

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

**Agenda Item 2: Safety and security in air traffic management
(ATM)**

2.2 Safety certification of ATM systems

:

AVIATION SAFETY REGULATORY INTERFACES

(Presented by the European Organisation for the Safety of Air Navigation
(EUROCONTROL) on behalf of its Member States and those of ECAC¹)

SUMMARY

Certification is a widely used process in ensuring aviation safety. The progressive extension of certification or safety regulatory activities into other sectors of the aviation industry such as in air traffic management and aerodromes, as well as the increasing integrated nature of aviation and more specifically ATM/CNS systems, means that effective safety regulatory (or safety certification) interfaces between these activities, are required in order to safeguard aviation safety.

New ATM/CNS developments imply changes to the airborne design, to the operations of aircraft, to the provision of ATM services and to aerodrome operations.

In such a context, there is a need to co-ordinate which safety requirements apply to each of the elements of the ATM/CNS system as well as the safety regulatory oversight and approval (or safety certification) processes, to ensure that allocated safety requirements are indeed implemented in a satisfactory manner.

Action by the conference is in paragraph 5.

¹ The ECAC Member States are: **Albania**, Armenia, **Austria**, Azerbaijan, **Belgium**, Bosnia and Herzegovina, **Bulgaria**, **Croatia**, **Cyprus**, **the Czech Republic**, **Denmark**, Estonia, **Finland**, **France**, **Germany**, **Greece**, **Hungary**, Iceland, **Ireland**, **Italy**, Latvia, Lithuania, **Luxembourg**, **Malta**, **Moldova**, **Monaco**, **the Netherlands**, **Norway**, Poland, **Portugal**, **Romania**, Serbia and Montenegro, **the Slovak Republic**, **Slovenia**, **Spain**, **Sweden**, **Switzerland**, **The former Yugoslav Republic of Macedonia**, **Turkey**, Ukraine and **the United Kingdom**).

The 31 Member States of EUROCONTROL appear in **bold**

*French, Spanish and Russian versions provided by EUROCONTROL.

1. INTRODUCTION

1.1 In many aviation sectors, certification is a widely used approach to ensuring continued safety and intended function.

1.2 An increasing number of new developments in air traffic management/communication, navigation, surveillance (ATM/CNS) affect not only air traffic management and aerodromes but also aircraft systems and operations.

1.3 This Paper aims at highlighting the need for national and regional aviation safety regulatory authorities to implement effective interfaces among themselves when:

- a) setting safety regulatory requirements for new ATM/CNS developments;
- b) verifying compliance with agreed safety regulatory requirements for new ATM/CNS developments; and
- c) issuing safety regulatory approvals or certificates for implementation of ATM/CNS related changes to the current ATM system.

2. OVERVIEW

2.1 Airworthiness certification

2.1.1 The objective of an airworthiness code, related certification process and airworthiness certificate is to ensure that the aeroplane is and remains airworthy, i.e., that the intrinsic safety of the aeroplane will be and remain within tolerable minima, in other words to control the risks of accident due to aeroplane design, construction and performance.

2.1.2 The scope of the airworthiness approval includes the aeroplane, its components and equipment, which should function safely and correctly under *anticipated operating conditions*.

2.1.3 Airborne instruments and equipment dealt with under airworthiness are those considered as “necessary for the safe operations of the aeroplanes in the *anticipated environment of operation*”.

2.1.4 Therefore, it is to be expected that the demonstration of compliance with the airworthiness code necessitates assuming and documenting the *anticipated operating conditions* so that provisions are made in the design of the aeroplane to address those in an airworthy manner.

2.2 Operational certification

2.2.1 The objective of any code for operational certification and related operational certification or approval process is to ensure that the operator is able and competent ‘to conduct safe and efficient operation’, according to specific criteria of safe operating practices. The objective is to control the risk of accident due to aeroplane operations.

2.2.2 The code of operational certification typically includes requirements bearing on the organisation of the operator and the method of control and supervision of flight operations² as well as on *aeroplane instruments and equipment (including navigation, communication and surveillance)*, all consistent with the *nature and extent of operations* specified.

2.2.3 There are some instruments and equipment dealt with under operational certification, which were not dealt with for the issuance of a certificate of airworthiness.

2.2.4 Instrument and equipment as per ICAO Annex 6 include those considered as necessary “to enable the flight crew to control the flight path of the aeroplane, carry out any required procedural manoeuvres and observe the operating limitations of the aeroplane in the expected operating conditions”. Annex 6 specifies as a minimum and under certain conditions, the carriage of GPWS (Ground Proximity Warning System), ELT (Emergency Locator Transmitter), ACAS II (Airborne Collision Avoidance System) and pressure altitude reporting transponder³, as well as communication and navigation minimum equipment⁴ (e.g., such as those required for specific RNP types or MNPS operations).

