



ASSEMBLY — 35TH SESSION

TECHNICAL COMMISSION

Agenda Item 23: Consolidated statement of continuing ICAO policies and practices related to communications, navigation, and surveillance/air traffic management (CNS/ATM) systems

DEVELOPMENT OF A GLOBAL GATE-TO-GATE SAFETY ASSESSMENT METHODOLOGY

(Presented by 41 Contracting States², Members of the European Civil Aviation Conference)

SUMMARY

This paper identifies the need to develop a global integrated system wide approach in aviation safety assessment that integrates all components of the aviation system in a balanced way.

ACTION BY THE ASSEMBLY

The Assembly is invited to adopt the actions proposed in paragraph 4.

REFERENCES

Assembly Resolutions:

A33-15; ICAO policy on CNS/ATM

A33-16; ICAO Aviation Safety Plans (GASP)

Eleventh Air Navigation Conference Recommendations:

AN-Conf/11-2/1; A framework for system safety

AN-Conf/11-2/2; ATS management programme/acceptable safety levels

AN-Conf/11-2/5; Monitoring of safety during normal operations

AN-Conf/11-2/6; Safety certification of ATM systems

AN-Conf/11-2/7; Safety oversight capabilities and procedures

¹ English and French versions provided by ECAC.

² Albania, Armenia, Austria*, Azerbaijan, Belgium*, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus*, Czech Republic*, Denmark*, Estonia*, Finland*, France*, Germany*, Greece*, Hungary*, Iceland, Ireland*, Italy*, Latvia*, Lithuania*, Luxembourg*, Malta*, Moldova, Monaco, Netherlands*, Norway, Poland*, Portugal*, Romania, Serbia and Montenegro, Slovakia*, Slovenia*, Spain*, Sweden*, Switzerland, The former Yugoslav Republic of Macedonia, Turkey, Ukraine, United Kingdom*.

³ Member States of the European Union are indicated with an asterisk (*) in the above list.

1. INTRODUCTION

1.1 The volume of air traffic is steadily increasing on a global basis. It is expected that this increase will result in safety problems that will require additional measures in order to maintain an adequate level of safety. The continuing increase of air traffic volume will result, if no action is taken, in an increase of the number of accidents and incidents unless we are able to further reduce the present accident and incident rate. The number of flights in Europe and in some other regions is forecast to grow by a factor of approximately two or more by the year 2020. Civil Aviation has been seen for some years as being a High Reliability Organization (HRO). This means that it is very safe, compared to other means of transport. However, limitations to the current modus operandi in enabling better standards for safety, capacity and efficiency require changes to today's Air Transport landscape. The growth of air traffic volume requires further improvement on a global scale. In the light of this development, member States will increasingly experience safety problems that require additional measures in order to maintain an adequate level of safety. Equally, the increasing complexity, integration, and automation in ATM as well as changes in the roles of ATM staff and airspace structure, all advocate a more formal and integrated approach to safety. New ways to manage safety have therefore to be explored in order to analyze the safety of flight operations and air traffic management in a total system approach. It will be extremely difficult to maintain an adequate level of safety in particular at airports and in airspace with a high traffic density but also and increasingly in certain developing regions that experience fast-growing air traffic. The need to enlarge the ATM capacity will result in more dependency of flight safety on newly introduced technology, procedures and automated functions with their individual risk of failure and new vulnerable interfaces.

1.2 The recent 11th ICAO Air Navigation Conference adopted the ICAO Global ATM operational concept that will be implemented over the next decade. This concept is based on an integral gate-to-gate consideration. A new approach to manage safety of the flight operation and air traffic management on an integrated basis should be part of this concept.

1.3 The 11th ICAO Air Navigation Conference endorsed also a recommendation (Rec.2.1) identifying the need for the development of a framework for a uniform and system-wide approach to safety.

1.4 At present, a number of studies are being carried out by Member States and Organizations (see Attachment) that are addressing new or extended approaches to aviation safety from either an air traffic management or flight operations perspective. They are developing either a certification/safety assessment or monitoring function, without all yet having an equally balanced aviation system-wide approach or without being based on a policy for an overall systems approach.

1.5 ECAC Member States identify the need for ICAO to take the lead in rulemaking for a global gate-to-gate safety assessment methodology to analyze and monitor the *safety of flight operations* and *air traffic management* on an integrated basis. The system should aim in this context at identifying all possible hazards, analyzing the associated risks and identifying measures to mitigate the risk in order to realize safety enhancements in a global context.

