International Civil Aviation Organization

The Fourth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/4)

Bangkok, Thailand, 25 – 28 October 2005

Agenda Item 5: Review of regional safety assessment activities/requirements

ACCEPTABLE LEVEL OF SAFETY WITHIN THE AIRSPACE OF HONG KONG, CHINA

(Presented by Hong Kong, China)

SUMMARY

This paper provides information in respect of the methodologies used by the Civil Aviation Department of Hong Kong, China to address issues of "acceptable levels of safety".

1. INTRODUCTION

1.1 In addressing the ICAO provisions for the implementation of safety management systems, the Civil Aviation Department (CAD) of Hong Kong, China has established the 'acceptable level of safety' applicable to the provision of ATS within Hong Kong airspace since November 2003.

2. DISCUSSION

2.1 Details of the methodologies adopted by the Hong Kong CAD have been included as the **attachment** to this paper.

3. ACTION BY THE MEETING

3.1 The meeting is invited to note the information in this paper in relation to acceptable levels of safety for the provision of ATS within the airspaces of Hong Kong, China.

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Acceptable Level of Safety
Applicable to the provision of ATS
within HK Airspace

1. Introduction

As of 27 November 2003, ICAO requires States to establish the acceptable level of safety (ALOS) applicable to the provision of ATS (Annex 11 Ch 2 para. 2.26.2). Furthermore, when applicable, safety levels and safety objectives shall be established on the based of regional air navigation agreements. The paper discusses and proposes the ALOS to be declared by ATMD.

2. ALOS

2.1 ALOS may be specified in qualitative or quantitative terms.

2.2 In devising the ALOS, typical Safety Management System concepts such as the risk tolerability principles are applied. The Risk Classification Matrix (RCM) methodology is employed in expressing the declared ALOS. Examples of RCM in the UK CAA and Airservices Australia Safety Management Manual are shown in Attachment 1.

2.3 In researching into the UK NATS Safety Management Manual it is noticed that the acceptability or tolerability of a certain severity classification, such as Technical Infringement in our case, may not necessarily be fixed at a particular probability of occurrence. This concept is adopted in developing our ALOS.

2.4 Attachment 2 shows the proposed ALOS in the form of risk matrix for a particular ATC stream in Hong Kong. The ALOS value for the combined (Tower, Approach and Enroute) situation will be 3 times that for individual stream.

3. Safety Monitoring

For safety assessment and monitoring purpose, value representing a 12-month period of risk estimates, updated every 3 months, is intended. The data can be expressed either in the original risk matrix form, or in bar-chart form similar to the one used by ICAO in the RVSM implementation within the Asia Pacific region (see ICAO sample in Attachment 3). It is considered that the latter is a more reader friendly version. The loss of separation occurrence figures and risk estimate values for the period between 1 Jan 02 and 30 Jun 03 are contained in Attachment 4, using both formats.

figures removed.

4. Future Plan

With more experience gained, we intend to develop other specific ALOS such as those for runway incursion and level bust, to enlarge both the width and depth of risk assessment and monitoring in ATM.

(Extracted from UK NATS Safety Managem

TABLE 2 SYSTEM RISK CLASSIFICATION

Probability Class (Hours)	*Severity Class*			
	Cat 1	Cat 2	Cat 3	Cat 4
Frequent $< 10^3$	A	A	A	B1
Probable 10^3 to 10^4	A	A	B1	B2
Occasional 10^4 to 10^5	A	A	B2	C
Remote 10^5 to 10^6	A	B1	C	C
Improbable 10^6 to 10^7	B1	B2	C	C
Extremely Improbable $> 10^7$	B1	C	C	C

5 SYSTEM RISK CLASSIFICATION

5.1 Having defined severity and probability it is possible to define the risk associated with the hazard and the acceptability of the risk. In general, the more severe the potential hazard the less acceptable to NATS is the risk of it occurring.

5.2 For any given severity classification an acceptable Risk Class can be assigned resulting from the probability of occurrence. Conversely, for any given severity and its associated probability, its Risk Class, and hence acceptability can be derived as follows (and see Table 2):

Class A Unacceptable.

Class B1 Undesirable, may exceptionally be acceptable but only with the endorsement of NATS DGATO and DG P&E.

Class B2 Acceptable upon review, with the endorsement of a System Safety Control Board.

Class C Acceptable upon review, with the endorsement of the Project/System Safety Manager.

