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Theme 1: The status of aviation safety today

Topic 1.1: Worldwide and regional trends in aviation safety

THE STATE OF FLIGHT SAFETY OF THE AIRCRAFT DESIGNED AND MANUFACTURED IN THE FORMER USSR FOR THE 30 YEARS OF OPERATION

(Presented by the Interstate Aviation Committee)

SUMMARY

This information paper contains the analysis of flight safety of aircraft designed and manufactured in the former USSR for the thirty years of operation.

1. INTRODUCTION

1.1 The limited information on the accident rate, presented by the USSR Aviation Administrations to the international organizations, did not make it possible to draw any objective conclusions about the flight safety level of Soviet-manufactured civil aircraft and aeronautical equipment, which at present are mainly operated in the member States of the Agreement.

2. THE STATE OF FLIGHT SAFETY OF THE AIRCRAFT DEVELOPED AND MANUFACTURED IN THE FORMER USSR FOR THE 30 YEARS OF OPERATION

2.1 At the beginning of this analysis it should be emphasized that both the Soviet Union and later the New Independent States have been paying great attention to flight safety. The air transport

¹ English and Russian provided by IAC.

system of the member States of the Agreement, providing for the operation of civil aircraft, established in the USSR and then modified, is currently functioning and meets international requirements.

2.2 In this connection, it should be noted that the deterioration of flight safety in the member States of the Agreement was observed in the period of transition to market in the sphere of air transportations in 1992-1998. This period was marked by unprecedented reforms in all spheres of social and economic activity, including the civil aviation infrastructure.

2.3 This period of civil aviation activity in the member States of the Agreement was characterized by a significant reduction in the scope of operations. Firstly, there was a decline of passenger and cargo traffic between regional settlements and an abrupt and considerable decline of aerial work in the national economy. The scope of aircraft aerial work has constantly reduced in all member States of the Agreement in the period under review. It has dropped by 4.5 times and only since 2000 has an increase in air traffic and aerial work been observed.

2.4 Over the course of several years, the member States of the Agreement have been facing a redistribution in the volume of operations among different aircraft.

2.5 Formerly in the USSR civil aviation the share of aerial work carried out by helicopters and light aircraft on local airways and in the national economy made up about 50 per cent of the total volume of operations in civil aviation. An abrupt "collapse" in the volume of operations on these aircraft, took place beginning in 1992 and led to the double reduction of their share in the total volume of operations by the year 2000.

2.6 One more peculiarity of the transition period which had considerable influence on the functioning of the whole air transport system is a significant increase in the number of airlines. This not only caused a direct conflict of commercial interests with flight safety issues, but also generated new accident rate factors. Such developments in the economic activity of the air transport system had a negative impact on flight safety.

2.7 Beginning in 1999 to 2003 there was a tendency towards improving flight safety in civil aviation of the member States of the Agreement up to the indices in the year 2003, which were not worse than those in the period before reorganization (Figures 1-2). An abrupt increase of the relative index of fatalities in fatal accidents in the year 2001 was caused by one fatal accident of a TU-154 aircraft in the Irkutsk area on 3 July 2001, in which 145 persons were killed. The indices of the year 2004 are indicative of the absence in the steady reduction of the accident rate. In 2004 the number of aircraft accidents per 100,000 flight hours increased practically twice, from 0.75 in 2003 up to 1.47 in 2004.

2.8 A distinctive feature of aircraft operations in the member States of the Agreement is that the level of flight safety of aircraft with a take-off mass of more than 10 tonnes (1-3 class aeroplanes according to the standards of the member States of the Agreement) in non-scheduled passenger and cargo operations is considerably lower than that in scheduled operations (Figure 2).

2.9 It should be noted that in spite of the general increase in the accident rate in civil aviation of the member States of the Agreement at the time of reforms in the field of aircraft operations, the flight safety level in scheduled passenger operations practically did not change. It corresponds to the average world level.