2. BACKGROUND

2.1 The gate-to-gate concept of operation is considering a flight as a continuous event, from planning, through execution of the flight to post-flight activities. The overall objective is to define, develop and implement an integrated concept that will enable a smooth and seamless process from flight preparation through flight execution to the evaluation of the flight. Key to this operational concept is whether it meets the user requirements and expectations in terms of capacity, efficiency, flexibility, interoperability etc. but most importantly, certain quantitative and qualitative safety levels.

2.2 Safety should be considered for *every component* of the system as well as for the *overall safety* of the concept as a whole. The prime responsibility for the safety of a gate-to-gate flight operation rests with the aircraft operator, the ATM service provider and the aerodrome operator. In a total aviation systems approach essential interfaces in each area of responsibility are related to the technical and operational standards being applied. This includes also human proficiency (training and licensing), maintenance and certification/airworthiness aspects of aircraft and systems performance and supporting facilities such as the provision of aeronautical and meteorological information.

2.3 A recent study carried out on behalf of the Department of Civil Aviation in the Netherlands has shown that major contributing elements to accidents and incidents are failures at the interfaces within the aviation system. Other studies also reveal that the design phase significantly contributes to overall safety. The most frequent intra-organizational and communication interface problems, that had a direct and immediate impact on flight safety, were identified within flight operations and within ATC. The degree of interdependence between ground-based and airborne components becoming more significant in the implementation of the future ATM operational concept, creating more technical and operational interfaces. A follow-up study has recently been initiated by the Netherlands.

3. BASIC CONCEPT

3.1 To achieve enhancements in safety it is essential to develop a harmonized and pragmatic methodology for integral *safety analysis* of all flight phases of the gate-to-gate concept including its interfaces. Because of the dynamic character and ongoing evolution of the aviation system the methodology should also aim at a continuous *safety performance monitoring* against defined safety targets where safety hazards are being identified and safety measures are implemented to mitigate the risks.

3.2 The 11th ICAO Air Navigation Conference recommended a framework for a uniform and system wide approach to safety as a logical method to manage aviation safety and a system of safety monitoring during normal operations.

3.3 Although the existing mechanism provides for safety certification, safety management and occurrence reporting systems in the individual aviation areas, disciplines and organizations, no provisions exist for a uniform and overall systems approach to safety.

3.4 A first step to be taken is a global and integrated approach for the safety assessment of the *flight operation* and the *ATM provision* to the air traffic. This integrated approach to safety assessment and management will require additional standards, recommended practices and guidance material in appropriate ICAO Annexes related to the flight operation and air traffic management.

3.5 Within this context there is a need to identify and analyze the processes and organizations that directly can influence safety. A top-down overview should be made of interfaces of all individual components of the aviation system and identify the related interfaces. Equally, there would be a need to analyze thoroughly the current ATM & flight operations safety approaches and safety assessment cultures, in order to build on existing practices.

3.6 The following aspects should be taken into account in developing an ICAO global safety assessment methodology:

- it should be global in nature and being applied worldwide (instead of only nationally or regionally) and, where practical, be implemented at regional level;
- it should consider all specific phases of flight and associated interfaces in ATS service provision, ATM facilities, supporting CNS systems, aircraft design and maintenance;
- it should allow for regional flexibility based on specific (low) traffic density, basic operational scenarios and level of complexity of the ATM system;
- covering all technical systems, managerial and operational aspects of air traffic management and the flight operation, focused on human, procedural, and equipment aspects (including soft and hardware);
- it should be able to identify errors in operational cockpit procedures including possible links to aircraft equipment design, airworthiness certification or maintenance which might result in a decrease of safety margins and being a hazard to the aircraft;
- a relationship of line operations safety audits (LOSA) implemented by airlines;
- addressing safety assessment of system components, its interfaces and the overall system performance;
- it should not be restricted to the introduction, change or decommissioning of ATM systems but also be of a continuous monitoring nature to the safety of the organization and its service provision (safety management systems);
- safety monitoring should not only be as a complementary means to qualification before and during operational use but be a mature part of the system;
- addressing safety aspects related to interaction of ATM across the FIR, at regional level (i.e. European Functional Airspace Blocks) and to neighboring ICAO regions;
- the system should be developed beyond the functional hazard assessment and also address the identification of “non-functional” hazards;
- the development of a model based risk assessment taking into account (existing) causal models, consequential models and safety models;

- assessing safety consequences of organizational or management changes in ATM provision or related to the flight operation; and
- the system should be able to deal with increasing integration –, automation-, and complexity of future air traffic and airborne systems, including integrity of data exchange by data-link systems and associated human factors like new responsibilities and functions of all related actors in the future aviation system.

