



International Civil Aviation Organization

**The 18th Meeting of the Regional Airspace Safety Monitoring Advisory Group
(RASMAG/18)**

Bangkok, Thailand, 01 – 04 April 2013

Agenda Item 3: Reports from Asia/Pacific RMAs and EMAs

SEASMA SAFETY REPORT

(Presented by Singapore)

SUMMARY

This paper presents the horizontal safety assessment report from the South East Asia Safety Monitoring Agency (SEASMA) for operations on the six major air traffic service routes within the South China Sea for the period 1 Jan 2012 through 31 Dec 2012. The assessment concludes that the Asia and Pacific Region Target Level of Safety (TLS) values established for lateral and longitudinal separation standards were satisfied for the six-route system with high statistical confidence during the 12-month period examined.

This paper relates to –

Strategic Objectives:

A: *Safety – Enhance global civil aviation safety*

1. INTRODUCTION

1.1 This working paper is a periodic assessment of whether flight operations on the six major South China Sea routes comply with APANPIRG-agreed Target Level of Safety (TLS) values for lateral and longitudinal separation standards. The examination period covered is from 1 Jan 2012 till 31 Dec 2012.

2. DISCUSSION

Executive Summary

2.1 **Table 1** provides the South China Sea airspace horizontal risk estimates. **Figure 1** presents the lateral and longitudinal collision risk estimate trends for South China Sea airspace during the period January 2012 to December 2012.

Risk	Risk Estimation	TLS	Remarks
RASMAG 17 Lateral Risk	1.23×10^{-9}	5.0×10^{-9}	Below TLS
RASMAG 17 Longitudinal Risk	0.43×10^{-9}	5.0×10^{-9}	Below TLS
Lateral Risk	1.89×10^{-9}	5.0×10^{-9}	Below TLS
Lateral Risk	0.79×10^{-9}	5.0×10^{-9}	Below TLS

Table 1: South China Sea Airspace Horizontal Risk Estimates

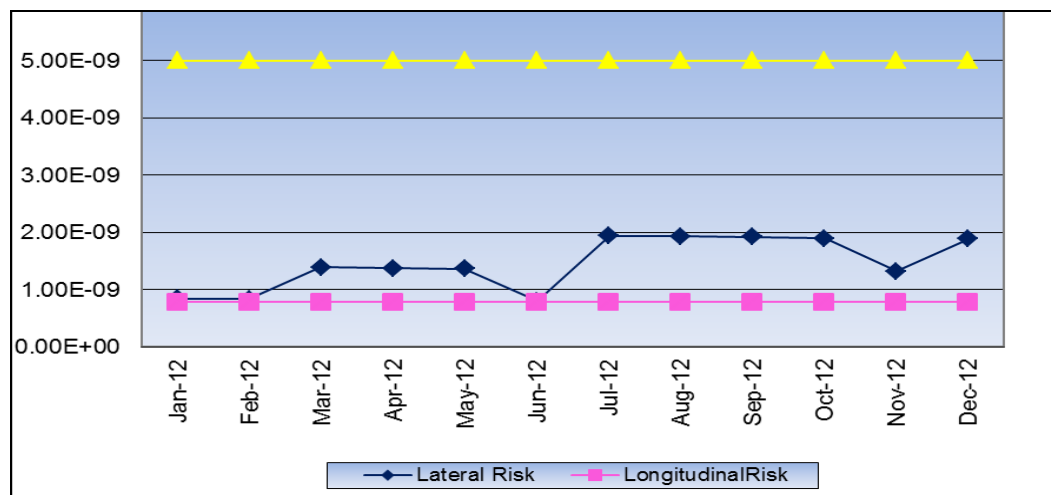


Figure 1: South China Sea Airspace Horizontal Risk Estimates

2.2 **Table 2** contains a summary of Large Lateral Deviations (LLD) and Large Longitudinal Errors (LLE) received by SEASMA for the South China Sea airspace.