2.10 The comparison of the flight safety level in passenger-carrying operations (scheduled and non-scheduled) in Soviet-manufactured aircraft with jet and turboprop engines and with a take-off mass

of more than 10 tonnes with the analogous foreign-manufactured aircraft showed that in the period before reorganization the average value of such generally accepted index as the number of fatal accidents per 100 000 flight hours in the USSR and other ICAO Contracting States, except for the United States, was practically the same. In the United States this index was three times better than in other ICAO Contracting States and in the USSR taken separately. After that in the course of five years it abruptly worsened from 0,034 in 1992 to 0,210 in 1997. In 1997-1998 this index reached the level of the ICAO Contracting States, and in the period 2000-2002 it again abruptly worsened. In 2003-2004 this index again reached the level of other ICAO Contracting States. Such considerable variations of the index value are caused by a relatively short total flying time of the aircraft fleet of the member States of the Agreement. One or two occurrences lead to abrupt index changes. Today annual flying time of the fleet of aircraft under review in the member States of the Agreement is approximately ten times less than the flying time of the aircraft fleet of other ICAO Contracting States.

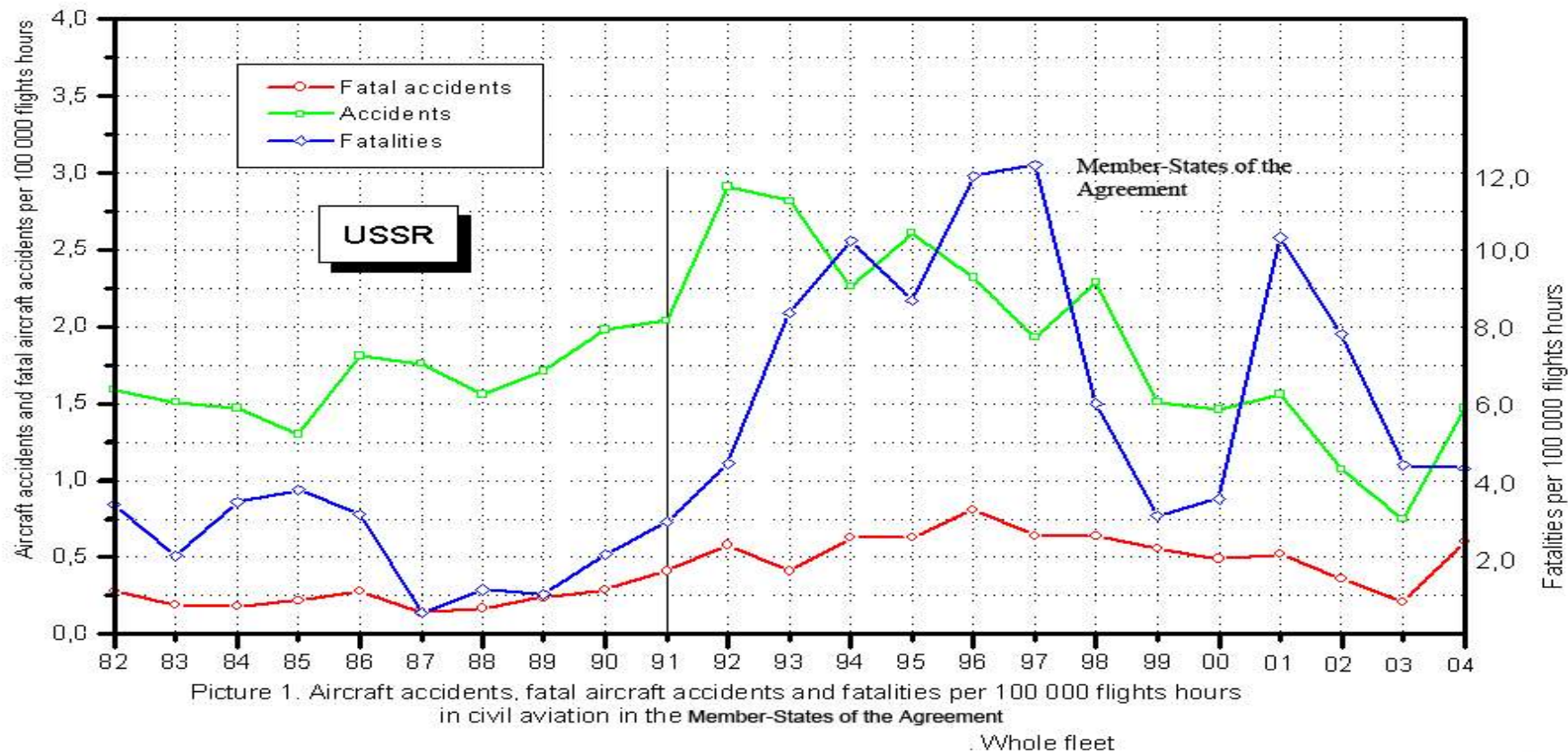
2.11 In ICAO Contracting States, mainly United States-manufactured aircraft as well as Airbus aircraft are being operated, but the flight safety level of the same aircraft types of different aircraft operators is sometimes very much different. This depends upon the country's economic condition, difference in the approaches of the Aviation Administrations and airlines to meet national and international flight safety requirements and the amount of means invested in the preparation of aircraft and equipment for flights, flight and ground personnel training, equipment of aerodromes with air traffic management (ATM) and air traffic control (ATC) facilities.

