

Accident and Incident Investigation In Soviet Practice

A two-pronged safety effort combines the investigation of both accidents and incidents to spread the data base and increase the potential for preventing future accidents.

Note: This article was prepared for FSF by the State Supervisory Commission for Flight Safety, Council of Ministers, U.S.S.R., (GOSAVIANADZOR) prior to changes that instituted commonwealth status for Russia and other Soviet republics.

One of the benefits that resulted from perestroika and glasnost was a relaxation of the government-imposed secrecy that had shrouded details of domestic U.S.S.R. aviation information and inhibited the benefits of shared safety data. The State Supervisory Commission for Flight Safety, Council of Ministers, U.S.S.R. (GOSAVIANADZOR) and Flight Safety Foundation-U.S.S.R. (FSF-USSR) were formed under the new open atmosphere and are sharing the benefits of two-way communication of aviation safety data with other nations.

The new information exchange has been reflected by the Flight Safety Foundation through publication in the Flight Safety Digest of: "U.S.S.R. Safety Information," (Statistics - March 1991); "Use of Flight Data Recorders to Prevent Accidents in the U.S.S.R.," (April 1991); and "U.S.S.R. Civil Aviation Flight Safety Analysis for 1990" (Statistics — July 1991). The following article highlights how preventive information is acquired not only from accidents, but from incidents as well.

Accident Investigation in Civil Aviation

The State Supervisory Commission for Flight Safety under the Council of Ministers of the U.S.S.R. (GOSAVIANADZOR) was established by the Council of Ministers in 1987. This independent government agency is charged with promoting aviation safety and preventing aviation accidents in the U.S.S.R.

GOSAVIANADZOR is authorized to supervise, on the governmental level, strict adherence by all ministries and other bodies, agencies and organizations of the U.S.S.R.:

- to standards of flying, air traffic control (ATC) operation and maintenance, airport operations, personnel training, accident and incident investigation; and,
- to airworthiness and airport worthiness requirements.

GOSAVIANADZOR can also supervise the process of developing and implementing preventive measures by ministries, other government bodies, agencies and organizations.

The commission investigates accidents in the U.S.S.R. involving Soviet airplanes with maximum takeoff weight of more than 30 metric tons (66,000 lb.) and helicopters that weigh more than 10 metric tons (22,000 lb.), plus all foreign aircraft that are involved in accidents in the U.S.S.R. GOSAVIANADZOR participates, in compliance with Annex 13 of the Chicago Convention, in the investigation of accidents involving Soviet aircraft in the territories of foreign states¹. It also supervises, on the governmental level, the creation and implementation of technical aspects of search and rescue of aircraft, their passengers and crews.

The commission also can issue airworthiness type certificates and operational certificates for airports to meet the operational weather minimums for International Civil Aviation Organization (ICAO) Categories I, II and III landings.

In order to carry out its functions, GOSAVIANADZOR has three structural divisions.

The first division is the State Aviation Register of the U.S.S.R., which issues airworthiness certificates for aircraft, aerodromes and their equipment. It also supervises determination of airworthiness of aircraft and operational acceptability of airports.

Airworthiness standards development in the U.S.S.R. has a history of more than 60 years. Current documentation includes the third edition of airworthiness standards for civil fixed-wing aircraft and the second edition of airworthiness standards for helicopters. Standards have also been established for airports and their equipment.

The Soviet standards fully correspond to ICAO requirements and in some cases exceed their minimum standards and those of U.S. Federal Aviation Regulations (FARs) and Joint Airworthiness Regulations (JARs).

The U.S.S.R. standards specify:

- classification of hazards;
- quantitative characteristics for assessing the probability of such hazards; and,
- requirements for expected operational conditions.

Standard methods of assessing compliance with regulations are set forth for all sections of the airworthiness regulations.

The second division of GOSAVIANADZOR incorporates State Aviation Inspection, a function that supervises strict adherence to flight and operational procedures and to ATC and flight support standards by all the ministries and other governmental bodies that operate civil aircraft.

Functions of investigation of civil aircraft accidents rest with a third division, the Department of Accident Investigation and Prevention, and a scientific research laboratory that has the means and methods to investigate accidents.

The laboratory participates in accident investigations, carries out independent research and tests, and submits its final results to the commission. Using flight data recorder (FDR) and cockpit voice recorder (CVR) data, the laboratory models the flight characteristics of aircraft, analyzes crews' actions in emergency situations, and works out and implements new methods of flight dynamics analysis and corresponding mathematical models.

