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MATS

CHAPTER 13

ATS SAFETY MANAGEMENT

International and Local Procedures
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CHAPTER 13
ATS SAFETY MANAGEMENT

13.1 GENERAL

13.1.1 While aviation accidents caused by shortcomings in ATS are rare, the consequences of such accidents are potentially disastrous. Safety in ATS requires a systematic approach to safety management, and current ATS systems provide multilayered defenses through such things as:

a) rigid selection criteria and training for controllers;

b) clearly defined performance standards, e.g. separation criteria;

c) strict adherence to proven Safety Operations;

d) significant international cooperation;

e) utilization of technological advances; and

f) ongoing system of evaluation, monitoring and improvement.

13.1.2 Keeping aircraft safely separated while expediting the flow of traffic in a highly dynamic situation presents unique challenges. Controller workload, traffic density and complexity increasingly pose significant risks to aviation. The frequency of air proximities, near mid-air collisions, runway incursions, technical losses of required separation, etc. are indicative of the continuing accident potential in the provision of ATS.

13.1.3 As traffic volumes and complexity continue to increase, ATS supervisors, investigators of ATS occurrences and safety managers will be required to learn more about the effects of human performance on the actions of ATS personnel. (Appendix "J" to this manual lists some of the more common Human Factors issues potentially affecting human performance in the provision of ATS.)

Note. See Appendix "J" human factors issues affecting human performance in Air Traffic Services .

13.1.4 States shall ensure that the level of Air Traffic Services (ATS) and communications, navigation and surveillance, as well as the ATS procedures applicable to the airspace or aerodrome concerned, are appropriate and adequate for maintaining an acceptable level of safety in the provision of ATS.

13.1.5 The requirements in respect of services, systems and procedures applicable to airspaces and aerodromes should be established on the basis of regional air navigation agreement in order to facilitate the harmonization of ATS in adjacent airspaces.

13.1.6 To ensure that the safety in the provision of ATS is maintained, the appropriate ATS authority shall implement formal and systematic safety management programmes for the air traffic services under its jurisdiction. Where appropriate, ATS safety management programmes should be established on the basis of a regional air navigation agreement.

13.2 OBJECTIVES OF ATS SAFETY MANAGEMENT

The objectives of ATS safety management are to ensure that :

a. the established level of safety applicable to the provision of ATS within an airspace or at an aerodrome is met; and

b. safety – related enhancements are implemented whenever necessary.

13.3 ICAO REQUIRMENTS

13.3.1 Annex 11 — Air Traffic Services requires that ATS providers implement an accepted SMS to ensure safety in the provision of ATS. Such an SMS shall ensure that actual and potential safety hazards can be identified, necessary remedial actions implemented and that continued monitoring ensures that an acceptable level of safety is being achieved.

13.3.2 The Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) provides guidance for safety management in ATS.

13.4 ATS SAFETY MANAGEMENT ACTIVITIES

13.4.1 An ATS SMS should include, *inter alia*, the following with respect to the provision of air traffic services:

a. monitoring of overall safety levels and detection of any adverse trends, including:

1. collection and evaluation of safety-related data; and

2. review of incident and other safety-related reports;

b. safety reviews of ATS units, including:

1. regulatory issues;

2. operational and technical issues; and

3. licensing and training issues;

c. safety assessments in respect of the planned implementation of airspace reorganization, the introduction of new equipment, systems or facilities, and new or changed ATS procedures; and

d. a mechanisms for identifying the need for safety - enhancing measures.

13.4.2 All activities undertaken in an ATS SMS shall be fully documented. All documentation shall be retained for such period of time as is specified by the appropriate authority.

13.5 MONITORING OF SAFETY LEVELS

13.5.1 Collection And Evaluation Of Safety – Related Data

13.5.1.1 Data for use in safety monitoring programmes should be collected from as wide a range of sources as possible, as the safety-related consequences of particular procedures or systems may not be realized until after an incident has occurred.