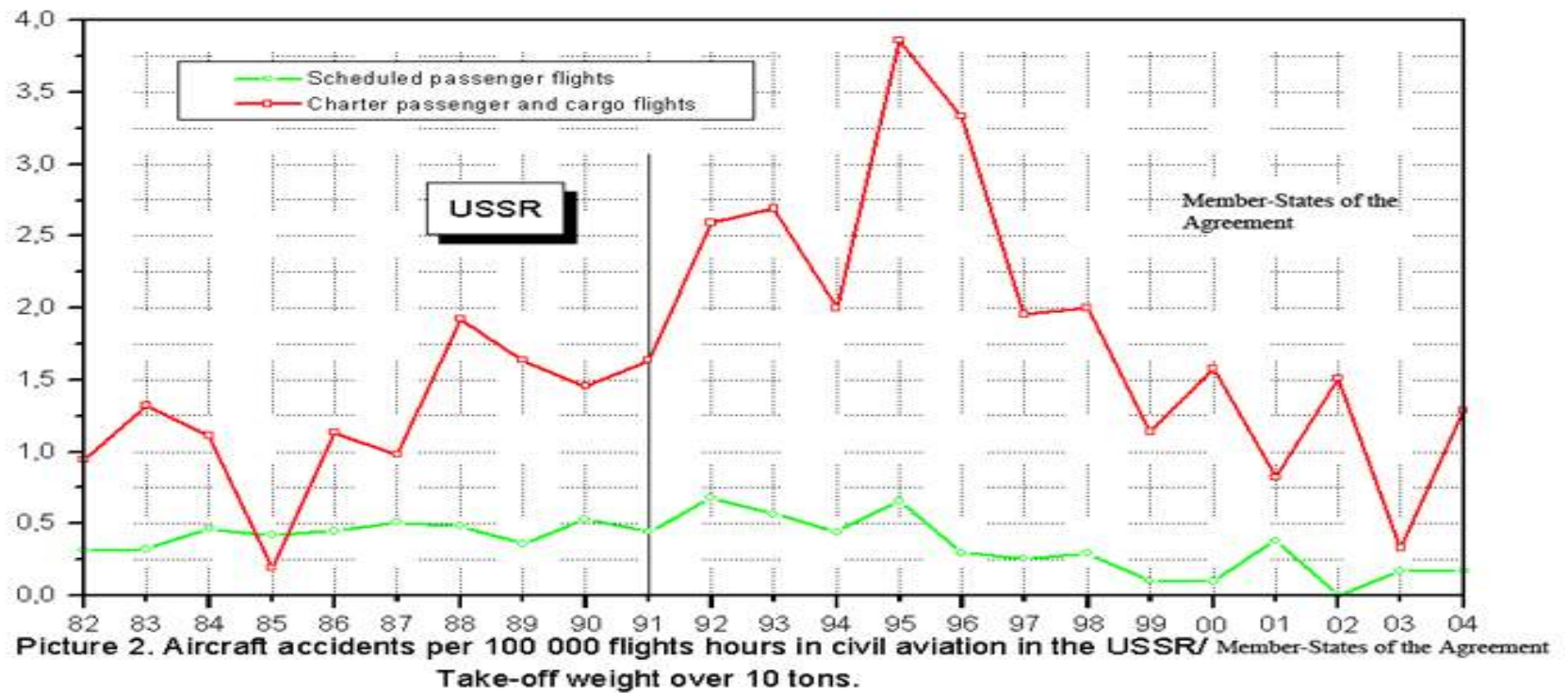
2.12 After the review of the general assessment of the accident rate in the member-States of the Agreement let us go on to the comparison of flight safety of different aircraft types.

