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ASSEMBLY — 38TH SESSION

TECHNICAL COMMISSION

Agenda Item 31: Aviation Safety — Emerging Issues

SUGGESTED MEASURES FOR LOC-I ACCIDENTS PREVENTION

(Presented by the Interstate Aviation Committee)

EXECUTIVE SUMMARY

Despite of the undertaken measures the loss of control in flight (LOC-I) accidents with transport category aircraft continue to account for the significant percentage in the world civil aviation, at this the majority of the accidents of this type end with fatalities and hull loss. Installation of the angle-of-attack indicator in the cockpit as mandatory equipment and the use of the new methods and elements in the simulator training procedures will allow decreasing the number of the accidents of this type.

Action: The Assembly is invited to consider suggestions contained in paragraph 3 of this paper and recommend that the Council carry out an analysis of possible measures required to decrease the LOC-I type accidents, including the development, if necessary, of the corresponding modifications to SARPs and ICAO guidance materials.

Strategic Objectives:	This working paper relates to the Safety Strategic Objective.
Financial implications:	It is expected that the financing of the actions suggested in this paper will be realized within the budget of ICAO programmes associated with the flight safety for 2014-2016
References:	Annex 1 — *Personnel Licensing* Annex 6 — *Operation of Aircraft* Doc 9868, PANS-TRG Doc. 9683, *Human Factor Training Manual* Doc. 9625, *Manual of Criteria for the Qualification of Flight Simulation Training Devices (English only)* State letter AN 12/11/6-13/56 dated 10 July 2013 Accident investigation reports: DHC-8-400 N200WQ (February, 12 2009), A330-203 F-GZCP (June, 1 2009), ATR72-201 VP-BYZ (April, 2 2012)

[1] English and Russian versions provided by the Interstate Aviation Committee.

(4 pages)

1. INTRODUCTION

1.1 Loss of control in flight (LOC-I) accidents continue to be one of the prevailing ones in the world civil aviation. In accordance with the International Air Transport Association (IATA) statistics for 2010-2012 this type of accidents amounts to 8 to 11 per cent of the total number of the accidents with the transport category aircraft. During the past five years, the above type of accidents has been among three major accident causes in the State-Members of the Agreement on Civil Aviation and Airspace Use. At the same time, in accordance with the statistics, more than 90 per cent of the accidents of this type end with fatalities and hull loss.

1.2 Investigations of the causes of LOC-I accidents demonstrate that most of them are related to the aircraft stall due to various reasons. Appropriate training programmes and modern full flight simulators (FFS) training as well as airborne equipment in the cockpit should assist the crew members to identify in due time the approach to a stall, to prevent a transition to the stall and, if necessary, to recover the aircraft from the stall.

1.3 At present ICAO is conducting a purposeful activity to introduce the necessary modifications into the existing documents (Annex 1 — *Personnel Licensing*, Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes* and the *Procedures for Air Navigation Services — Training* (PANS-TRG, Doc 9868), as well as to issue new documents (*Manual on Aeroplane Upset Prevention and Recovery Training* (Doc 10011)) to ensure the flight crew members training on the prevention of the aircraft upset position and the aircraft upset recovery.

2. DISCUSSION

2.1 Existing airworthiness regulations require that natural warning (buffeting) and/or artificial (annunciation) signs should exist to warn that a stall is approaching.

2.2 The experience obtained by the Interstate Aviation Committee during the investigation of accidents and incidents related to the stall demonstrates that, as usual, pilots had regular flight simulator training on the identification of the approach of the stall and on the recovery of the aircraft to the normal flight. The training provisions, envisaged by the modifications introduced into the ICAO documents (para. 1.3), are being already fulfilled in many respects during the conduct of the training. At the same time in the course of real flight pilots could not always identify the approach to the stall and/or a transition to the stall, therefore, obtained knowledge and skills on the recovery of the aircraft to the operational flight envelope had not been applied. In some cases when the pilots correctly identified a situation they, as a rule, successfully applied obtained skills on the recovery of the aircraft to the normal flight. Thus a key problem related to the preventive measures against this type of the accidents is to assist pilots to detect a situation during a real flight in due time.

2.3 To simplify the discussion the aircraft stall can be divided into two types: stall, which is preceded by the firing of the warning systems, such as aural and visual warnings, shaking of the pilot's control column, natural buffeting etc. (further – stall of the first type), and stall on the operational angles-of-attack before the firing of appropriate warnings, for example related to the decrease of the lift due to the icing (further – stall of the second type). During the stall of the second type the warning system may fire after the actual stall of the aircraft.

