International Civil Aviation Organization

Third Meeting of the Bay of Bengal Reduced Horizontal Separation Implementation Task Force (BOB-RHS/TF/3)

Singapore, 18 – 21 February 2010

Agenda Item 4: Safety Analysis and Airspace Monitoring Issues

LETTER OF AGREEMENT FOR MONITORING OF AIRCRAFT NAVIGATION ERRORS IN THE BAY OF BENGAL AREA

(Presented by Singapore)

SUMMARY

The purpose of this working paper is to discuss the need to establish a program to monitor aircraft navigation errors in the Bay of Bengal area to support the implementation and continued safe operation of reduced horizontal separation minima. This can be achieved by means of an agreed program by the respective States to collect data and reports navigational errors to determine that the target level of safety (TLS) of the operations.

Action by BOB-RHS/TF/3 is at Paragraph 3.

1. INTRODUCTION

1.1 The implementation of reduced horizontal separation minima requires continuous monitoring of aircraft navigation errors. This includes the identification and reporting of any Large Lateral Deviations (LLD) or Large Longitudinal Errors (LLE). This is to ensure that the target level of safety (TLS) of the operations within the airspace in question meets the regionally established TLS.

1.2 Monitoring of aircraft navigation errors is a joint responsibility between the aircraft operators, the States of Registry, and the air navigation services providers of the FIRs concerned. An established program by means of a Letter of Agreement (LOA) could clearly spell out the responsibilities and procedures to be followed by respective States and FIR authorities.

2. DISCUSSION

2.1 Currently, there is no established regional reporting framework for aircraft navigation errors over the Bay of Bengal area since the implementation of the EMARRSH routes in 2002. Moving forward, to further improve safety and efficiency for flights traversing across the Bay of Bengal area, there is a need to start the monitoring of aircraft navigation errors in the area.

2.2 The first step to this would be to identify suitable designated areas which monitoring can be done by means of surveillance. This is usually from the point an aircraft leaves the surveillance coverage till the point where it will enter surveillance coverage again. There are also occasions that the

monitoring is done within total surveillance coverage. On day-to-day basis, air traffic controllers carrying out their ATC duties should be the front line first person to initiate the report should they encounter any aircraft with navigational errors.

2.3 There is also a need to collect the traffic movement count for each route portion in the area. This will make up the figures required for the analysis to compute the Target Level of Safety (TLS). The traffic movements along with any occurrences of navigational errors are computed on a monthly basis. As such there's a need to collect monthly traffic movement counts.

2.4 A Letter of Agreement should be put in place as agreed by the relevant States to ensure that the procedures for reporting of navigation errors and traffic movement counts are clearly spelt out. An example of such an LOA that is used for the monitoring of aircraft navigation errors for the South China Sea area can be found on the Appendix A.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) Note the need for a program to continuously monitor aircraft navigation errors for the implementation of reduced horizontal separation.

b) Identify the areas where monitoring of aircraft navigation errors can be carried out.

c) Discuss a way forward to commence the monitoring program by way of an LOA amongst the States concerned.

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OPERATIONAL LETTER OF AGREEMENT BETWEEN

General Administration of Civil Aviation of China	China
Civil Aviation Department	Hong Kong, China
Directorate General of Civil Aviation	Indonesia
Department of Civil Aviation	Malaysia
Air Transportation Office	Philippines
Civil Aviation Authority	Singapore
Aeronautical Radio of Thailand Ltd	Thailand
Civil Aviation Administration	Viet Nam

FOR

MONITORING OF AIRCRAFT NAVIGATION ERRORS

IN THE

SOUTH CHINA SEA AREA

Operational Letter of Agreement

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Operational Letter of Agreement

Overview

Introduction

The following document is a Letter of Agreement (LOA) between those Air Traffic Service (ATS) authorities shown on page one of this document. The letter of agreement details monitoring procedures between the following ATS units:

Bangkok ACC	Hanoi ACC
Ho Chi Minh ACC	Hong Kong ACC
Jakarta ACC	Kota Kinabalu ACC
Kuala Lumpur ACC	Manila ACC
Sanya ACC	Singapore ACC

Objective

The objective of this LOA is to define agreed procedures for the monitoring, notification, investigation, analysis and reporting of aircraft navigation errors in respect of aircraft to which reduced horizontal separation minima is applied when operating on the following designated RNAV routes:

L642	M771	N892
L625	M767	N884

Scope

The procedures contained in this LOA implement the performance monitoring requirements associated with the introduction of the reduced horizontal separation standard, and for the reporting and monitoring of gross lateral and longitudinal navigational errors.