Accident and incident investigation is regulated by the *Aircraft Accident Investigation Manual*, mandatory for every level of investigation. The latest edition of the manual was adopted in 1989.

This manual includes:

- general issues, classification and definitions;
- order and organization of accident investigation;

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- order and organization of incident investigation; and,
- order of implementing recommendations and measures based on the results of accident investigation.

The principle goal of accident investigation is prevention of similar accidents in the future. The standard establishes that accident investigation should not exceed 30 days. When there is a need for special time-consuming research or tests, this period may be extended by the highest officials of GOSAVIANADZOR.

When an accident occurs, a commission is assigned to investigate it, and consists of its chairman who is the investigator-in-charge (IIC), his deputy and members. If the investigation commission considers it necessary, experts may also be invited to participate. Commissions investigating accidents with light airplanes and helicopters on behalf of ministries and other governmental bodies, include experts possessing special knowledge in these areas. They also must have experience in the field of accident investigation and have no direct involvement with these accidents.

The standard determines the procedure of reporting aircraft accidents, as well as the initial actions of aviation officials before the investigation commission arrives on the accident scene. After the investigation commission arrives, subcommissions in the main directions of the work are usually formed — flight, engineering and administrative. If the IIC considers it necessary, he may form other subcommissions. The subcommissions usually are comprised of working groups.

The list of members of the subcommission and working groups and plans of their work are approved by the chairmen of the subcommissions. The major methodological and organizational decisions on the investigation are made by the IIC with the advice of the members of

the commission. After their work is complete, the working groups make reports that are reviewed and discussed at the meetings of subcommissions. These reports are used as a basis for the subcommissions' reports which are then reviewed at the meetings of the commission.

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Based on the results of the investigation, the commission prepares a formal accident report (the act) plus a special report for computerized recording, the form of which is based upon the ICAO Aircraft Accident/Incident Reporting System (ADREP) system. The date of the act approval, by senior officials of GOSAVIANADZOR or of ministries of other governmental bodies which assigned a commis-

sion to investigate an accident with a light airplane or a helicopter, is considered the date of the investigation termination.

The standard determines the rights and duties of the IIC, his deputy, members of the commission and experts. According to the standard, subcommissions carry out the following:

- The flight subcommission establishes the correlation between the accident and the professionalism of the crew members, the quality of operation procedures, ATC and flight support. It takes into consideration the influence of the aircraft structure, environmental and human factors. It also assesses the actions taken by the crew members and authorities during the emergency.
- The engineering subcommission examines the condition of the aircraft, the nature of its operation and the quality of maintenance. It identifies possible structural and production deficiencies and, if necessary, organizes special tests in order to find the correlation between the accident and the condition of the aircraft.
- The administrative subcommission evaluates the search and rescue operations,

determines the aircraft payload, its distribution and attachment, identifies deviations from weight and balance standards, renders help to the injured persons and their relatives and meets their claims, clears the accident site and evaluates losses.

The methodological basis for accident investigation in the U.S.S.R. includes the following publications: *Methodological Guide for Accident Investigation*, adopted in 1977; *Medical Aircraft Investigation Manual* of 1986; and *Methodological Guide for Analysis of Deviation in Aviation System During Accident and Incident Investigation* of 1987. In addition, *Principles of Modelling and Evaluation of Flight Dynamics During Accident Investigation* and *Principles of Studying Human Factors in Accident Investigation* are also used.

Introduction of new aircraft, new airport equipment, improved and broader use of data recorders and greater emphasis on human factors considerations during accident investigations resulted in the need to update the *Methodological Guide for Accident Investigation*. Some principal changes also were made to the *Aircraft Accident Investigation Manual*, that became effective in 1989.

The main distinctions of the new edition of the *Aircraft Accident Investigation Manual* compared to the previous (1988) edition include a change in the classification of aircraft accidents. The definition of aircraft accidents was brought close to that of the ICAO definition. In the new edition, practically all the cases previously classified as emergency events, are now considered accidents. This reduces the possibility of misunderstanding. The borderline between accidents and incidents has been more clearly defined.

The latest edition of the manual includes a new approach to classification and analysis of the occurrences not classified as accidents. Accident investigation procedures have been changed in the following way:

- The IIC's rights have been broadened.
- A more democratic approach to considering the options of the parties participating in the investigation is guaranteed.
- More flexible organizational methods of investigation have been established in everything concerning the membership in the investigation commission.