13.5.1.2 The appropriate ATS authority should establish a formal incident reporting system for ATS personnel to facilitate the collection of information on actual or potential safety hazards or deficiencies related to the provision of ATS, including route structures, procedures, communications, navigation and surveillance systems and safety significant systems and equipment as well as controller work loads.

Note. Guidance related to both mandatory and voluntary State incident reporting systems is contained in the Safety Management Manual (SMM) (*Doc 9859*).

13.6 INCIDENT REPORTING SYSTEMS

13.6.1 As part of an ATS SMS, a confidential voluntary incident reporting system provides one of the best tools for hazard identification. Doc 4444 requires a formal incident reporting system for ATS personnel to facilitate the collection of information on actual or potential safety hazards or deficiencies related to the provision of ATS.

13.6.2 In addition to mandatory State requirements for reporting accidents and incidents, the ATS organization may define the types of hazards, events or occurrences with risk potential that staff are expected to report. An effective reporting system makes provision for the voluntary reporting of any situation or condition that an employee believes poses accident potential in a blame-free, non-punitive environment.

Note. Fore details see Appendix "I" to this manual.

13.6.3 Review of incident and other safety related reports

13.6.3.1 Safety related reports concerning the operation of Air Traffic Services, including air traffic incident reports, shall be systematically reviewed by the appropriate ATS authority in order to detect any adverse trend in the number and types of incidents which occur.

13.6.3.2 Reports concerning the serviceability of ATS facilities and systems, such as failures and degradation of communications, surveillance and other safety significant systems and equipment, shall be systematically reviewed by the appropriate ATS authority in order to detect trend any in the operation of such systems which may have an adverse effect on safety.

13.7 SAFETY REVIEWS

13.7.1 General requirements

13.7.1.1 Safety reviews of ATS units shall be conducted on a regular and systematic basis by personnel qualified through training, experience and expertise and having full understanding of relevant Standards and Recommended Practices (SARPs), Procedures for Air Navigation Services (PANS), safe operating practices and Human Factors principles.

13.7.2 Scope

13.7.2.1 The scope of ATS unit safety reviews should include at least the following issues :

13.7.2.1.1 ***Regulatory issues to ensure that :***

a. ATS operations manuals, ATS unit instructions and air traffic control (ATC) coordination procedures are complete, concise, and up – to – date.

b. The ATS route structure, where applicable, provides for :

1. adequate route spacing; and

2. **crossing points for ATS routes located so as to reduce the need for controller intervention and for inter – and intra – unit coordination.**

c. **The separation minimum used in the airspace or at the aerodrome are appropriate and all the provisions applicable to those minima are being complied with;**

d. **Where applicable, provision is made for adequate observation of the manoeuvring area, and procedures and measures aimed at minimizing the potential for inadvertent runway incursions are in place. This observation may be performed visually or by means of an ATS surveillance system;**

e. **Appropriate procedures for low visibility aerodrome operations are in place;**

f. **Traffic volumes and associated controller workloads do not exceed defined, safe levels and that procedures are in place for regulating traffic volumes whenever necessary.**

g. **Procedures to be applied in the event of failures or degradations of ATS systems, including communications, navigation and surveillance systems, are practicable and will provide for an acceptable level of safety; and**

h. **Procedures for the reporting of incidents and other safety-related occurrences are implemented, that the reporting of incidents is encouraged and that such reports are reviewed to identify the need for any remedial action.**

13.7.2.1.2 ***Operational and technical issues to ensure that:***

a. **the environmental working conditions meet established levels for temperature, humidity, ventilation, noise and ambient lighting, and do not adversely affect controller performance.**

b. **Automation systems generated and display flight plan, control and coordination data in a timely, accurate and easily recognizable manner and in accordance with Human Factors principles.**

c. Equipment, including input/output devices for automation systems, are designed and positioned in the working position in accordance with ergonomic principles;

d. Communications, navigation, surveillance and other safety significant systems and equipment;

1. **are tested for normal operations on a routine basis;**
2. **meet the required level of reliability and availability as defined by the appropriate authority;**
3. **provide for the timely and appropriate detection and warning of system failures and degradations;**
4. **include documentation on consequences of system, sub – system and equipment failures and degradations;**
5. **include measures to control the probability of failures and degradations; and**
6. **include adequate backup facilities and/or procedures in the event of a system failure or degradation; and**

e. detailed records of systems and equipment serviceability are kept and periodically reviewed.