2.2.5 In addition, references are made in ICAO Annex 6 to specific requirements to be met, as a minimum, by the operators *in the airspace and aerodromes where its aeroplanes intend to fly*. These requirements are typically published in Aeronautical Information Publications (AIP) or as Regional Supplementary Procedures (ICAO Doc 7030) or in Regional Air Navigation Plans.

2.2.6 The demonstration of compliance with the code of operational certification necessitates ensuring that the laws, regulations and procedures prescribed for the areas and airspace to be traversed (in which operations are to be conducted) are met.

2.3 ATM safety regulatory approval (or safety certification)

2.3.1 States should set up target level(s) of safety for the provision of air traffic services (ATS) in the national airspace and at aerodromes in order to meet the provisions of ICAO Annex 11 section 2.26⁵.

² Including requirements on Flight documents, Training Programme, and Maintenance arrangements

³ The latter is explicitly intended to improve the effectiveness of ATS

⁴ The latter is explicitly intended to meet “the requirements of ATS”

⁵ Amendment 40

2.3.2 In addition, States should ensure that safety significant changes to ATM are implemented after their safety impact has been demonstrated to remain within tolerable safety minima.

2.3.3 World-wide, safety regulation in ATM is increasingly established in a manner which ensures as a minimum the separation of safety regulatory and service provision functions.

2.3.4 In a safety regulatory regime, there are two elements of regulations which need to be operated: “Rule-making” and “Safety Oversight”⁶:

2.3.4.1 National Rule-Making is expected to enforce as a minimum those safety provisions which are internationally agreed (e.g., ICAO standards and Recommended Practices) into national safety regulatory framework;

2.3.4.2 Safety Oversight may be understood as “the function undertaken by a Civil Aviation Authority (CAA) to verify that safety regulatory objectives and requirements are effectively met”;

2.3.4.3 National Rule-Making is also expected to specify the safety oversight and safety regulatory approval processes (or safety certification process) related to the introduction of new systems and changes in ATM/CNS;

2.3.4.4 The safety objective of the national safety rule/code for ATM and any related safety regulatory approval (or safety certification) is to ensure that the safety levels achieved by air traffic management in the national airspace meets the applicable target level of safety for that airspace; in other words, the objective is to control the risk of accident due to ATM.

2.3.5 It should be noted that, whether or not a safety regulatory regime formally separate from service provision is implemented, States are responsible for ensuring that ATM services are provided within agreed minimum tolerable safety levels and comply with applicable national safety rules for ATM.

2.3.6 The provision of safe ATM services requires the existence of specific ground but also airborne functions and procedures for aircraft flying into the national airspace.

2.4 **Aerodrome certification**

2.4.1 Another recent development is the certification of aerodromes where similar certification processes are proposed to ensure adequate operational capability, *inter alia*, from a safety viewpoint.

2.4.2 States are expected to establish a regulatory regime so that compliance with the specifications in Annex 14 can be effectively enforced for aerodromes open to public use⁷.

⁶ In other words, surveillance or supervisory functions.

⁷ This requirement of ICAO Annex 14 applies to aerodromes used for international operations as well as, if possible, for aerodromes open to public use. In Europe, every public aerodrome is considered as open to international operations.

2.4.3 In addition, States are expected to set up target level(s) of safety for national aerodromes in a manner consistent with Annex 11, section 2.26.

2.4.4 This implies a certification process against the national aerodrome rules, aiming to ensure that the safety levels achieved by aerodrome operations meet the applicable target levels of safety for each aerodrome. The safety objective is to control the risk of accident due to aerodrome design and operations.

2.4.5 The provision of aerodrome services relies on the existence of ATM, meteorological (MET) services and aeronautical information services (AIS) as well as specific ground but also airborne functions and procedures. Indeed, some airborne equipment is required to fly and land at specific aerodromes (e.g., instrument landing system (ILS)).

3. SAFETY REGULATORY INTERFACES IN AVIATION

3.1 The use of many safety regulatory (or safety certification) activities as referred to in Paragraph 2 implies a number of separate, but closely related, safety regulatory functions (or safety certification functions) at national or regional levels.

3.2 According to the overview provided in Paragraph 2 of this paper, there appears to be an in-built interface being incorporated into the various ICAO Annexes⁸.

3.3 In general the individual parts of the aviation system appear to have received a great deal of attention, in terms of design, operation and safety regulation (or safety certification). However, the interfaces between them seem to have received rather less, even if documented to some extent in ICAO Annexes, because they are difficult to quantify and have no clear ownership.