Risk Classification Matrixes And Decision Criteria, Continued

Risk matrix and decision criteria

When the likelihood and the severity of the hazard have been estimated using the previous two matrixes, the following risk matrix is available as a decision tool for management decisions. As well as decisions about existing ATS systems and procedures, this matrix may be of use in deriving functional level safety requirements for new systems (Document AA:Safe:104 refers)

Likelihood of event per operational hour per sector/unit		**Severity Category**			
If qualitative estimated used	**If quantitative estimate used**	**Cat 1**	**Cat 2**	**Cat 3**	**Cat 4**
Frequent	$Ps > 10^{-3}$	A	A	A	C
Probable	$10^{-3} > Ps > 10^{-4}$	A	A	B	D
Occasional	$10^{-4} > Ps > 10^{-5}$	A	A	C	D
Remote	$10^{-5} > Ps > 10^{-6}$	A	B	D	D
Improbable	$10^{-6} > Ps > 10^{-7}$	B	C	D	D
Extremely improbable	$Ps < 10^{-7}$	C	D	D	D

Continued on next page

Acceptable Level of Safety, Ps
(probability of loss of separation per aircraft movement)

Probability of Occurrences per movement		Severity Category			
Qualitative	Quantitative	Collision	AIRPROX	OD	TI
Frequent	$Ps > 10^{-3}$	A	A	A	B
Probable	$10^{-3} > Ps > 10^{-4}$	A	A	B	C
Occasional	$10^{-4} > Ps > 10^{-5}$	A	A	C	D
Remote	$10^{-5} > Ps > 10^{-6}$	A	B	D	D
Improbable	$10^{-6} > Ps > 10^{-7}$	A	C	D	D
Extremely Improbable	$Ps < 10^{-7}$	B	D	D	D

A = Unacceptable
B = Undesirable, may exceptionally be acceptable but only with the endorsement of ADG(ATM) and ADG(FS)
C = Acceptable upon review, with the endorsement of ADG(ATM)
D = Acceptable

Attachment 2

(Extracted from ICAO Asia Pacific RVSM Implementation Task Force Meeting 18, Working Paper 12)