3.7 ECAC Member States strongly supports the development of a harmonized highly valid gate-to-gate safety assessment methodology by ICAO. It is suggested to have the gate-to-gate safety assessment methodology be developed in co-operation with organizations currently active in this area such as EUROCONTROL and the Flight Safety Foundation. This would ensure that any ICAO strategic initiative towards a global aviation safety management approach benefits from the result of on going activities in the development of gate-to-gate safety assessment methodologies.

3.8 ECAC Member States are prepared to participate actively in such a new initiative.

4. ACTION BY THE ASSEMBLY

4.1 The Assembly is invited to:

- a) consider the need for a gate-to-gate approach to safety assessment and management;
- b) add to the ICAO Technical work programme 2004-2007 the following subject:
 - to develop a standardized gate-to-gate safety assessment methodology to be applied globally initially from a integrated ATM and flight operation context;
 - to address all related components that constitute the aviation safety system such as ATS and airport services and facilities, integrity of manufacturing and maintenance and safety oversight aspects with specific attention to the safety of the interfaces;
 - to review and amend, where appropriate, the ICAO Annexes, specifically from the viewpoint of interfaces with other disciplines, to ensure compatibility;
 - to develop guidance material to support the aviation community in applying the methodology; and
- c) invite Contracting States and Organizations that are active in the development of safety systems to contribute to the development of an ICAO global safety assessment methodology.

ATTACHMENT

SOME CURRENT SAFETY ACTIVITIES IN MEMBER STATES AND ORGANISATIONS

1. The Netherlands

1.1 A pilot study, based on a gate-to-gate approach, has been carried out for the Netherlands Civil Aviation Department by the National Aerospace Laboratory (NLR) to identify interface problems within the aviation system that potentially are associated with accidents. Central to the objective was to identify whether systematic analysis of interfaces could lead to safety improvements. The overall approach employed in this study was to provide a top-down overview of interfaces within the aviation system and the different types of interfaces that are important with respect to safety and to analyze a set of accidents in detail to identify which interface problems contributed to the accidents. The base-up analysis resulted in the identification of 125 interface problems for 26 accidents; an average of *4.8 interface problems per accident*. Interface problems were, therefore, detected between major disciplines of the aviation system. A general observation after an analysis of the accidents was that in many cases all information was available to prevent the accident, but the information was not passed on to the right person at the right time. The fact that the information that could have prevented the accident is available somewhere in the aviation system is of particular importance, because this supports the expectation that safety could be improved if interfaces are systematically analyzed and better handled. The pilot study demonstrated that interfaces problems pose a serious risk to aviation safety. It is recommended to initiate an international effort to identify and rectify interface problems within the commercial air transport system with the objective to improve safety. New approaches have to be developed to realize safety enhancements.

1.2 A follow-up study will systematically explore ways to handle interfaces in a more effective way by regulations, organization, technology and safety culture. The investigation will focus primarily on solutions and address the fundamental issues of the interface problems. In particular, attention will be given to airport, operations, training and ATC and be complementary to the work carried out in the field of aircraft certification, maintenance and (flight) operations (FAA). The follow-up study will be carried out in cooperation with the FAA and Flight Safety Foundation (FSF).

2. ICAO

2.1 Under the Chicago “Convention on civil Aviation” member states are required to provide a safe air transport service within their defined airspace.

2.2 The 11th ICAO Air Navigation Conference (October 2003) endorsed the ICAO Global ATM Operational Concept, that is based on an integrated gate-to-gate ATM concept, intended to be implemented globally over the next decade. The gate-to-gate ATM concept is considering and managing flight as a continuous event, from planning, through execution of the flight to post-flight activities.