2.13 We will try to make an objective (based on operational data) comparative assessment of flight safety of the major similar types of Soviet-built and foreign-built jet and turboprop planes. For these purposes we have selected civil aviation aircraft operated longer than 30 years, i.e. aircraft of the same generation, type of capacity and range.

2.14 The trustworthy comparison of domestic and foreign aircraft flight safety in the field of accidents is difficult to achieve since these events are categorized differently. Often the limited information on the events in question is not sufficient to assess the extent of the aircraft damage, which in turn would not allow us to define an event as an accident or an incident. That is why for the purposes of comparison we have selected fatal accidents only when at least one person was killed on board an aircraft.

2.15 Now let us compare flight safety of different types of aircraft based on a relative number of fatal accidents.





2.16 At present, there are more than ten types of wide-body planes worldwide (about 3 200) produced by Airbus Industrie, Boeing, Lockheed Martin and Ilyushin. With planes IL-86, operated since 1980 there was one fatal accident in 2002 without passengers when ferrying the empty plane from Sheremetievo Airport to Pulkovo Airport (14 crewmembers were killed). There were no fatal accidents in passenger-carrying operations involving a wide-body IL-86, for all periods of operation.

2.17 From the beginning of passenger operations up to 2004 there were 34 fatal accidents on B-747 Classic DC-10, L-1011, A300B2/B4 which are analogous to IL-86. At that time, the average ratio of this figure for fatal accidents per 100 000 flight hours was 0,034 (see Figure 3).

2.18 The IL-62, IL-62M long-range narrow-body aircraft safety level in comparison with similar Western products DC-8, B-707, for a total period of operation is the same as a DC-8 and a little better than a B-707 (see Figure 4).

2.19 The level of flight safety of the middle-range Tu-154, Tu-154M planes and short-range TU-134, YAK-40 for the total period of their operation is not worse than their like of foreign made. The Fokker F-28 and BAC-1-11 safety level is inferior to USSR/CIS built planes (see Figure 4). The B-727 plane is the best in the world on flight safety in a group of narrow-body first and second generation planes and its safety level is close to the high standards of fourth generation wide-body planes. At the same time it should be noted that presently the fleet of all B-727 models has a total flight hours substantially more than the rest of the types of narrow-body jets – more than 100 000 000.

2.20 Comparison of the safety level of most popular domestic AN-24 turboprop planes in the USSR and in the member States of the Agreement with similar Fokker F-27 has proved that its record is better than the F-27 by 2,6 times (see Figure 4).

2.21 *Thus, the level of flight safety of most Soviet-made types of aircraft is not worse than the level of Western analogues.*

