ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 2: Safety and security in air traffic management (ATM)
2.1 Safety management systems and programmes :

MONITORING SAFETY DURING NORMAL ATS OPERATIONS

(Presented by the Secretariat)

SUMMARY

This paper advocates the importance of collecting safety data during normal aviation operations, as part of systemic safety management programmes. The paper introduces the concept of monitoring normal ATS operations, presents the Line Operations Safety Audit (LOSA) as a tool to this end, and discusses the extension of LOSA to the ATS environment.

Action by the Conference is in paragraph 7.

1. INTRODUCTION

1.1 Annex 11 — *Air Traffic Services*, and the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), include requirements regarding the establishment of systematic and appropriate safety management programmes for air traffic services (ATS). These are relatively new requirements and, consequently, many ATS organizations are still in the process of establishing their safety management programmes. In contrast, Annex 6 — *Operation of Aircraft*, has included the requirement for airlines to establish an accident prevention and flight safety programme since 1990. Airlines have over a decade of experience in safety management programmes. This paper presents the latest developments regarding safety management programmes in the airline environment and proposes that developing ATS safety management programmes can benefit and build on the experience from the airlines.

2. ANALYSIS OF SOURCES OF AIRLINE SAFETY DATA

2.1 Sources of data for safety management programmes vary among airlines, but a number of sources are common in most of the programmes. Each of these sources provides empirical safety data, and the combination of data from all these sources has been the real added value of systemic safety management programmes. Each of these sources, however, presents particular shortcomings.

2.2 Accident investigations have been a primary source of safety information in aviation. However, accidents are infrequent events that oftentimes reflect the linking of rare factors. As a result of such infrequency, it is at times difficult for accident investigations to uncover unsafe operational practices in time to appropriately deal with them.

2.3 Incident reports provide insights into a far larger data base of saves and near misses. Incident reports suffer, however, because of their voluntary nature. Despite efforts to assure pilots and other aviation personnel of the non-jeopardy nature of reports, these assurances do not elicit complete reporting. This is mainly because of concerns about sanctions against the reports. Nevertheless, incident reporting provides invaluable information and allows airlines to take safety action prior to accidents and serious incidents.

2.4 Line checks provide minimal diagnosis obtained at significant cost (one major airline cites a cost of US $1 000 per line check with little utility in obtained information). Industry statistics indicate that less than 1 per cent of line checks are deemed unsatisfactory. Pilots are certainly displaying their best, but not necessarily their normal (i.e. unmonitored) behaviours during line checks.

2.5 Lastly, flight data monitoring for safety analysis, without jeopardy to flight crews, has become routine lately. These programmes provide essential information about what happens in terms of deviations from organizational expectations; however, the data do not, by themselves, provide any insights into why the deviations occurred.

2.6 While the combined safety data from these sources can provide airlines with an understanding of the strengths and weaknesses of their operations, a further shortcoming of all sources discussed is that they derive their data from occurrences. A fundamental building block of systemic safety management programmes is to capture data from processes, from routine operations, to enable errors and failures to be detected, and remedial action taken, before they lead to occurrences. This requires monitoring of normal operations, to obtain safety data on flight crew and situational factors during uneventful flights. To this end, airlines have initiated the implementation of a tool to obtain safety data from normal operations called the Line Operations Safety Audit (LOSA).

3. LINE OPERATIONS SAFETY AUDIT (LOSA)

3.1 On November 1999, the Air Navigation Commission agreed on a five-year plan of action on Flight Safety and Human Factors for the period 2000 — 2004. The plan of action included, inter alia, the development of LOSA as an airline safety management tool for the collection and analysis of data from normal operations. LOSA was also considered essential to the Global Aviation Safety Plan (GASP) objective of continued integration of Human Factors considerations into the aviation environment.

3.2 The University of Texas Human Factors Research Project developed LOSA, with funding from the Federal Aviation Administration (FAA). After several years of development and refinement, LOSA has turned into a strategy of systematic line observations to provide safety data on the way an airline's flight

operations system functions. The data generated by LOSA provide diagnostic indicators of organizational strengths and weaknesses in flight operations (ICAO *Line Operations Safety Audit* (LOSA) manual (Doc 9803)).