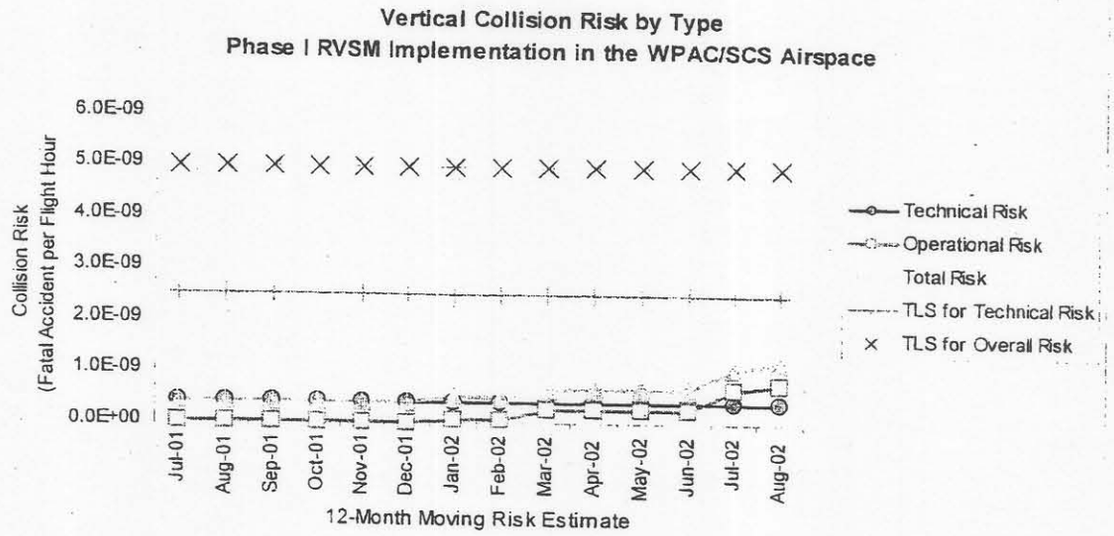


Figure 1: Trends of Risk Estimates for Phase I RVSM Implementation in WPAC/SCS

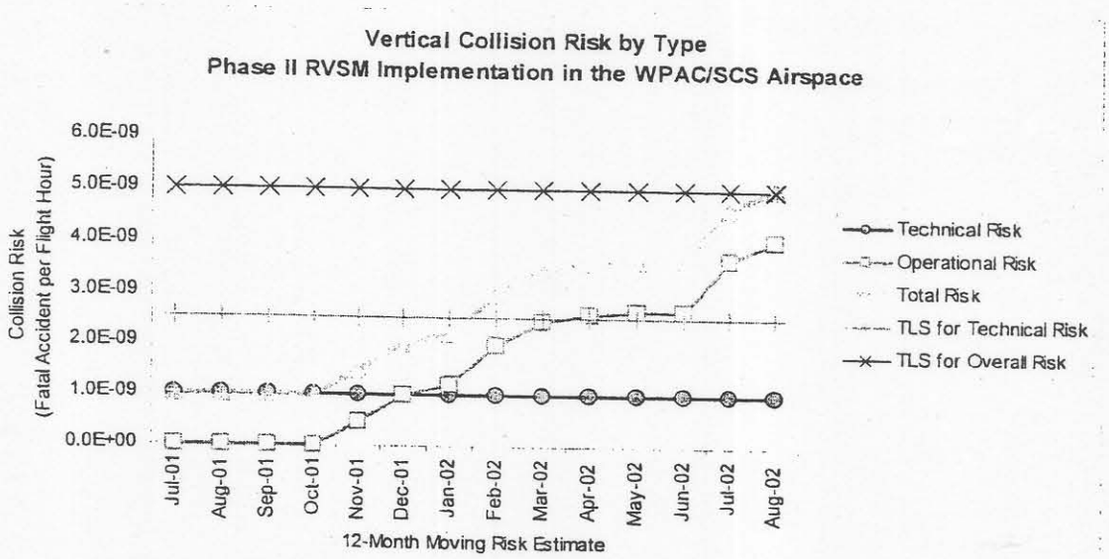


Figure 2: Trends of Risk Estimates for Phase II RVSM Implementation in WPAC/SCS

2. Methodology in the Classification of ATC Incidents

To accurately reflect the nature and severity of an ATC incident, the following quantitative methodologies are adopted in the classification of incidents.

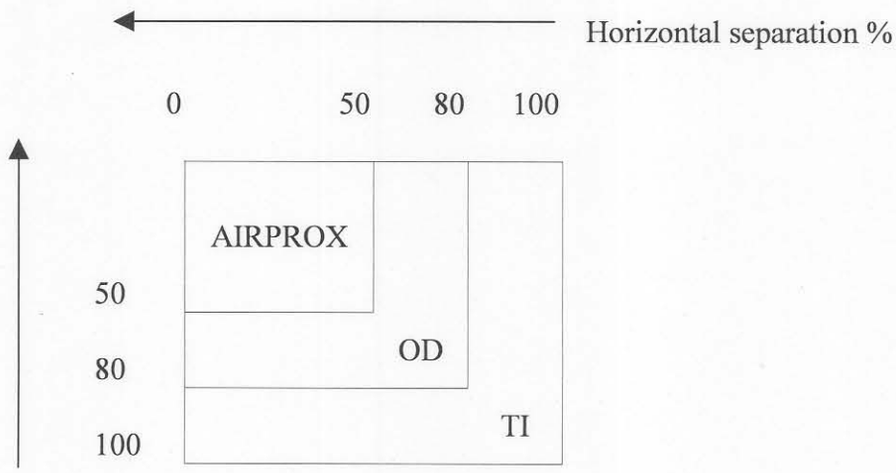
2.1 Under Radar or Procedural Control Environment

a) **AIRPROX** – an occurrence when both horizontal and vertical separations between aircraft are less than 50% of the required standards.

b) **Operational Deficiency (OD)** – an occurrence when both horizontal and vertical separations between aircraft are less than 80% of the required standards but not to the extent as to constitute and AIRPROX incident.

c) **Technical Infringement (TI)** – an occurrence when both horizontal and vertical separations between aircraft are less than the required standards but not to the extent as to constitute an OD or an AIRPROX incident.

The above classification of ATC incidents is presented graphically as below.



2.2 Aerodrome Control

2.2.1 The mode of operations in aerodrome control is more flexible, particularly when visual separation is applied for aircraft operating within the vicinity of the airport. As such, it is likely that adoption of the aforementioned methodology to classify aerodrome incident may not be able to reflect correctly the risk of that incident. Under the circumstances, the following classification is preliminarily adopted to focus on traffic scenario between a preceding departure aircraft and a subsequent landing aircraft on the same runway.

a) **AIRPROX** – an occurrence involving a reduction of separation between a departing and a landing aircraft on the same runway by more than 20% of the runway length and to the extent of having a risk of collision as reported by ATC and/or flight crew.

b) **Operational Deficiency** – an occurrence involving a reduction of separation between a departing and a landing aircraft on the same runway by more than 20%

of the runway length but not to the extent of having a risk of collision as reported by ATC and/or flight crew.

c) **Technical Infringement** – an occurrence involving a reduction of separation between a departing and a landing aircraft on the same runway by 20% or less of the runway length.