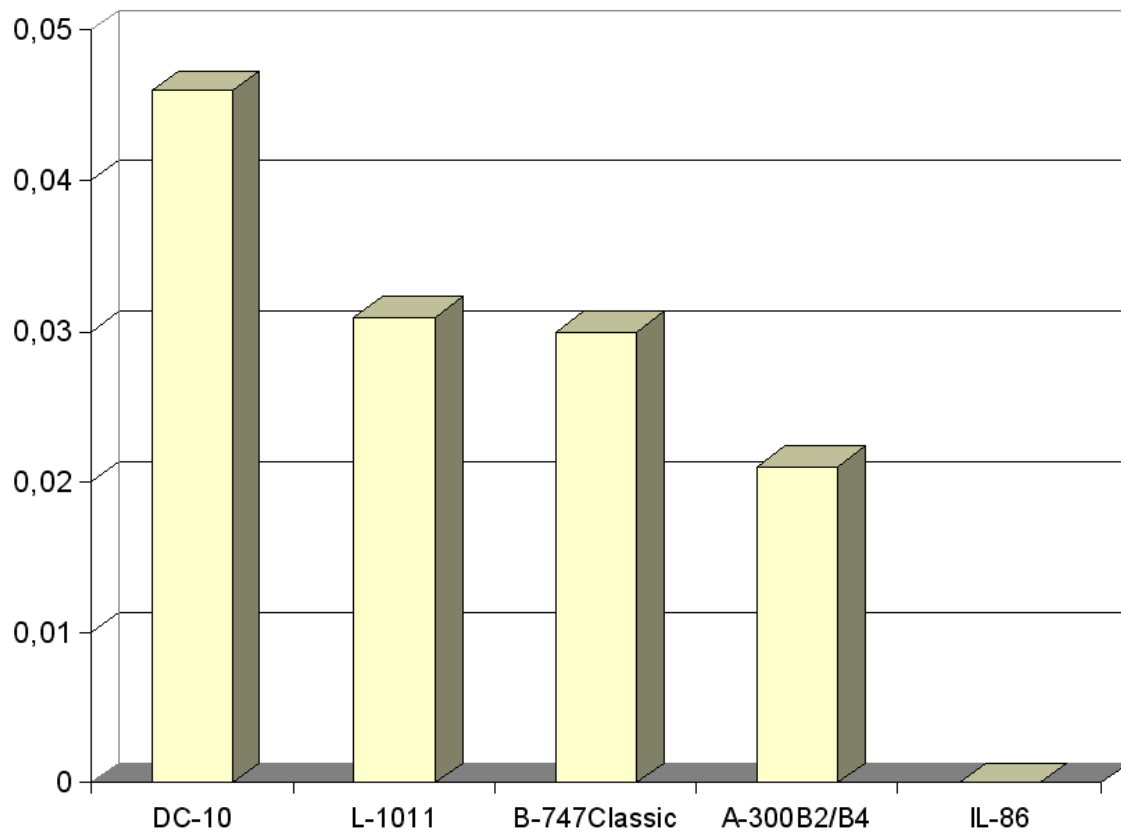


Figure 3. Accidents caused by different reasons on one generation wide-body passenger planes per 100,000 flight hours from the beginning of their service world-wide