4. THREAT AND ERROR MANAGEMENT (TEM) MODEL

4.1 LOSA is based on the threat and error management (TEM) model, and it is defined by ten operating characteristics (Appendix refers). The TEM model proposes that threats and errors are an integral part of daily flight operations and that they must be managed by the flight crews to ensure the safe outcome of flights.

4.2 Threats are events external to the flight deck that must be managed by the flight crew during normal, every day flights. Such events increase operational complexity and pose a potential safety risk to the flight. Threats may be expected by the crew and anticipated and briefed in advance. They may also be unexpected, occurring suddenly and without any warning or briefing possibility. Threats may be relatively minor (a slight discrepancy in dispatch papers) or major (an incorrect altitude assignment). For example, a fuel loading error made by ground staff is considered a threat. The crew did not originate the event, but they must manage it. Other examples of threats are errors in ATC clearances discovered by the crew, dispatch paperwork errors, discrepancies in passenger boarding counts by cabin attendants, similar callsigns, maintenance deficiencies, weather, terrain, unfamiliar airports, and so forth. From a systemic safety management perspective, threats are the precursors of errors.

4.3 Errors are actions or inactions by the crew that lead to deviations from organizational or flight crew intentions or expectations. Errors in the operational context tend to reduce the margin of safety and pose a potential risk to the flight. Errors may be minor (selecting the wrong altitude into the mode control panel, but catching it quickly) or major (forgetting to do an essential checklist).

4.4 The TEM model provides a quantifiable framework to collect and categorize safety data. In LOSA, trained observers record and code potential threats to safety and how the threats are addressed during the flight. They also record and code the errors such threats generate, and how flight crews manage these errors.

4.5 The TEM model has been successfully incorporated into airline training programmes and, in some cases, has replaced crew resource management (CRM) training. The ATS equivalent of CRM training is called team resource management (TRM) training. The integration of the TEM model in TRM training may lay the foundations for future normal operations safety monitoring in ATS.

5. THE EXTENSION OF LOSA TO ATS

5.1 The introduction of monitoring of normal operations as a safety management source of data in ATS is feasible. Furthermore, the Air Navigation Commission has requested that the Secretariat explore the extension of LOSA to ATS, under the activities of the Flight Safety and Human Factors Programme. However, as with other safety initiatives that originated in the airline environment, an adaptation of LOSA is required.

5.2 A comparison of airline safety data sources (paragraph 2 refers) to ATS shows the following similarities and differences:

a) accident investigations in ATS are, in general terms, conducted in the same way as in airlines;

b) incident reporting in ATS suffers from the same limitations as in the airlines. In many ATS organizations the operational personnel is reluctant to report incidents for fear of sanctions. Only where well-protected voluntary reporting programmes exist are reports received with a degree of consistency;

c) line checks are non-existent in ATS, and only a few ATS organizations conduct individual proficiency checking, yielding scant systemic safety information;

d) there is no ATS equivalent to flight data monitoring programmes used by airlines. Some ATS organizations use their automated systems to obtain statistical feedback, for instance, on the correct application of separation standards. Such monitoring, however, is often aimed at instituting administrative proceedings in addition to data collection. Therefore, the organization learns that a loss-of-separation incident occurred, but does not obtain information about why the separation fell below expected standards.

5.3 It can be concluded that the amount of safety data available in the ATS environment is less than that in the airline environment. Rather than arguing against the implementation of monitoring of normal operations in ATS, the comparison in paragraph 5.2 suggests that implementation of further sources of safety data in ATS should be explored in a systemic way.

5.4 Some of the ATS organizations that already have a safety management programme in place are in the early stages of an adaptation of LOSA for the ATS environment, in order to collect safety data during normal ATS operations. To distinguish the ATS tool, ATS organizations involved in the development of a programme to collect safety data from normal operations have tentatively adopted the acronym NOSS (Normal Operations Safety Survey), in which the term "survey" corresponds with the phraseology used in ATS organizations with safety monitoring programmes. It is expected that NOSS will share most of the operating characteristics from LOSA (Appendix refers), with modifications where necessary.

6. CONCLUSIONS

6.1 Systemic safety management in ATS is not yet as developed and established as in the airlines. ATS organizations need to explore the various sources of safety data available to them when establishing their respective safety management programmes. To that end, ATS organizations can benefit from the experience of airlines.

