ▶ Full picture of operational circumstances ?
 - Much information is available
 - Not all information can be remembered
 - No positive identification of wake nor generator
- ▶ Full coverage ?
 - No (neither with a mandatory system?)
- ▶ Encounter severity ?
 - Maybe 2 severity levels, subjective (rating scale?)

Wake Vortex Reporting Requirements

- Capability of **Reporting by / via ATC**
 - ▶ Full picture of operational circumstances ?
 - Much information is available
 - No positive identification of wake nor generator
 - ▶ Full coverage ?
 - No (neither with a mandatory system?)
 - ▶ Encounter severity ?
 - No (at most indirect)

Wake Vortex Reporting Requirements

- Capability of **Automatic WVE reporting**
 - ▶ Full picture of operational circumstances ?
 - Much information is available
 - Positive identification of wake and generator possible
 - ▶ Full coverage ?
 - Possible (or at least high)
 - Partially (but with a known equipage level)
 - ▶ Encounter severity ?
 - Yes (limitations for post flight data processing)

Wake Vortex Reporting Requirements

- Main limitations of **Pilot reporting**
 - ▶ Full operational picture is
 - not available (e.g. generator aircraft info)
 - not remembered or not asked
 - ▶ Reporting level is not known
 - ▶ Severity level is not standardized (or not asked)

- **Cannot be used to establish baseline safety level**
- **Low level of confidence in monitoring safety trends**
- **Can help identifying critical and/or relevant operational conditions**

Wake Vortex Reporting Requirements

- Main limitations of **Automatic WVE reporting**
 - ▶ Currently no system is available
 - ▶ Severity level is not standardized
 - ▶ A/C equipage required / low initial equipage level

- **Could be used to establish baseline safety level**
- **Objective monitoring of safety trends**
- **Can identify critical and/or relevant operational conditions**

Wake Vortex Reporting Requirements

- Parts of Automatic WVE Reporting System
 - ▶ WVE Identification (including generator identification)
 - ▶ WVE Severity Assessment
 - ▶ Data transmission, storage, and link with safety management systems
- Key enabler:
 - ▶ Current and future air-to-air data link standards

Wake Vortex Reporting Requirements

• Automatic WVE Severity Assessment

Example:

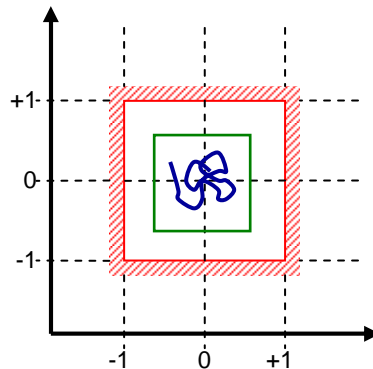
Multi-criteria set
(12 criteria)

Three output levels:

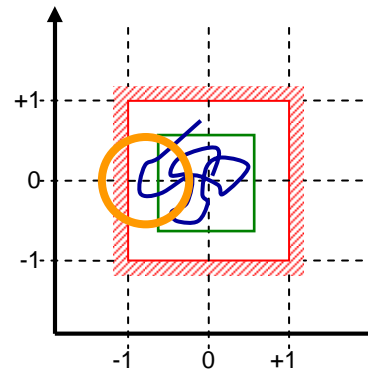
- Normal operation
- Reportable event
- Significant event

All data available
onboard the A/C

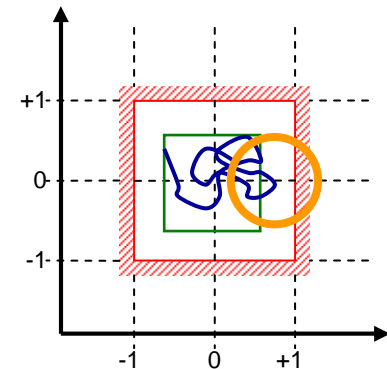
AAE - Aircraft Attitude Envelope



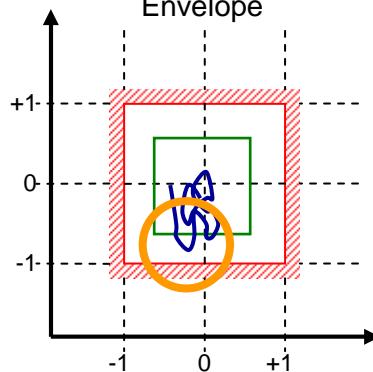
ACE - Attitude Control Envelope



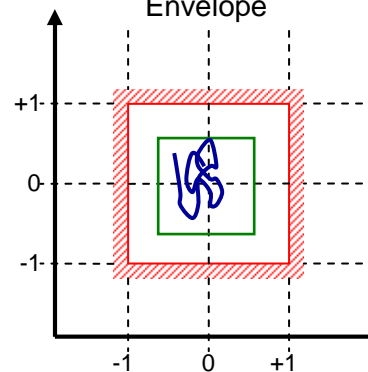
FPE - Flight Path Envelope



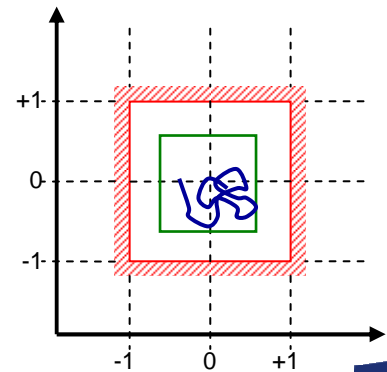
SIE - Structural Integrity Envelope



CAE - Cabin Acceleration Envelope



AFE - Air Flow Envelope



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