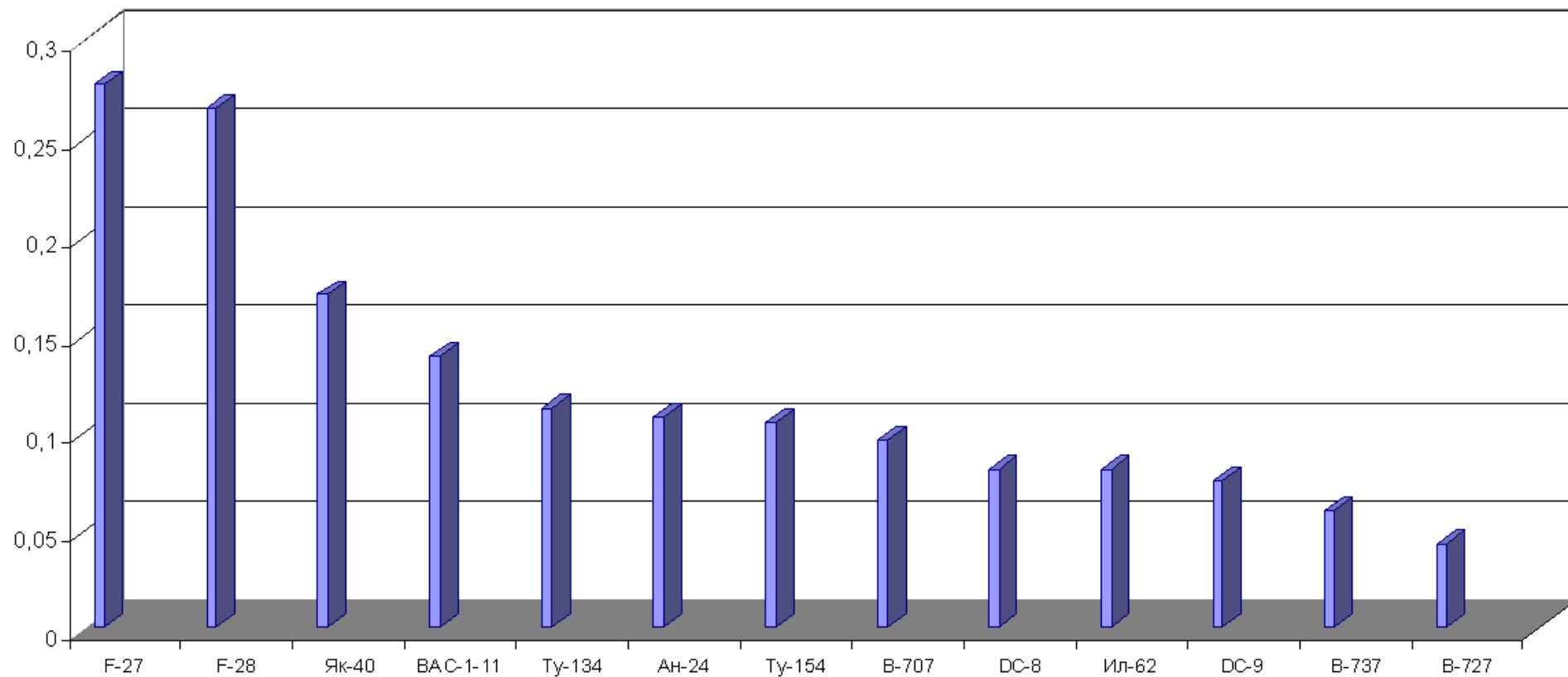


Figure 4. Accidents caused by different reasons on 1st and 2nd generation presently in service world-wide narrow-body jet and turboprop passenger planes per 100,000 flight hours

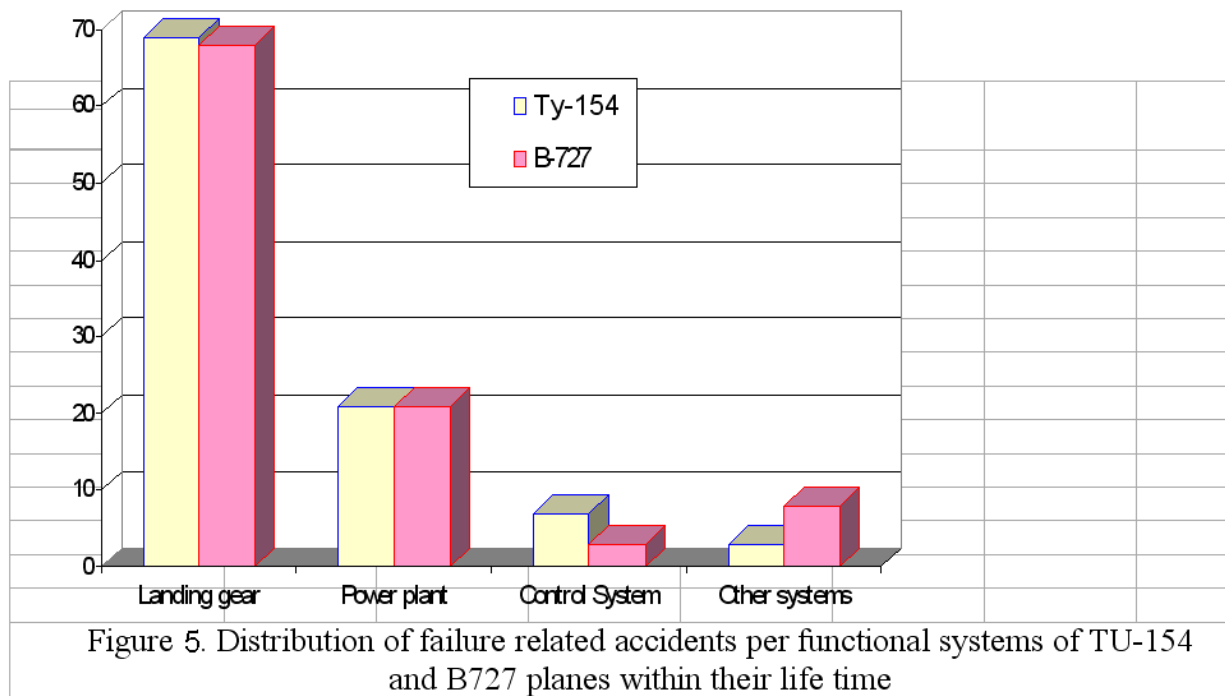
2.22 It is important to note that the distribution of Soviet-made and Western passenger jet and turboprop accident cases mainly coincide. More than 70 per cent of fatal accidents are related to human factors.

