



WORKING PAPER

TWELFTH AIR NAVIGATION CONFERENCE

Agenda Item 2: Aerodrome operations – improving airport performance
2.1: Airport capacity

REDEFINITION OF ICAO CATEGORIES FOR WAKE TURBULENCE (RECAT)

(Presented by the Presidency of the European Union on behalf of the European Union and its Member States¹; by the other Member States of the European Civil Aviation Conference²; and by the Member States of EUROCONTROL)

EXECUTIVE SUMMARY

PANS-ATM divides aircraft into different wake turbulence weight categories and defines the required wake turbulence separation between aircraft depending on their wake turbulence category. In recent years, knowledge about wake turbulence behaviour and aircraft resistance to wake turbulence in the operational environment has increased thanks respectively to measured data, improved understanding of physical wake decay processes, and several campaigns of flight test and flight simulation.

In 2005 the FAA and EUROCONTROL jointly undertook the “RECAT” project split into several phases. This work has highlighted the impact of regional fleet mix differences on the potential benefits. The second phase of RECAT is planned to focus on and support a global static “pair-wise” solution.

Action: The Conference is invited to agree to the recommendation in paragraph 5.

1. INTRODUCTION

1.1 The demand for airport capacity increases every year. A main constraint on airport capacity is the runway, which accommodates only a limited number of flights per unit of time.

1.2 This capacity is often directly linked with the minimum separations between aircraft on arrival or departure. The minimum separation between two aircraft is prescribed by ICAO *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444) and includes wake turbulence separation criteria.

1.3 PANS-ATM divides aircraft into three different wake turbulence weight categories (Heavy, Medium, Light; a fourth sub-category “Super Heavy” is defined by State letter). The use of weight categories means in principle that the worst case (i.e. largest weight difference between the vortex generating aircraft and the

¹ Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom. All these 27 States are also Members of ECAC.

² Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Georgia, Iceland, Moldova, Monaco, Montenegro, Norway, San Marino, Serbia, Switzerland, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.

following encountering aircraft) is safe. For any other combination of aircraft, there may be an over-protection, and hence a potential loss of runway throughput.

1.4 Based on experience and triggered by events e.g. wake turbulence encounter reports, but also in order to potentially increase runway throughput, some States or regions use slightly modified wake turbulence classes rather than the ones prescribed in PANS-ATM.

1.5 In recent years, knowledge about wake turbulence behaviour and aircraft resistance to wake turbulence in the operational environment has increased thanks respectively to measured data, to improved understanding of physical processes and to several campaigns of flight test and flight simulation of wake turbulence encounter. It was clearly confirmed that weight is an important parameter to determine safe separations, but not the only one, thereby making the allocation of aircraft to weight categories an issue.

1.5.1 Efforts conducted on the wake turbulence assessment of single aircraft (e.g., the A380 and B748 individually by EUROCONTROL, the FAA and European regulatory entities (JAA and later EASA) could contribute towards and be efficiently supplemented by broader assessment of wake turbulence separation minima for all aircraft.

1.6 It is mainly for the above reasons that it was considered appropriate to re-consider ICAO wake turbulence separation minima and that a joint FAA-EUROCONTROL initiative was launched in 2005. This work is an input to the ICAO Wake Turbulence Study Group.

1.7 The initiative, RECAT, was split into different phases:

- a) Phase 1 (RECAT-1): Optimization of the ICAO wake turbulence separation classes, with up to six categories;
- b) Phase 2 (RECAT-2): Replacement of the Separation Classes with a static “pair-wise” regime, where each aircraft pair has its appropriate wake turbulence separation minima; and
- c) Phase 3 (RECAT-3): Dynamic Pair-wise Separation, where also actual conditions, such as aircraft mass and atmospheric/meteorological conditions, are considered when establishing the required wake turbulence separation minima.

1.8 The initial work aimed at understanding the fleet mix in the European and American airports and at establishing the relationship between the number of classes and operational benefits.

1.9 Initially the only criterion used was that no individual aircraft should be exposed to wake turbulence encounter risk (combination of severity and probability of the hazard) greater than exists under the current ICAO categories and associated separation minima. This assessment included severity as well as frequency. During the analysis it became clear, from a broad look at wake encounter risk relative to aircraft roll control authority, there is more conservativeness in the potential wake encounter risk for Heavy to Heavy operations than for other aircraft pairs under ICAO separation minima. It also became apparent that there is less conservativeness in the potential wake encounter risk for Light (US Small) behind upper Heavy aircraft than for other aircraft pairs under ICAO separation minima.