The procedures for developing new measures based upon the results of accident investigation as one of the main preventive methods have become more thorough. Terms and responsibilities for developing such measures are outlined in the new manual. Records of recommendations and monitoring the development of measures will be computerized.

For the first time, a new inter-agency system of incident investigation and analysis was established for the purpose of developing and implementing preventive measures. Operators and manufacturers will consider the results of all incident investigations.

One of the major tasks of the manual is the standardization with ICAO requirements of classification, methods of accidents investigation and prevention. However, some national features remain.

ICAO Annex 13 and the manual have different areas of application. Annex 13 determines the procedures of investigation of an accident involving an aircraft of one member state in the territory of another member state. It establishes the order of cooperation between these states as well as between the state of manufacture and the state whose interests may be undermined by this accident. The manual is a purely intrastate document and considers only investigations of accidents with Soviet civil aircraft in the U.S.S.R.. The manual deals only with the problems of cooperation with the state of manufacture.

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Nevertheless, considering the Annex 13 recommendation concerning possible standardization of national and international investigation procedures, reviewing differences between them is justified. The essence of these differences can be summarized in three categories.

First, according to Annex 13, the criterion of an accident is the presence on board the aircraft of crew members or passengers. According to the manual, the criterion of the accident is the presence on board the aircraft of any person intending to make a flight, regardless of his being a member of the crew or a passenger or some other person. Such a distinction is justified by the notion that "passenger" and "crew member" in the U.S.S.R. has a clear legal definition; it is either a person with a ticket or one who is included in a special passenger list (passenger), or a person authorized to carry out the flight (a crew member). In this regard, all those on board the aircraft who have no necessary permission, are not considered either passengers, or crew members. At the same time, in terms of consequences of an accident, such persons are treated equally with passengers and crew members. The definition used in the manual allows classification of an aviation accident, the case of aircraft capture, hijacking and unwarranted takeoff resulting in serious consequences. This is impossible under the ICAO definition.

Second, Annex 13 regards as a criterion of an accident serious injuries of persons outside the aircraft. The manual disregards such cases unless they result in substantial consequences

for the aircraft and the people on board. This approach is justified by the fact that these people, having nothing to do with the given flight, should not be considered as a threat to flight safety and, accordingly, the occurrence of their injuries should not be classified as an aircraft accident. Such cases, if they are of no danger to the safe operation of the aircraft, should be considered an unhappy event rather than an aircraft accident. Currently, however, this item of the manual is being revised and is expected to be brought into full compliance with the ICAO standards.

Third, Annex 13 also regards serious injuries as a criterion of an aviation accident. The manual classifies an occurrence as an accident only in case of fatal injuries. This approach is determined by the occurrences with serious injuries to people on board the aircraft without heavy consequences for the aircraft itself. As a rule, these cases are connected with the carelessness of the injured person himself.

The training of civil aviation accident investigators is accomplished at the Leningrad Civil Aviation Academy. The instructors are teachers and professors of the Academy and specialists of GOSAVIANADZOR, as well as of scientific and research organization of ministries and other governmental bodies. In the course of training, students learn practical skills in accident investigation and in decoding and analyzing data recorder information. They are also taught to organize and use a flying laboratory that is based aboard an An-12 airplane, work out recommendations and prepare the necessary documentation.

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Incident Investigation in Civil Aviation

Accident prevention through identifying and eliminating deficiencies in the aviation system is the cornerstone of flight safety in the U.S.S.R. This premise, which has been real-

ized by aviation organizations worldwide, is fully recognized by the Soviet civil aviation authorities, including GOSAVIANADZOR. In addition, the experience gained by

GOSAVIANADZOR and other civil aviation authorities of the U.S.S.R. has brought to the forefront that primary emphasis on accident investigation in the search to identify deficiencies is an expensive learning process in terms of the grave social and material consequences of these accidents.

While analyzing the factors of accidents, the U.S.S.R. has recognized that great human and material losses are the result of a combination of factors, although each one looked at separately may seem innocuous from the point of view of potential consequences. This is precisely why the concept of accident prevention based on early identification and detection of deficiencies through the investigation of incidents has gained broad recognition.

The term "incident" has been used in Soviet civil aviation for a long time. However, it sometimes has entailed interpretations that were at variance with the description accepted by ICAO. Today, though, the U.S.S.R. interpretation of an incident is in line with that adopted by ICAO. An incident denotes a deviation from the proper functioning of the aircraft, crew, ATC or maintenance service which has not caused an accident, but at the same time posed a potential threat to flight safety. Under a different set of circumstances, it could result in an accident.