2.4 Presently in the course of a flight crew simulator training on the modes related to the reaching of the critical angles of attack by the aircraft are performed in accordance with the program,

which was discussed with the crew in advance and which is known to them (scenario-based training): during a horizontal flight at a sufficient altitude the airspeed is decreased up to the activation of the warning system. After that the crew performs an acceleration procedure and recovery of the aircraft to the operational flight envelope. Thus we train only skills related to the addressing of the stall of the first type.

2.5 Training mentioned in the preceding paragraph allows crew members to perfect their actions and to acquire skills of recovery of the aircraft to the normal flight after the recognition of a critical condition approach (stall). At the same time training provided in accordance with the above scenario may create a false feeling of simplicity of the recognition of a stall approach. In the real flight the stall often takes place not in accordance with the studied and usual for the pilots scenario but unexpectedly, with autopilot ON, before the activation of the appropriate warnings and often in the proximity of the ground, when the only right decision to be taken to push the control column is blocked by a psychological factor.

2.6 During the stall and after the recovery the aircraft, usually, is in an upset position. At that time pitch and bank as well as speed and acceleration could considerably exceed values usually experienced by the pilot. Apart from that as our experience with the accidents investigation demonstrates, an upset condition can be related to other factors (apart from stall).

2.7 Software of the most existing flight simulators does not allow introducing a stall at any stage of the flight unexpectedly to the crew. It is also not always possible to provide training on the recovery of the aircraft from the fully developed stall. At the same time the experience accumulated during the test flights, as well as available mathematical apparatus and technical capabilities allow duly retrofit simulators.

2.8 Nature of the stall even for one type of the aircraft could differ depending on the flight mode, aircraft configuration and on the initial conditions (rate of speed loss or the angle-of-attack growth). Ideally a pilot should be aware of all types of the stall. To simulate the stall of different types on one simulator for the particular type of the aircraft – is a difficult and sometimes not reasonable task. It is more effective to consider an idea of creating a specific simulator, which could allow to simulate all major types of stall, combining efforts and available knowledge of the scientific-research organizations of various countries as it is the case in the European program SUPRA (Simulation of Upset Recovery in Aviation).

2.9 Stall of the second type could take place, for example, under the icing or other “contaminations” of the lifting surfaces of the aircraft. As an example could be considered an accident with the ATR72-201 VP-BYZ aircraft after take-off, which took place in April 2012, when due to the icing the aircraft stalled at the operational angles-of-attack before the firing of the aural warning and stick-shaking took place. The crew did not recognize the stall and did not take actions on the recovery of the aircraft.

2.10 Analysis of the accident revealed that most probably if the situation was timely evaluated and proper actions recommended in the Flight Crew Operations Manual (FCOM) were undertaken it could have been possible to recover an aircraft. During the initial climb, in order to ensure “usual” climb rate the crew had to set the angle-of-attack 4-5 degrees higher than for a flight with the “clean” wing. At that stage of the flight increased values of the angle-of-attack were the only parameter, which could have assisted the crew to identify unambiguously in advance (before the stall) the fact of considerable decrease of the lift. The flight crew didn’t have that option because the angle-of-attack indicator was not available on board.

2.11 A possibility of controlling the angle-of-attack by the crew, with the availability of an appropriate training and procedures (checklist on different flight stages) will significantly assist in a situational awareness of the crew in various abnormal situations, such as flight of the aircraft with the non-removed ground or in-flight icing, incorrect calculation (non-awareness) of the gross weight, failure of the speed indicators etc. and prevent a transition to the stall.

3. CONCLUSION

3.1 In order to successfully solve the problems considered in this paper it is necessary to apply a complex approach, which envisages further steps in the direction of the flight simulators' and the corresponding flight personnel training programmes' modernization, as well as the installation of the angle-of-attack indicator in the cockpit.

3.2 For the purpose of realizing this approach, it is necessary to consider the need to develop further recommendations and suggestions on supplementing appropriate ICAO documents, in particular:

a) provisions of Annex 1 (taking into consideration the contents of the State letter AN 12/11/6 – 13/56 dated 10 July 2013 and comments received from the Contracting States) related to the threats' recognition and performing of actions in abnormal and emergency situations, and the appropriate procedures and guiding material in the *Procedures for Air Navigation Services — Training* (PANS-TRG, Doc 9868) and *Human Factors Training Manual* (Doc 9683);

b) provisions of Annex 6 — *Operation of Aircraft* in respect of providing angle-of-attack indicators in the commercial aviation aircraft of the established category (according to the take-off weight and the number of passengers), performing IFR flights;

c) guidance material contained in the *Manual of Criteria for the Qualification of Flight Simulators* (Doc 9625) related to the requirements to the flight simulators in respect of providing additional possibilities of an unexpected stall simulation at any stage of flight and simulation of an aircraft behaviour in a fully developed stall; and

d) modification of the requirements and recommendations on the pilot training, taking into account the implementation of the above recommendations.

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