Code	Deviation Description	No.
A	Flight crew deviates without ATC Clearance	1
D	ATC system loop error	2
E	ATC Coordination errors	1
Total		4

Table 2: Summary of South China Sea Airspace LLD and LLE Reports

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper;
- b) note the performance on the South China Sea RNAV routes is compliant with the APANPIRG-agreed lateral and longitudinal TLS; and
- c) discuss any relevant matters as appropriate.

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Appendix: SEASMA Safety Report for the South China Sea

Background

1.1 The lateral separation standard applied in the six South China Sea routes – L642, M771, N892, L625, N884 and M767 – is 50NM. The longitudinal separation minimum applied is 50NM for pairs of co-altitude aircraft on L642 and M771 and 10 minutes, with Mach number technique applied, or 80NM RNAV for the rest of the four routes.

Results of Data Collection

1.2 The fidelity of large-error and traffic-count reporting by each responsible air navigation service provider (ANSP) for the period Jan 2012 through Dec 2012 is shown in table 1.

Month	Report Received from:		
	Hong Kong, China	Philippines	Singapore
Jan 2012	Yes	Yes	Yes
February 2012	Yes	Yes	Yes
March 2012	Yes	Yes	Yes
April 2012	Yes	Yes	Yes
May 2012	Yes	Yes	Yes
June 2011	Yes	Yes	Yes
July 2011	Yes	Yes	Yes
August 2011	Yes	Yes	Yes
September 2012	Yes	Yes	Yes
October 2012	Yes	Yes	Yes
November 2012	Yes	Yes	Yes
December 2012	Yes	Yes	Yes

Table 1: Record of ANSP Reporting by Month for Period Jan 2012 through Dec 2012

Reported Traffic Counts for Jan 2012 through Dec 2012 Monitoring Period

1.3 **Table 2** presents the total traffic counts reported by month transiting all South China Sea monitoring fixes for the period Jan 2012 through Dec 2012.

Monitoring Month	Total Monthly Traffic Count Reported Over Monitored Fixes	Cumulative 12-Month Count of Traffic Reported Over Monitored Fixes Through Monitoring Month
January 2012	10452	110809
February 2012	9387	112259
March 2012	10059	113413
April 2012	10004	114535
May 2012	10285	115489
June 2011	10012	116308
July 2011	10200	117005
August 2011	10222	117510
September 2012	9982	117964
October 2012	10299	119212
November 2012	10246	119610
December 2012	10759	120106

Table 2: Monthly Count of Monitored Flights Operating on South China Sea RNAV Routes for the period Jan 2012 through Dec 2012

Monitoring Reports

1.4 **Table 3** presents the cumulative totals of Large Lateral Deviations (LLDs) and Large Longitudinal Errors (LLEs) LLDs and LLEs for the period January 2012 until December 2012.

Monitoring Month	Monthly Count of LLDs Reported Over	Cumulative 12-Month Count of LLDs Reported Over Monitored Fixes	Monthly Count of LLEs Reported Over Monitored Fixes	Cumulative 12-Month Count of LLEs Reported Over Monitored Fixes
January 2012	0	2	0	0
February 2012	0	2	0	0
March 2012	1	3	0	0
April 2012	0	3	0	0
May 2012	0	3	0	0
June 2011	0	2	0	0
July 2011	2	4	0	0
August 2011	0	4	0	0
September 2012	0	4	0	0
October 2012	0	4	0	0
November 2012	0	3	0	0
December 2012	1	4	0	0

Table 3: Monthly Count of LLDs and LLEs Reported on South China Sea RNAV Routes for the period Jan 2012 through Dec 2012

1.5 **Table 4** presents the cause of deviation in the LLD report received for the period Jan 2012 through Dec 2012.

Deviation Code	Cause of Deviation	No of Occurrences
A	Flight crew deviate without ATC Clearance	1
D	ATC system loop error	2
E		1

Table 4: Cause of LLD deviation

Risk Assessment and Safety Oversight

1.6 This section presents the results of safety oversight to the lateral and longitudinal separations standards applied in the South China Sea RNAV route structure. Analysis techniques used are in conformance with the internationally applied collision risk methodology.