3.4 It is also recognised that until recently and except in a limited number of countries, no codes/rules existed for ATM and aerodromes specifically requiring the safety assessment of changes to their systems and operations. Except in some instances in the navigation domain, the air traffic services (ATS) or ATM (and related air/ground interface) standardisation and implementation processes relied more on good engineering practices and on feed back from experience than on formal safety processes and formal determination of safety objectives and requirements.

3.5 Components of the aviation system are now becoming increasingly integrated. A total aviation system approach to safety is therefore necessary if all risks are to be identified and satisfactorily mitigated.

3.6 Safety regulatory approval (or safety certification) of certain system elements, without reference to other system aspects and factors, will not ensure that system safety remains sufficiently addressed.

3.6.1 For example, airborne equipment, instruments and functions installed for the purpose of ATM, even if not required for the issuance of an airworthiness certificate, should not render the aeroplane unworthy. As such, they should be subject to airworthiness requirements. Related Failure Conditions would need to be

⁸ E.g., ICAO Annexes 6, 8, 11 and 14.

assessed to determine to what extent they can prevent the aeroplane's continued safe flight and landing.

3.6.2 Equally, those airborne equipment, instruments and functions or procedures being installed and used for the purpose of air traffic management should allow applicable airspace and aerodrome target levels of safety to be met. Indeed, the overall safety of an airspace and aerodrome is related, among other things, to the level of equipage and adequacy of operations of aeroplanes flying into that airspace.

3.7 Therefore, there is a need to clarify which safety regulatory requirements apply to ATM/CNS as opposed to airworthiness, and how organisations responsible for the design and operations of new ATM/CNS systems can reconcile, in one implementation, the safety objectives and requirements derived from applicable codes/rules for airworthiness, operational certification, ATM safety regulatory approval and aerodrome certification.

3.8 A total system approach must therefore be adopted for the determination and implementation of safety requirements in ATM/CNS, relying on appropriate, effective and sound safety regulatory practices and interfaces.

3.9 It is essential that, at a national level, as well as across national boundaries, adequate mechanisms and interfaces are established to ensure that safety regulatory and safety certification activities are conducted in a co-ordinated way. Such co-ordination may involve:

3.9.1 Agreement on the determination, validation and allocation of safety requirements to the airborne and ground parts of the ATM/CNS system in order to show compliance with applicable airworthiness, operational certification, ATM and aerodrome safety rules/codes.

3.9.2 Publication and enforcement of agreed co-ordinated safety requirements (e.g., through international standards, regional and/or national safety regulatory material, Aeronautical Information Services and/or ICAO Regional Supplementary Procedures (SUPPs, ICAO Doc 7030) and regional air navigation plans).

3.9.3 Verification by airworthiness and operational certification authorities in charge of issuing the airworthiness certificate(s) and operational certificate(s) for aeroplane/operator that the sub-set of safety requirements required in the national AIP or/and ICAO Doc 7030 where aeroplanes are going to fly are met (Safety Oversight/Surveillance functions).

3.9.4 Verification by ATM and aerodrome safety regulatory authorities that the sub-set of safety requirements allocated to the provision of ATM/aerodrome services are met (Safety Oversight/Surveillance functions).

3.9.5 Issuance of airworthiness, operational certificate(s), aerodrome certificate and ATM safety regulatory approval (safety certificate), as appropriate.

3.10 This is likely to grow in a safety regulatory shortfall if nothing is done with the emergence of more complex ATM/CNS implementation, as it is widely recognised that accidents are often the result of a combination of events, resulting from various parts of the aviation system.

4. CONCLUSION

4.1 Certification is a widely used process in ensuring aviation safety.

4.2 The extension of certification or other safety regulatory activities into other sectors of the aviation industry such as ATM and aerodrome operations, together with the increasingly integrated nature of aviation and more specifically of ATM/CNS systems, means that effective interfaces between these activities at national, regional and international levels, are required in order to safeguard aviation safety.

4.3 In such a context, there is a need to co-ordinate:

- a) the safety requirements which apply to each of the elements of the ATM/CNS system and how these are allocated across the ATM/CNS system; and
- b) the safety regulatory oversight and approval (or safety certification) processes to ensure that allocated safety requirements are indeed implemented in satisfactory manner.

5. ACTION BY THE CONFERENCE

5.1 The Conference is invited to encourage national and regional authorities responsible for airworthiness, operational certification, ATM safety regulatory approval (safety certification) and aerodrome certification to establish effective and formal interfaces among themselves at national level as well as across national boundaries.

— END —