Note. In the context above, the terms reliability and availability have the following meanings :

1. ***Reliability:*** *the probability that a device or system will function without failure over a specified time period or amount of usage; and*
2. ***Availability:*** *The ratio of percentage of the time that a system is operating correctly to the total time in that period.*

13.7.2.1.3 *Licensing and training issues to ensure that :*

a. controllers are adequately trained and properly licensed with valid ratings;

b. controller competency is maintained by adequate and appropriate refresher training, including the handling of aircraft emergencies and operations under conditions with failed and degraded facilities and systems;

c. controllers, where the ATC unit/control sector is staffed by teams, are provided relevant and adequate training in order to ensure efficient teamwork;

d. the implementation of new or amended procedures, and new or updated communications, surveillance and other safety significant systems and equipment is proceeded by appropriate training and instructions;

e. controller competency in the English language is satisfactory in relation to providing ATS to international air traffic; and

f. standard phraseology is used.

13.8 SAFETY ASSESSMENTS

13.8.1 Need for safety assessments

13.8.1.1 A safety assessment shall be carried out in respect of proposals for significant airspace organizations, for significant changes in the provision of ATS procedures applicable to an airspace or an aerodrome, and for the introduction of new equipment, systems or facilities, such as :

a. a reduced separation minimum to be applied within an airspace or at an aerodrome;

b. a new operating procedure, including departure and arrival procedures, to be applied within an airspace or at an aerodrome;

c. a reorganization of the ATS route structure;

d. a resectorization of an airspace;

e. physical changes to the layout of runways and/or taxiways at an aerodrome; and

f. implementation of new communications, surveillance or other safety – significant systems and equipment, including those providing new functionality and/or capabilities.

Note 1. A reduced separation minimum may refer to the reduction of a horizontal separation minimum, including a minimum based on Required Navigation Performance (RNP), a reduced vertical separation minimum of 1000 Ft between FL 290 and FL 410 inclusive (RVSM), the reduction of a separation minimum based on the use of an ATS surveillance system or a wake turbulence separation minimum or reduction of minima between landing and/or departing aircraft.

Note 2. When, due to the nature of the change, the acceptable level of safety cannot be expressed in quantitative terms, the safety assessment may rely on operational judgement.

13.8.1.2 Proposals shall be implemented only when the assessment has shown that an acceptable level of safety will be met.

13.8.2 Safety – significant factors

13.8.2.1 The safety assessment shall consider relevant all factors determined to be safety – significant, including :

a. types of aircraft and their performance characteristics, including aircraft navigation capabilities and navigation performance;

b. traffic density and distribution;

c. airspace complexity, ATS route structure and classification of the airspace;

d. aerodrome layout, including runway configurations, runway lengths and taxiways configuration;

e. type of air-ground communications and time parameters for communication dialogues, including controller intervention capability;

f. type and capabilities of surveillance system, and the availability of systems providing controller support and alert functions. Where ADS-B implementation envisages reliance upon a common source for surveillance and/or navigation, the safety assessment shall take account of adequate contingency measures to mitigate the risk of either degradation or loss of this common source (i.e. common mode failure); and

g. any significant local or regional weather phenomena.

Note 1. See DOC 4444 chapter 5, section 5.11 concerning reductions in separation minima.

Note 2. Guidance material on methods of expressing and assessing a safety level and safety monitoring programmes is contained in Annex 11, attachment B, the Air Traffic Services Planning Manual (Doc 9426), the Manual on Implementation of a 300 m (1000 Ft) Vertical Separation Minimum between FL 290 and FL 410 Inclusive (Doc 9574), the Performance-based Navigation Manual (Doc 9613) and the Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689).