2.23 The causes of systems failures are practically the same. Table 1 shows that most aviation accidents connected with failures of functional systems for the whole period of operation of one of the most wide-spread jets TU-154, happened as a result of two operational systems malfunctioning in particular: landing-gear (in twenty cases) and engine (in six cases). These two systems failures were the cause of 90 per cent of accidents of technical failures. On the B-727s which is analogue to TU-154, there were fifty-six accidents connected with landing-gear failures and 17 accidents connected with engine failure, amounting to 91% of all technical related failures. Types of functional system failures on TU-154 and their influence on flight safety are practically the same as on B-727 (see Table 1). The percentage of functional systems failures in accidents with TU-154 and B-727 also coincides (see Figure 5).

Table 1

Distribution of accidents caused by equipment failure on TU-154 and B727 per functional systems and types of failures since the beginning of operation till 2004

System	Type of system failures	B727	Tu-154
Landing-gear	Non-deployment	43	15
	Folding	10	4
	Tire burst	3	0
	Nose wheel control failure	0	1
All failures within the system		56	20
Power plant	Uncontained engine failure	13	5
	Engine starter failure	0	1
	In flight shut down	2	0
	Engine separation from aircraft	2	0
All failures within the system		17	6
Control system	Jamming of flaps	0	2
	Jamming of slats	2	0
All failures within the system		2	2
Other systems		5	1
Total failures within A/C systems		80	29



2.24 The TU-154 main accidents were non-deployment of one of the landing-gear on approach stage causing considerable damage to the aircraft when the aircraft wings touched the surface during rolling (in fifteen cases). Besides that, the TU-154 period of operation in question four aviation accidents took place due to landing-gear folding. As to B-727 forty-three aviation accidents took place due to non-deployment one of landing-gear and ten due to landing-gear folding during rolling.

2.25 The TU-154 aviation accidents, resulted from engine failure, were not caused by localized destruction of engine and engine systems. During the TU-154 period of operation six aviation accidents took place due to destruction of engine components as to B-727, - 13 similar cases took place.

2.26 Not localized destructions created dangerous malfunctions of other functional systems and forces which created emergency situations.

2.27 The ratio of failure grounds on other types of aircraft is roughly the same. The reasons of failures of Soviet made aircraft and foreign-made aircraft practically coincide. The statistical data of aviation accidents connected with TU-154, TU-134, Boeing-727, Boeing-737, DC-9, BAC-1-11 and F-28 systems failures are identical.

2.28 This situation may be explained by the fact that the contemporary level of aviation science and technology is not good enough to manufacture absolutely reliable technical systems. New aircraft design is being carried out on the basis of failure-proof methods when a safe completion of flight with failed system becomes possible because of using back-up and becomes possible because of using back-up and stand-by systems. Aviation creation methods have no differences in principle.

2.29 As experience was gained, shortcomings of aviation technics and technology were eradicated, the requirements connected with airworthiness, air and ground personnel training were improved. The steady aviation transport systems, ensuring a rather high level of flight safety, were

created. At the initial period of civil aircraft operation within approximately 20 years the aviation technique was created and developed.

2.30 As aviation technique improved, the rate of technique accidents decreased from 40 per cent to 15 per cent but the rate of human factor accidents increased from 50% to 80%.

3. **CONCLUSION**

3.1 The Conference is invited to note the average indications of Soviet-manufactured civil aircraft and turboprops flight safety were and remain not worse than the Western manufactured planes.

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