For the purposes of this LOA, the term ‘Service Providers’ refers to organisations which are responsible for the provision of Air Traffic Control (ATC) services.

The term ‘Regulatory Authority’ refers to those organizations responsible for the investigation of navigational errors. In some cases, the Regulatory Authority may be the same as the Service Provider.

Effective Date

This letter of agreement becomes effective on 23 June 2008

Overview, continued

Background

The use of these horizontal separation standards is restricted to aircraft which meet the requirements detailed in the respective States' AIP Supplements. This includes a requirement for RNP 10 / RNP 4 Performance Based Navigation (PBN) approval and it is the responsibility of the operator to ensure that such requirements are satisfied when so declared.

PBN approval includes operators meeting certain requirements with regard to crew training and in-flight operating procedures. The responsibility for approval for such operations rests with the State of Registry of the Operator.

Monitoring navigation errors is a joint responsibility between the aircraft operators, the States of Registry, and the ATC providers. There are established requirements for the operators to monitor navigation performance under the terms of their PBN Approval. This document sets out the responsibilities and procedures to be followed by staff of the signatory organizations to this LOA.

Area of Applicability

The procedures outlined in this LOA shall be applied to all aircraft operating on the following designated RNAV routes:

L642	M771	N892
L625	M767	N884

Monitoring Procedures

Lateral Deviations

Monitoring shall be based on radar observations.

When the radar controller observes a lateral deviation of 15NM or more, the controller shall:

- Immediately advise the pilot in command; and
- Provide the 'Duty Supervisor' with the necessary information to enable Part 1 of the Navigation Error Investigation Form (as shown in **Appendix A**) to be completed.

Where an aircraft is off-track as the result of ATC approved diversion (e.g. due weather), no notification under the terms of this Letter of Agreement need be submitted.

Longitudinal Deviations

Monitoring of longitudinal errors shall be accomplished by reporting occurrences where the observed longitudinal separation, following a check, is either less or more than the expected longitudinal separation as detailed below.

Where a time standard is being used, this check will follow the receipt of a routine position report. Notification, in accordance with **Appendix A**, shall be submitted in all cases where:

- The separation standard is infringed; or
- The expected time between two aircraft varies by 3 minutes or more, even if the applicable separation standard is not infringed; or
- A pilot estimate varies by 3 minutes or more from that advised in a routine position report.

Where a distance standard is being used, the check may be based on ADS, radar observations, or it may be the result of a specific request for RNAV distance reports. Notification, in accordance with **Appendix A**, shall be submitted in all cases where:

- The separation standard is infringed; or
- The expected distance between two aircraft varies by 10NM or more, even if the applicable separation standard is not infringed.

Notification Procedures

Action by ATC Unit	The duty supervisor, when advised of the deviation, shall be responsible for completion and submission of a Navigation Error Investigation Form. A copy of the aircraft's flight plan shall be attached to the Navigation Error Investigation Form, and forwarded to the Chief of ATC. The Chief of ATC shall forward copies of the Navigation Error Investigation Form (Parts 1 to 4) to the aircraft operator and the State of Registry of the aircraft or the State of the Operator, as considered appropriate. In addition, the copy for the aircraft operator shall be sent with a covering letter (as provided in **Appendix A**) requiring the operator to complete the Navigation Error Investigation Form and to provide reasons for the error.

Investigation Procedures

Investigation Procedures

The investigation of errors notifiable under this Letter of Agreement is a joint responsibility of the operator, the Regulatory Authority of the airspace in which the error occurred, and the State of Registry or State of the Operator of the aircraft involved.

The initial investigation shall be undertaken by the aircraft operator, who is responsible for supplying all data and comments needed to complete the form at **Appendix A**. The completed reports are to be returned by the operator to the originating Regulatory Authority. For aircraft registered in States not included in this LOA, these reports are also to be forwarded to the State of Registry of the aircraft or the State of the operator.

Further action by States other than signatories to this LOA is outside the scope of this agreement, and shall be at the discretion of that State.

On receipt of the completed report from the aircraft operator, the relevant Regulatory Authority will first check that all information required has been supplied and, if necessary, the Regulatory Authority shall request and further information from either the operator, the State of the Operator, or the State of Registry of the aircraft.

If the completed form from the aircraft operator is not received within 14 days of the date of dispatch, the Regulatory Authority will contact the operator and request the completed form.

Once the completed information has been received, the Regulatory will complete Part 5 of the Navigation Error Investigation Form as detailed in **Appendix A**. The cause of the error is to be classified in accordance with the criteria specified in Part 5.