13.9 SAFETY – ENHANCING MEASURES

13.9.1 Any actual or potential hazard related to the provision of ATS within an airspace or at an aerodrome, whether identified through an ATS safety management activity or by any other means, shall be assessed and classified by the appropriate ATS authority for its risk acceptability.

13.9.2 Except when the risk can be classified as acceptable, the ATS authority concerned shall, as a matter of priority and as far as practicable, implement appropriate measures to eliminate the risk or reduce the risk to a level that is acceptable.

13.9.3 If it becomes apparent that the level of safety applicable to an airspace or an aerodrome is not, or may not be achieved, the appropriate ATS authority shall, as a matter of priority and as far as practicable, implement appropriate remedial measures.

13.9.4 Implementation of any remedial measure shall be followed by an evaluation of the effectiveness of the measure in eliminating or mitigating a risk.

13.10 ATS SAFETY MANAGEMENT SYSTEMS

13.10.1 Doc 9859 provides ten steps for " getting started " in setting up an SMS. The ten steps have equal application to safety management in ATS, and that chapter should be read in conjunction with this section. In addition, the considerations discussed below apply to managing safety in ATS.

13.10.2 Safety Performance Indicators and Safety Targets

13.10.2.1 The notion of safety performance indicators and safety targets is introduced in Doc 9859. Before attempting to determine whether the safety performance of a system, or the safety impact of planned changes to it, is acceptable, a decision must be made concerning what criteria will be used to judge acceptability. ICAO provisions relating to safety management for aircraft operators, aerodrome operators and ATS providers incorporate requirements pertaining to achieving an acceptable level of safety. The acceptable level of safety shall be determined by the State concerned.

13.10.2.2 Annex 11 requires States to establish an acceptable level of safety applicable to the provision of ATS within their airspace and at their aerodromes.

13.10.2.3 In order to determine what is an acceptable level of safety, it is first necessary to decide on appropriate safety performance indicators and then on what represents an acceptable outcome. The safety performance indicators chosen need to be appropriate for the application. Typical measures which could be used in safety management in ATS include:

a. maximum probability of an undesirable event, such as a collision, loss of separation or runway incursion;

b. maximum number of incidents per 10 000 aircraft movements;

c. maximum number of short-term conflict alerts (STCAs) per 10 000 aircraft movements.

13.10 .2.4 Since aviation accidents are rare events, accident rates are not good indicators of safety performance. They may be of limited value at the global, regional or national level. However, the absence of accidents may belie many unsafe conditions in the system, creating situations "ripe for an accident". Accident rates are even less useful as an indicator of safety when applied to individual aerodromes or flight information regions (FIRs). For any given FIR, for example, the expected time between en-route accidents could be in excess of 100 years.

13.10.2.5 Incident rates may be more useful indicators of ATS safety performance, for example, reported air proximities, technical losses of separation, TCAS warning and alert messages, losses of radar coverage and power outages.

13.10.2.6 Indicators based on safety occurrences are only as good as the reporting or monitoring systems through which such occurrences are recorded and tracked. For this to be effective, the culture of the organization must encourage the filing and recording of the required reports.

Note. The importance of an organization's safety culture is discussed in Doc 9859 .

13.10.2.7 Whenever quantitative safety performance targets are set, it must be possible to measure, or estimate, the achieved level of safety in quantitative terms. If a target of this type is to be applied to en-route operations within a single FIR, or instrument approaches at a single aerodrome, then the expected frequency of accidents is so low that data on actual accidents will not give a valid indication of whether the target is being met.

13.10.2.8 Quantitative targets are used, for example, in assessing the safety of operations in Reduced Vertical Separation Minimum (RVSM) airspace. However, in this case, the assessment of the achieved level of safety is done using mathematical collision risk models which can estimate the expected rate of accidents from data on aircraft height deviations that did not result in an accident. Similar models are used in the estimation of collision risk as the result of lateral deviations from track in the North Atlantic Minimum Navigation Performance Specifications (MNPS) airspace, and oceanic airspace where Required Navigation Performance (RNP) based separation minima are used.

13.10.2.9 The techniques used in this form of safety assessment are beyond the scope of this manual. Further information on collision risk models can be found in the Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689).