2.2.2 Between aircraft operating in the vicinity of the aerodrome with less than the prescribed minima, e.g. a departure takes off in front of a missed-approach aircraft; an Operational Deficiency shall be assumed unless it is proved otherwise by evidence. In an incident involving aircraft operating under VFR in the vicinity of the airport, Control Zones (CTR) or in the Uncontrolled Airspace Reporting Areas (UCARAs), the same categorization principle should be applied. It shall however be emphasized that nothing shall restrain an investigator from re-categorizing an incident should more evidence be revealed in the process of investigation.

2.3 Minor Occurrence

Minor occurrence is an event that does not involve a loss of standard separation but it may have long-term implication on operational safety. Examples to this category include non-compliance with ATC procedures, breach of regulations, or other occurrences likely to arouse public interest. It should be noted that reporting of and investigation into minor occurrences are proactive measures to enhance overall operational and system safety. ATC personnel shall therefore be encouraged to report on minor occurrences; and a database shall also be put in place by ATMD to facilitate the study of safety trend through data analysis.

2.4 Serious Incident

2.4.1 The term "serious incident" is defined by the ICAO and adopted by CAD as "an incident involving circumstances indicating that an accident nearly occurred".

2.4.2 The incidents listed below are typical examples of incidents that are likely to be serious incidents. The list is not exhaustive but only serves as guidance for defining serious incident, in which ATC may possibly be involved.

(a) Near collision requiring timely avoidance manoeuvres to avert a collision or an unsafe situation or when an avoidance action would have been appropriate.

(b) Controlled flight into terrain only marginally avoided.

(c) Aborted take-offs on a closed or engaged runway.

(d) Take-offs from a closed or engaged runway with marginal separation from obstacle(s).

(e) Landings or attempted landings on a closed or engaged runway.

(f) Take-off/landing or attempted take-off/landing on a taxiway.

2.4.3 Based upon the above examples, it is likely that an AIRPROX situation occurring in Hong Kong with a high risk of collision between aircraft will be considered as a serious incident. Under the circumstances, the DDGCA will initiate an investigation into the incident in accordance with the ICAO Annex 13 criteria. Depending on the findings of the initial investigation, DDGCA may recommend to the DGCA for the conduct of a Field Investigation by an Investigation Team in accordance with the procedure as detailed in para. __.

3 Risk Assessment

The ICAO risk assessment codes of Categories A to D as given below are adopted for the purpose of classifying the risk of an incident. Incident investigators shall take note of the applicable situation of these categories, as stipulated in the following Risk Categorisation Table.

Risk Categorisation Table		
Category Code	**Risk Assessment**	**Applicable Situation**
A	Risk of collision	An aircraft proximity in which a serious risk of collision existed. Practically, collision avoidance is due to chance rather than an act on the part of the pilot or ATC.
B	Safety not assured	An aircraft proximity in which the safety of the aircraft may have been compromised. The occurrence would have probably resulted in a collision if no action had been taken by either pilot or ATC.
C	No risk of collision	An aircraft proximity in which no risk of collision existed. A situation where the direction and altitude of the aircraft would have made a collision improbable, regardless of evasive actions taken by pilot or ATC.
D	Risk undetermined	Insufficient information was available to determine the risk involved, or inconclusive or conflicting evidence precluded such determination.

Statistics on Movement and Occurrences

Area Stream	Jan 02 – Dec 02	Apr 02 – Mar 03	Jul 02 – Jun 03	Oct 02 – Sep 03
Total Movements				
No. of TI				
No. of OD				
No. of AIRPROX				

Approach Stream	Jan 02 – Dec 02	Apr 02 – Mar 03	Jul 02 – Jun 03	Oct 02 – Sep 03
Total Movements				
No. of TI				
No. of OD				
No. of AIRPROX				

Tower Stream	Jan 02 – Dec 02	Apr 02 – Mar 03	Jul 02 – Jun 03	Oct 02 – Sep 03
Total Movements				
No. of TI				
No. of OD				
No. of AIRPROX				