6.2 Monitoring of normal operations is an emerging methodology that supports safety management programmes. ICAO supports LOSA, and the development of normal operations monitoring programmes is a central focus of the ICAO Flight Safety and Human Factors Programme for the period 2000 — 2004. ICAO will aim to increase awareness of international civil aviation about the importance of normal operations monitoring programmes, and encourage and facilitate, as much as possible, the development and progress of programmes such as NOSS.

6.3 ATS organizations may first need to introduce established sources of safety data collection (e.g. incident reporting) before moving on to programmes for the collection of data from normal operations such as NOSS. The inclusion of such programmes should, nevertheless, be an objective for ATS organizations within the context of their safety management programmes. The incorporation of the TEM model in TRM training programmes is considered a building block towards the implementation of programmes aimed at the monitoring of normal operations in ATS.

7. ACTION BY THE CONFERENCE

7.1 The Conference is invited to note the information contained in the paper and take it into account in the discussions under Agenda Item 2.

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APPENDIX

LINE OPERATIONS SAFETY AUDIT (LOSA)
OPERATING CHARACTERISTICS

LOSA is defined by ten operating characteristics that act to ensure the integrity of the methodology and its data. These characteristics are:

1. **Jump-seat observations during normal flight operations.** LOSA observations are limited to regulary scheduled flights. Line checks, initial line indoctrination or other training flights are off-limits, since they provide an unrealistic picture of performance.

2. **Joint management/pilots' association sponsorship.** LOSA will only succeed as a viable safety project if there is support not only from management, but also from the pilots' association as well. The joint sponsorship provides a "check and balance" for the project to ensure that change as a result of LOSA data will be made. Most typically, a LOSA steering committee is formed with representatives from both groups.

3. **Voluntary crew participation.** Observers must first ask the flight crew for permission to be observed. If the crew declines, the observer simply takes another flight with no questions asked. A high number of declines should serve as an indicator that there are critical "trust" issues to resolve.

4. **De-identified, confidential, and non-disciplinary data collection.** LOSA observation forms do not record names, flight numbers, dates, or any other information that can identify a crew. The purpose of LOSA is to collect safety data, not to punish pilots. Airlines cannot allow themselves to squander a unique opportunity to gain insight into their operations by having pilots fearful that a LOSA observation could be used against them for disciplinary reasons. If a LOSA observation is ever used for disciplinary reasons, the acceptance of LOSA within the airline will most probably be lost forever.

5. **Targeted observation instrument.** The current tool used to conduct a LOSA is the LOSA Observation Form developed by the University of Texas Human Factors Research Project. The form is based upon the TEM model.

6. **Trained observers.** Pilots conduct LOSA. Observation teams will typically include line, instructor, safety, and management pilots, and representatives of the pilot organization. It is critical to select observers that are respected and trusted within the airline.

7. **Trusted data-collection site.** To maintain confidentiality, airlines must have a trusted data-collection site. At the present time, all observations are sent off-site directly to the University of Texas Human Factors Research Project, which manages the LOSA Archive. This ensures that no individual observations will be misplaced or improperly disseminated through the airline.

8. **Data verification roundtables.** Data-driven programmes like LOSA require quality data management procedures and consistency checks. For LOSA, these checks are done at data verification roundtables. A roundtable consists of three or four department and pilot association representatives that scan the raw data for inaccuracies. The end product is a database that is validated for consistency and accuracy according to the airline's standards and manuals, before any statistical analysis is performed.

9. **Targets for enhancement.** The final product of LOSA is a data-driven list of "Targets for enhancement." As the data are collected and analysed, patterns emerge. Certain errors occur more frequently than others, certain airports or events emerge as more problematic than others, certain SOPs are routinely ignored or modified, and so forth. These patterns are identified for the airline as LOSA targets for enhancement. It is then up to the airline to develop an action plan based on these targets, using experts from within the airline to implement appropriate change strategies.

10. **Feedback results to the line pilots.** To ensure long-term success of LOSA, airlines must communicate the results back to the line pilots. Pilots need to see not only the results of the audit, but also management's plan for improvement.

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