Incident investigation in the U.S.S.R. is mandatory. In order to avoid misunderstanding in the classification of incidents, and bearing in mind that there is some ambiguity in the interpretation of what should be classified as an incident, a list has been prepared that indicates 30 specific incidents that are to be investigated. A concept is employed in which as many incidents as possible are registered and investigated. This provides the operator and the manufacturer with the maximum amount of information available on the identified deficiencies.

However, the U.S.S.R. is aware that not all the deviations have the same impact on safety and,

therefore, must be treated differently according to the degree of danger they pose. If a detected deficiency belongs to a high-risk area and could lead to an accident, it receives immediate attention and widespread corrective action. But if it proves to be less of a danger and poses no direct threat to flight safety, such as an unretracted gear after takeoff, decisions on the time and procedures required to eliminate this deficiency and the necessity to take action on it would be made based upon economic expediency.

All of the work on incidents can be divided into two stages. The first stage is the investigation proper. According to the Soviet system, incidents are usually investigated by the operators — by the civil aviation units that are directly involved. Such an order, an obvious departure from the principle of impartiality, is necessary because the corresponding government authorities are physically unable to investigate all the incidents. On a yearly basis, the number of incidents covered under the accepted official investigation list alone runs into several thousand a year. This high number of investigated incidents stems from the principle that stresses "more information for accident prevention."

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In order to neutralize any possible partiality of the operator in the investigation of technical malfunctions, the rules require a mandatory participation by the manufacturer or a team from the repair or maintenance facility. The investigations are supervised by GOSAVIANADZOR and central bodies of the Ministry of Civil Aviation.

Incidents generally are investigated with the same principles and in the same order as accidents except for some simplification of the procedures. Another difference is that the incident investigation report, prepared by the investigation team, is not final and is subject to approval by the General Inspectorate on Flight Safety of the U.S.S.R. Ministry of Civil Aviation with consent from GOSAVIANADZOR.

The principle goal of the first stage is to gather factual information that would be used during the second stage — analysis and implementation of preventive measures. The second stage categorizes the data, screens out deficiencies and produces general recommendations to direct the preventive measures.

The main problem at this stage is to provide an adequate assessment of the incident's degree of danger. To solve this problem, a situational approach is employed that singles out four levels of danger of any given situation:

- adverse flight condition;
- hazardous situation;
- emergency situation; or,
- catastrophic situation.

Incidents characterized by situations from hazardous down the list to catastrophic are considered serious. These categories of incidents receive priority in planning the preventive steps.

Incidents are analyzed by a special group of experts, mostly representing scientific and research bodies of the operator and manufacturer. Any decision on the necessity and the nature of preventive actions is made by the operator and the manufacturer within their competence.

Implementation of this system has been complicated by a few facts which were basically associated with two problems. The first problem is maintenance of a high quality of investigation by the operator. In general, incident investigation is a function that is not typical for an operator, at least on the level of regional units. First, because it is rather specific and requires the participation of well-trained experts who may not be available, and second, because incidents are so unpredictable and frequent, their investigation distracts the operator from his direct duties.

In this respect, it is not easy to convince the operator of the need to investigate as many incidents as possible. It is even more difficult to convince the operator to launch a comprehensive and objective investigation. Since the U.S.S.R. firmly believes in the necessity of thorough incident investigation, one of the primary solutions of this problem is the creation of special regional bodies for incident investigations. These bodies would act independently of the operator.

The second problem is purely methodological and involves complex issues such as providing adequate evaluation of the level of danger of the given incident and determining the effectiveness of the elimination of identified deficiencies.

Complexity of the problem is based on the absence of common formal methods of conducting analysis. Today, it is being solved to a certain extent subjectively, using the method of expert evaluation. This problem might be solved by working out scientifically substantiated methods of conducting situational analysis. This is what the U.S.S.R. is doing now, and the results that have been achieved signal that in the near future the problem will be solved.

These are, in general terms, the basic concepts adopted in the U.S.S.R. on the use of incident-related information for accident prevention. It is hoped that their broad implementation will produce a higher level of early accident prevention and make it easier to optimize the measures aimed at the elimination of the identified deficiencies. ♦

Reference

1. "Statute of the State Supervisory Commission for Flight Safety Under the Council of Ministers of the U.S.S.R.," State Supervisory Commission for Flight Safety Under the Council of Ministers (GOSAVIANADZOR). Photocopies of this nine-page statute are available by request from the Flight Safety Foundation.

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