13.10.3 Safety Organization

13.10.3.1 How an ATS centre or unit is organized for safety management will to a large extent depend on the volume and complexity of its activities. For example, at a large centre, such as at an international airport, there are several discrete ATS activities(en-route, terminal, arrival and departure, tower, ground, etc.). The effectiveness of the safety decision - making processes will be largely dependent on how the diverse interests of all the service providers are integrated into a coherent "system".

13.10.3.2 The Centre Manager or Unit Chief alone will not be able to implement an SMS. In addition to the cooperation and commitment of other managers and staff, the Centre Manager or Unit Chief will probably depend on the guidance and assistance of a dedicated SM. In appointing an SM, management must avoid the temptation to delegate accountability for safety to the SM rather than to all managers and employees.

13.10.3.3 As in other aviation activities, the provision of ATS requires a risk – based approach to decision-making. The same processes described elsewhere in this chapter are required for reducing or eliminating risks in the provision of ATS. Risk management requires a coherent system for identifying hazards, assessing the risks and implementing viable measures for controlling the risks. (See Doc 9859.)

13.10.3.4 The Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) requires that all reports of incidents, or reports concerning the serviceability of ATS facilities and systems (such as failures or degradation of communications, surveillance and other safety significant systems and equipment) be systematically reviewed by the appropriate ATS authority in order to detect any trends in the operation of such systems which may have an adverse effect on safety.

13.10.4 ATS Regulatory Authority

13.10.4.1 Functions Of The ATS Regulatory Authority

13.10.4.1.1 As outlined in Doc 9859 Chapter 3, a State requires a regulatory Authority to oversee the implementation of its legislation and regulations governing air safety. The core functions of the regulatory authority with respect to ATS safety are:

a. developing and updating the necessary regulations;

b. setting national safety performance targets; and

c. providing oversight of ATS providers.

13.10.5 Safety Manager (SM)

13.10.5.1 The principles for organizing for safety management, and the functions and roles of an SM are outlined in Doc 9859.

13.10.5.2 Ideally, the SM for an ATS unit should have no responsibilities other than safety. The SM should be a member of the management team of the organization, and needs to be at a sufficiently high level in the management hierarchy to be able to communicate directly with other senior managers. Examples of tasks to be included in an ATS SM's terms of reference include:

a. to develop, maintain and promote an effective SMS;

b. to monitor the operation of the SMS and to report to the Chief Executive Officer on the performance and effectiveness of the system;

c. to bring to senior management's attention any identified changes needed to maintain or improve safety;

d. to act as the focal point for dealings with the safety regulatory authority;

e. to provide specialist advice and assistance regarding safety issues;

f. to develop a safety management awareness and understanding throughout the entire organization; and

g. to act as a proactive focal point for safety issues.

13.10.6 Risk Management

13.10.6.1 As in other aviation activities, the provision of ATS requires a risk-based approach to decision - making. The same processes described elsewhere in this manual are required for reducing or eliminating risks in the provision of ATS. Risk management requires a coherent system for identifying hazards, assessing the risks and implementing viable measures for controlling the risks. (See Doc 9859)

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13.10.7 Emergency Response

13.10.7.1 ATS personnel must be prepared to continue to provide services through emergency situations, such as following an accident, a power or communication failure, loss of radar coverage, and security threat. Emergency procedures must be in place to guide operations without further compromising safety. The appropriate response of the unit requires a sound Emergency Response Plan (ERP).

13.10.7.2 The ERP should reflect a collaborative effort between management and the operational personnel who will have to execute it, in particular the controllers. Backup procedures must be in place and be regularly tested to ensure the continued provision of services to maintain the safe, expeditious and orderly flow of air traffic — perhaps at a degraded level, for example, shifting to procedural control in the event of a radar failure.

13.10.8 Safety Investigations

13.10.8.1 When an accident or serious incident occurs, competent investigators must be available to conduct an investigation in order to:

a. better understand the events leading up to the occurrence;

b. identify hazards and conduct risk assessments;

c. make recommendations to reduce or eliminate unacceptable risks; and

d. communicate the safety messages to the appropriate stakeholders.