2.3 In this context the Air Navigation Conference that recommended a unified logical framework to manage aviation safety identified the need for a new approach to aviation safety. It is foreseen that the ATM panel will address this subject. Taking an overall systems approach to safety as it is considered important to develop a requirement for safety management programme which are not confined with any single ICAO annex but holistically integrates across the various aviation disciplines, organizations etc., while remaining grounded on the “real” world and at the service of the aviation sector/industry.

3. EUROCONTROL

3.1 Safety regulations and safety management are major activities in the Organization through the Safety Regulation Commission (SRC) and the Agency.

3.2 The harmonized safety regulatory requirement ESARR 4 mandates the use of Risk Assessment and Mitigation, including hazard identification, in Air Traffic Management, when introducing and/or planning changes to the ATM System. In this requirement, Risk Assessment and Mitigation must be addressed using a Total System Approach.

3.3 The EUROCONTROL Air Navigation Systems Assessment Methodology document proposes a methodology to conduct Risk Assessment and Mitigation of ATM changes. It has recently been updated with a refined Risk Classification Scheme, and the adoption of a Total System Approach.

3.4 The High level European Action Group (AGAS) has identified priority actions in the area of implementing and overseeing Safety regulations and of safety management in the provision of ATM services. Early 2004 a Strategic Safety Action Plan (SSAP) has been approved by the EUROCONTROL Provisional Council that contains a structured approach to enhance safety by a wide range of actions. Although the ESARR's are being implemented by the ECAC States, it should be mentioned that in a number of ECAC States the safety framework (Regulator and ANSP) is not yet mature. The action plan with an ambitious time schedule is focused on areas where the greatest benefits will be gained such as:

- Human factors
- Incident and data sharing
- ACAS
- Ground based safety nets
- Runway safety
- Enforcement of ESARRs and monitoring implementation
- Awareness of safety matters
- Safety and human factors R&D: One of the action under the AGAS SSAP R&D Action area is concerned with the “development of enhanced risk assessment methods to ensure that future tools and systems can be fully assessed”. This work area will seek to develop an integrated risk picture for ATM in Europe, showing the relative safety priorities in the gate-to-gate ATM cycle. The picture for 2004 that will be the baseline against which the safety significance of the future changes to the aviation landscape will be measured is under development.

Note.— This latter R&D activity is fully coordinated with the FAA, as part of Action Plan (AP)15. Although the scope of those studies cover ATM, the interdependence nature of ATM means that the ATM risk models being developed will address aviation as a whole.

4. EU

4.1 In addition to the improvement of overall efficiency for general air traffic and to optimize capacity of the ATM system, a major objective of the Single European Sky regulatory framework is to enhance current safety standards in European airspace. Based on the EU Single Sky requirements for supervision, monitoring and impact assessment it will be necessary to further develop the overall safety assessment system at operational and technical level to be applied by the National Supervisory authority. In that respect the currently established European Aviation Safety Agency (EASA), as a supra national body, will play an important role to develop and to apply a harmonized safety assessment methodology in the European region.

5. FAA

5.1 The Certification Process Study (CPS) is an initiative by the FAA and the FSF that focuses on the interface between designs/certification and flight operation/ maintenance and identify possible safety improvements. In addition and consistently with the FAA activity as part of AP15, the FAA Technical centre is sponsoring an analysis consisting of methodology development, hazard identification, risk calculations and prioritizations, causal modelling, and simulations for the entire aviation system. The Gate-to-gate Safety Concept, initiated by the Netherlands and later on joined by the FAA and the Flight Safety Foundation, in principle focuses on the total aviation system. The Flight Safety Foundation organizes a workshop on this subject on September 21 for which representatives for all disciplines in the aviation system have been invited.

6. JAA

6.1 The JAA has launched the JAA Safety Strategy Initiative (JSSI) to develop a focused safety agenda to achieve continuous improvement of the JAA safety system. The program consists of two complementary parts:

- a historical approach based on past accident analysis; and
- a predictive approach based on an analysis of ongoing or future changes affecting aviation system and identifying associated hazards and risks.

7. CONSIDERATIONS

7.1 It seems that none of the methodologies being under study has yet effectively addressed the safety in a **gate-to-gate** context taking into account all the aspects in ATM and the **flight operation** in one single overall safety system. Major problems in aviation safety exist in some developing regions. From a safety point of view, based on a gate-to-gate context, high priority should be given to improvements in those areas. ICAO could play an important coordinating role to develop an overall safety system and the appropriate rule making to be applied at a global scale.