Estimate of the CRM Parameters

1.7 The lateral separation standard between the six RNAV routes is 50NM. The form of the lateral collision risk model used in assessing the safety of operations on the South China Sea RNAV routes is:

$$N_{ay} = P_y(S_y)P_z(0) \frac{\lambda_x}{S_x} \left\{ E_y(\text{same}) \left[\frac{|\bar{x}|}{2\lambda_x} + \frac{|\dot{y}(S_y)|}{2\lambda_y} + \frac{|\bar{z}|}{2\lambda_z} \right] + E_y(\text{opp}) \left[\frac{\bar{V}}{\lambda_x} + \frac{|\dot{y}(S_y)|}{2\lambda_y} + \frac{|\bar{z}|}{2\lambda_z} \right] \right\}$$

1.8 The longitudinal separation standard for co-altitude aircraft on RNAV routes L642 and M771 is 50NM; for the other four RNAV routes, the longitudinal separation standard is either 10 minutes with Mach Number Technique (MNT) or 80NM RNAV.

1.9 The form of the longitudinal collision risk model used in assessing the safety of operations on the South China Sea RNAV routes is:

$$N_{ax} = P_y(0)P_z(0) \frac{2\lambda_x}{|\dot{x}|} \left[\frac{|\dot{x}|}{2\lambda_x} + \frac{|\dot{y}(0)|}{2\lambda_y} + \frac{|\dot{z}|}{2\lambda_z} \right] \times \sum_{k=m}^N \sum_{K=k}^M Q(k) \times P(K > k)$$

1.10 **Table 5** summarizes the value and source material for estimating the values for each of the inherent parameters of the internationally accepted Collision Risk Model (CRM).

Model Parameter	Definition	Value Used in TLS Compliance Assessment	Source for Value
For Lateral Collision Risk Model			
N _{ay}	Risk of collision between two aircraft with planned 50NM lateral separation	5.0 x 10 ⁻⁹ fatal accidents per flight hour	TLS adopted by APANPIRG for changes in separation minima
S _y	Lateral separation minimum	50NM	Current lateral separation minimum in the South China Sea
P _y (50)	Probability that two aircraft assigned to parallel routes with 50NM lateral separation will lose all planned lateral separation	2.02 x 10 ⁻⁹	Value required to meet exactly the APANPIRG-agreed TLS value using equation (1), given other parameter values shown in this table.
λ _x	Aircraft length	0.0399NM	Based on December 2012 TSD operations on L642/M771
λ _y	Aircraft wingspan	0.0350NM	
λ _z	Aircraft height	0.0099NM	
P _z (0)	Probability of vertical overlap for airplanes assigned to the same flight level	0.538	Commonly used in safety assessments
S _x	Length of half the interval, in NM, used to count proximate aircraft at adjacent fix for occupancy estimates	120NM, equivalent to the +/- 15-minute pairing criterion	Arbitrary criterion which does not affect the estimated value of lateral collision risk
E _y (same)	Same-direction lateral occupancy	0.0	Result of direction of traffic flows on each pair of RNAV routes
E _y (opp)	Opposite-direction lateral occupancy	0.219	Based on December 2012 TSD
\bar{V}	Individual-aircraft along-track speed	507 knots	Based on December 2012 TSD
$ \dot{y}(S_y) $	Average relative lateral speed of aircraft pair at loss of planned lateral separation of S _y	75 knots	Conservative value based on assumption of waypoint insertion error
$ \dot{z} $	Average relative vertical speed of a co altitude aircraft pair assigned to the same route	1.5 knots	Conservative value commonly used in safety assessments