13.10.8.2 The investigation of minor incidents, such as losses of separation, may yield evidence of systemic hazards. For maximum effectiveness, management should focus on determining risks rather than identifying persons to discipline. How this is done will be influenced by the safety culture of the organization. The credibility of the investigative process will largely hinge on the technical competence and objectivity of the investigators.

13.10.9 Safety Oversight

13.10.9.1 Maintenance of high standards in ATS implies a programme of monitoring and surveillance of the activities of all controllers and supporting staff, as well as of the reliability and performance of their equipment.

13.10.9.2 The objective of the safety oversight of ATS providers is to verify compliance with relevant:

a. ICAO SARPs and procedures;

b. national legislation and regulations; and

c. national and international best practices.

13.10.9.3 The methods of safety oversight may include safety inspections and/or safety audits of the organizations concerned. Safety oversight should also involve a systematic review of significant safety occurrences. As outlined in Doc 9859 , one of the core elements of an SMS is safety audits. The safety oversight procedures need to be standardized and documented to ensure consistency in their application.

13.10.9.4 The staff responsible for this oversight function require a good knowledge of, and preferably, practical experience in, safety management procedures. Doc 4444 requires that qualified personnel having a full understanding of relevant procedures, practices and factors affecting human performance, conduct safety reviews of ATS units on a regular and systematic basis.

13.10.9.5 Doc 4444 also requires that data used in safety monitoring programmes be collected from as wide a range of sources as possible, as the safety-related consequences of particular procedures or systems may not be realized until after an incident has occurred. Thus, the audit programme should include the safety interfaces with all users of the ATS system, operators, airport management and any contracted service providers.

13.10.10 Managing change

13.10.10.1 The provision of ATS is a dynamic activity. Doc 4444 requires that a safety assessment be carried out in respect of any proposals for significant airspace reorganizations, for significant changes in the provision of ATS procedures applicable to a defined airspace or an aerodrome, and for the introduction of new equipment, systems or facilities. Examples of significant changes include:

a. reduced separation minima;

b. new operating procedures, including arrival and departure procedures (STARs and SIDs);

c. reorganization of the ATS route structure;

d. re-sectorization of an airspace; and

e. implementation of new communications, surveillance or other safety - significant systems and equipment, including those providing new functionality and/or capabilities.

13.10.10.2 In brief, a safety assessment involves a multidisciplinary group of experts who systematically identify hazards and recommend measures to reduce or eliminate the inherent risks to an acceptable level. Further information on conducting safety assessments is contained in Doc 9859 .

13.10.10.3 Factors to be considered in conducting a safety assessment include:

a. types of aircraft and their performance characteristics, including their navigation capabilities and performance;

b. traffic density and distribution;

c. airspace complexity, ATS route structure and the classification of the airspace;

d. aerodrome layout, including runway and taxiway configurations and preferences

e. air-ground communications capabilities and usage;

f. surveillance and alerting systems; and

g. significant local topography or weather phenomena.

13.11 CHANGING ATS PROCEDURES

13.11.1 Air traffic systems are particularly vulnerable during periods of changing procedures, whether modifying existing procedures or introducing new ones. Risk management techniques are used in working through the effects of proposed changes. The principles of risk management are outlined in Doc 9859 .

13.11.2 The objective of assessing ATS procedures is to provide assurance that, as far as reasonably practicable, potential hazards associated with the control of aircraft have been identified and actions to mitigate the significant risks associated with the hazards have been put in place. Typically, this risk management process involves the following:

a. hazard identification (HAZid);

b. hazard analysis, including likelihood of occurrence;

c. consequence identification and analysis; and

d. assessment against risk criteria.

13.11.3 When management proposes to develop, validate, change or introduce operational procedures, where practicable they should:

a. utilize hazard identification, risk assessment and risk management techniques prior to the introduction of the procedures;

b. use simulation to develop and evaluate the new procedures;

c. implement changes in small, easily manageable steps to allow confidence to be gained that the procedures are suitable; and

d. commence changes in periods of low traffic density.