1.10 It is also clear that if aircraft are distributed into more classes, each class will include a narrower range of aircraft types and protection needs. With those narrower ranges, more precise required separation can also be determined, and some separations can safely be reduced. On the other hand, more classes lead to more complexity for the air traffic controller, creating the need for support tools.

1.11 An outcome of the analysis was agreement that, as six classes are already used today at some aerodromes, this would be the best compromise for short term implementation without need for additional support tools.

2. SHORTER TERM APPLICATION AND BENEFITS

2.1 An initial categorisation scheme with six categories was jointly developed and proposed by the RECAT participants. Those six categories were optimized for a combination of fleet mix samples at five US and four European capacity constrained airports. The proposal provided capacity gains, set against the current ICAO HML categorisation system, at all nine airports for the tested samples, but not the same capacity gain for each airport. However, further alternative capacity assessments with other fleet mix samples showed different results including a capacity loss for one airport compared to its current practices. Further consultation with stakeholders led to additional work, in particular on refining aspects of the methodology to conduct the safety assessment, and on optimizing capacity gains for the fleet mixes found at European (and perhaps other) airports. Therefore, a second proposal was studied to optimise the capacity benefit enhancement by tailoring the categories. It was assessed on a sample of peak traffic at Paris Charles de Gaulle airport, considered as a representative situation for a number of other airports., showing a potential for a significantly higher capacity increase compared to the initial RECAT proposal (5.5% vs less than 1% for that airport).

2.2 These differing traffic mixes (and hence operational need) have led to the current situation where there are now two separate Phase 1 (i.e. RECAT-1) proposals developed:

- a) the initial proposal explained above, now nearing implementation in the US; and
- b) a second proposal intended to refine safety aspects of the methodology and better address traffic mix such as that found in Europe, where the development process is nearing completion in view of short-term implementation at some locations.

3. RECAT PHASE 2, PAIR-WISE SEPARATION

3.1 Through RECAT Phase 2, currently under definition, it is envisaged that the six categories from Phase 1 will be replaced by a regime under which each aircraft pair will have its own separation minima defined, with a focus on optimisation for the approximately 100 aircraft types that create 99% of world-wide demand. In reality, due to the very similar behaviour of many aircraft, because the very small aircraft can all be considered to be equal, and because most aircraft pairs are not wake constrained but rather constrained by minimum radar separation, it is expected to lead to a manageable number of unique wake turbulence minima.

3.2 States can decide how to implement the pair-wise separation minima. Implementation can be accomplished by grouping the aircraft into categories, similar to today's ICAO wake turbulence classes and RECAT Phase I. The grouping will depend on local or national needs, and hence be tailored to the local situation. As automation is developed to move the operations toward the goal of dynamic separation envisioned in NextGen and SESAR, an ANSP may decide to increase the number of categories or eliminate categories altogether, with the automation providing the support tools necessary to address the complexity issues.

3.3 In order to manage a complex situation where a multitude of minima can be used, controller support in terms of separation tools for radar and aerodrome controllers may be required. However for areas where fewer categories are defined there will be no need for a separation tool.

3.4 RECAT Phase 2 preparation is a medium-term project that will be supported by SESAR and NextGen.

4. CONCLUSION

4.1 During RECAT Phase 1 it was agreed that six wake turbulence classes were manageable without providing controller management tools.

4.2 Learning from the experience gained in the USA and Europe with RECAT Phase 1, the RECAT Phase 2 should focus on pair-wise separation minima, thus provide ANSPs an opportunity to form groupings based on local capacity optimisation. This Phase 2 flexibility should also allow an ANSP to change its groupings at any time, for instance to address changes in fleet mix over time, while still adhering to the harmonized set of pair-wise separation minima. Phase 2 will also provide global harmonization through ICAO acceptance of the Phase 2 safety methodologies and resulting pair-wise separation minima.

4.3 The ICAO work should now progress collaboratively the definition of a static pair-wise global solution as envisaged in the next phases of RECAT. Harmonization will be ensured by adoption of pair-wise separation minima by ICAO. Local optimization will be accomplished by categorizing, as necessary, according to local fleet mix. Flexibility, to address changes in fleet mix demand, will come from the ability to modify local categories over time while still ensuring that the categorical system provides for all of the pair-wise separation minima adopted by ICAO.

5. RECOMMENDATIONS

5.1 The Conference is invited to:

- a) note the information presented in this paper and the performance benefits related to progressive optimisation of the wake turbulence separations (this refers to ASBU Modules B0-70, B1-70 and B2-70); and
- b) recommend that ICAO support the continuation of the RECAT Phase 2 activities, with a view to having revised global provisions in place in the foreseeable future.

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