Model Parameter	Definition	Value Used in TLS Compliance Assessment	Source for Value
For Longitudinal Collision Risk Model			
N_{ax}	Risk of collision between two co-altitude aircraft with planned longitudinal separation equal to at least the applicable minimum longitudinal separation standard	5.0×10^{-9} fatal accidents per flight hour	TLS adopted by APANPIRG for changes in separation minima
$P_y(0)$	Probability of lateral overlap for airplanes assigned to the same route	0.2	Based on December 2012 TSD
$ \dot{x}(m) $	Minimum relative along-track speed necessary for following aircraft in a pair separated by m at a reporting point to overtake lead aircraft at next reporting point	100 knots	Based on December 2012 TSD
$ \dot{y}(0) $	Relative across-track speed of same-route aircraft pair	1 knot	Based on December 2012 TSD
m	Longitudinal separation minimum in NM	50NM	Current preferred longitudinal separation minimum on RNAV routes L642 and M771; used for all RNAV routes in TLS compliance assessment
N	Maximum initial longitudinal separation in NM between aircraft pair which will be monitored by air traffic control in order to prevent loss of longitudinal separation standard	150NM	Arbitrary value of actual initial separation beyond which there is negligible chance that actual longitudinal separation will erode completely before next air traffic control check of longitudinal separation based on position reports
M	Maximum longitudinal separation loss in NM observed over all pairs of co-altitude aircraft	Dependent on initial longitudinal separation distance	Based on December 2011 TSD
$Q(k)$	Proportion of aircraft pairs with initial longitudinal separation k	Initial distribution of longitudinal separation for RNAV routes L642 and M771 used in RASMAG/9 safety assessment	Based on December 2012 TSD
$P(K > k)$	Probability that a pair of same-route, co-altitude aircraft with initial longitudinal separation of k NM will lose at least as much as k NM longitudinal	Values derived to satisfy TLS of 50NM longitudinal separation minimum	Based on December 2012 TSD

Model Parameter	Definition	Value Used in TLS Compliance Assessment	Source for Value
For Longitudinal Collision Risk Model			
	separation before correction by air traffic control		

Table 5: Summary of Risk Model Parameters Used in the CRM

Safety Oversight

1.11 **Table 6** summarizes the results of the airspace oversight, as of Dec 2012.

Type of Risk	Risk Estimation	TLS	Remarks
Lateral Risk	1.89×10^{-9}	5×10^{-9}	Below TLS
Longitudinal Risk	7.85×10^{-10}	5×10^{-9}	Below TLS

Table 6: Lateral and Longitudinal Risk Estimation

1.12 **Figure 1** presents the results of the collision risk estimates for each month using the cumulative 12-month LLD and LLE reports since Jan 2012.

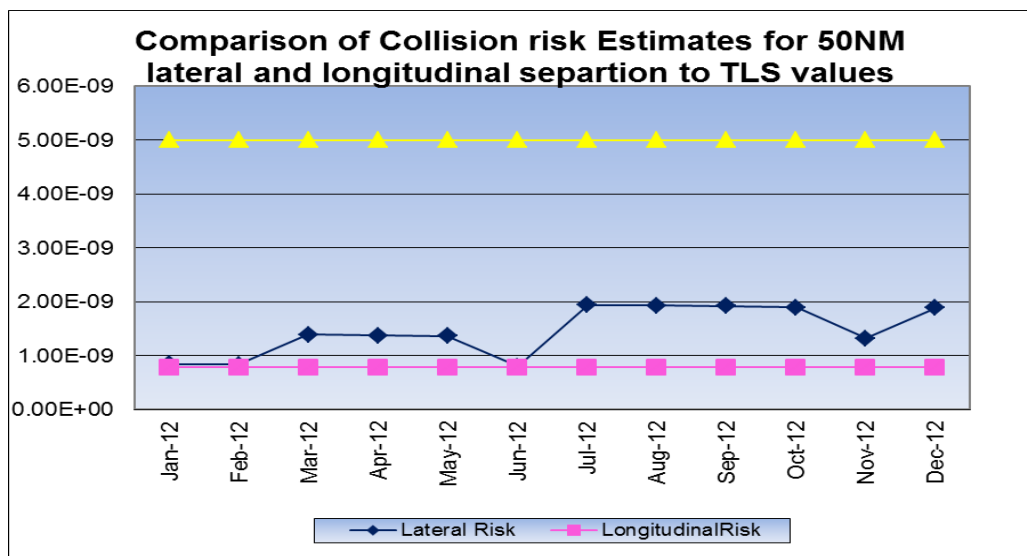


Figure 1 - Assessment of Compliance with Lateral and Longitudinal TLS Values Based on Navigational Performance Observed During South China Monitoring Program

1.13 The estimates of lateral and longitudinal risk show compliance with the corresponding respective TLS values during all months of the monitoring period.