13.11.4 As outlined in Doc 9859 , risk assessment of ATS procedures is best conducted by a group including:

a. those responsible for procedure design;

b. staff with current knowledge and experience of the procedural area under assessment, i.e. system users — ATS personnel and pilots to assess the procedures from an operational perspective;

c. engineering specialist — to provide expert opinion on equipment performance;

d. safety/risk specialist — to guide the application of the methodology; and

e) Human Factors specialist.

Note 2. Appendix "K" to this manual provides further guidance for the risk assessment of ATS procedures

13.12 THREAT AND ERROR MANAGEMENT

Note. For more details, See Doc 9859.

13.12.1 Threat and Error Management (TEM) framework assists in understanding, from an operational perspective, the interrelationship between safety and human performance in dynamic and challenging operational contexts. While threats to operational safety have long been recognized, the principles of TEM make it possible to manage the three basic components of the TEM framework: threats, errors and undesired states.

13.12.2 Threats and errors are a normal part of everyday operations. To prevent them from degenerating into undesired states, ATCOs must routinely manage such threats and errors. To maintain safety margins in ATC operations, ATCOs must also manage any undesired state that may arise from such threats and errors. These actions may offer the last opportunity to avoid an unsafe outcome.

13.12.3 Threats, errors and undesired states must all be managed within a set of contextual complexities. For example, controllers must deal with adverse meteorological conditions, airports surrounded by high mountains, congested airspace, aircraft malfunctions, and errors committed by other people outside of the ATC room such as flight crew, ground staff or maintenance workers. The TEM model considers these complexities as threats because they all have the potential to negatively affect ATC operations by reducing margins of safety.

Note. Appendix "L" to this manual examines TEM in ATS in more detail.

13.13 NORMAL OPERATIONS SAFETY SURVEY (NOSS)

13.13.1 Until recently, safety monitoring relied on staff identifying actual or potential hazards to the safe operation of the system, and submitting reports. If unsafe practices have become part of the normal method of operating, it is unlikely that the staff involved would recognize these as being unsafe and file reports through the safety occurrence reporting system.

13.13.2 Observation-based methods provide an additional means of gathering data that does not rely on the individuals involved. Several airlines have introduced a programme called Line Operations Safety Audit (LOSA) to monitor flight operations under normal operating conditions.

Note. For more details about (LOSA) see Doc 9859.

13.13.3 LOSA is a proven method for identifying hazards and for developing coping strategies for normal flight deck operations. The aim of the monitoring is to gather data on operational threats, crew errors, and their their management. The observations are made by observers, trained in LOSA techniques, sitting in the jump seat on regular scheduled flights. By monitoring normal operations, much can be learned about pilots' successful strategies for managing normal threats, errors and undesirable states.

13.13.4 The lessons of LOSA are being applied to ATC. However, because ATC operations differ significantly from flight operations, the evolving methodology, known as Normal Operations Safety Survey (NOSS), will differ too. The idea behind NOSS is to provide the ATC community with a means for obtaining robust data on threats, errors and undesired states. Analysis of NOSS data, together with safety data from conventional sources, should make it possible to focus the safety change process on the areas that need attention the most.

13.13.5 NOSS builds on the TEM framework. In its simplest form, NOSS involves over-the-shoulder observations during normal shifts. Analysis of these normative data in conjunction with data acquired through other means (such as incident reporting schemes and occurrence investigations) should provide ATC management with a means for focusing the safety change process on those threats which most erode the margins of safety in the ATC system.

13.13.6 NOSS recognizes that controllers routinely manage the threats, errors and undesired states that they face each day during the course of normal operations. Their timely intervention preserves the desired margins of safety — before an unsafe outcome (i.e. an accident or incident arises).

13.13.7 Understanding how effective controllers deal with the evolving situation is vital to developing the necessary countermeasures to preserve defenses within the ATS system. Since safety management strategies are best directed against systemic threats rather than individual errors, the primary objective of NOSS must be to identify threats, not just to count errors.

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