The decision as to whether any further investigation is warranted will be taken by the Regulatory Authority based on their assessment of the seriousness of the error.

Analysis of Errors & Reporting

At the end of each month, Service Providers shall forward to the Air Traffic Services Division, Civil Aviation Authority of Singapore (CAAS), a copy of all completed Navigation Error Investigation Forms (Parts 1 to 5) covering reported errors or nil reports for that month, together with data on the number of movements on the routes being monitored as recorded by the relevant Flight Data Processing System, or other auditable means.

CAAS shall be responsible for calculation of the frequency of the errors, in accordance with Doc 7030.

Each six months, the Monitoring Authority should prepare an assessment schedule setting out the results of the monitoring for the preceding six-month period and forward a copy of this schedule to:

a. All signatory States to the Monitoring Letter of Agreement; and

b. The Chairman of the APANPIRG ATM/AIS/SAR Sub-Group, through the ICAO Bangkok Office.

Permitted Error Rate Exceeded

Where the summary statistics show a long term trend which could result in the Permitted Error Rate being exceeded, ATC Authorities of the States concerned, in conjunction with the ICAO Regional Office, will jointly consider the causes, to determine if the problems can be eliminated, and to take appropriate remedial action.

Revision

This LOA shall remain in force until it is cancelled or superseded.

For any reason, which might make it advisable to change this agreement and its associated attachments, the interested State shall propose the pertinent revision.

Operational Letter of Agreement

Authority

China	Name Designation Department
Hong Kong, China	Name Designation Department
Indonesia	Name Designation Department
Malaysia	Name Designation Department

Continued on next page

Authority, Continued

Philippines	Name Designation Department
Singapore	Name Designation Department
Thailand	Name Designation Department
Viet Nam	Name Designation Department

Operational Letter of Agreement

Appendix A

NAVIGATION ERROR REPORT

Dear

Air Traffic Control service providers are monitoring traffic on routes in the South China Sea Area, as part of the implementation of reduced separation minima on those routes.

These procedures require the reporting and investigation of:

i) Lateral tracking errors of 15NM or more;

ii) Variations of longitudinal separation of three minutes or more; or

iii) Variations of longitudinal separation of 10NM or more.

A Navigation Error Investigation Form relating to one of your aircraft is enclosed.

An investigation of this occurrence is required. A detailed explanation should be provided within 10 days, using the attached Navigation Error Investigation Form. In your reply, you are also requested to indicate any corrective action taken to prevent future occurrences.

Yours faithfully,

NAVIGATION ERROR NVESTIGATION FORM

Instructions for Service Provider responsible officer:

Please ensure that Part 1 of this form has been completed to the maximum extent possible, and distribute according to the requirements of the Letter of Agreement on monitoring of aircraft navigation errors in the South China Sea Area.

Instructions for aircraft owner/operator:

Please supply any details required in Part 1 of this form which have not already been completed, together with the information requested in Parts 2, 3 and 4 (if applicable), and return to:

[*Appropriate Regulatory Authority*]

Instructions for Investigating Agency (Regulatory Authority):

Please complete Part 5 of this form and return to:

[*Appropriate Service Provider*]

NAVIGATION ERROR INVESTIGATION FORM

PART 1 - To be completed by responsible officer in the Service Provider (and aircraft owner/operator if need)		
ATC Unit Observing Error:		
Date/Time (UTC):		
Type of Error: (tick one) ☐ LATERAL ☐ LONGITUDINAL		
Details of Aircraft		
	First Aircraft	**Second Aircraft (when longitudinal deviation observed)**
Aircraft Identification:		
Name of owner/Operator:		
Aircraft Type:		
Departure Point:		
Destination:		
Route Segment:		
Cleared Track:		
Position where error was observed: (BRG/DIST from fixed point or LAT/LONG)		
Extent of deviation – magnitude and direction: (NM for lateral, min/NM for longitudinal)		
Flight Level:		
For All Errors		
Action taken by ATC:		
Other Comments:		

**** (Please Attach ATS Flight Plan)**

NAVIGATION ERROR INVESTIGATION FORM

PART 2 - Details of Aircraft, and Navigation and Communications Equipment Fit (To be completed by aircraft owner/operator)			
LRNS	**Number of Systems (0, 1, 2 etc.)**	**Make**	**Model**
INS			
IRS			
GNSS			
FMS			
Others (please Specify)			
COMS			
HF			
VHF			
SATCOM			
CPDLC			
Which navigation system was coupled to the autopilot at the time of observation of the error?			
Which NAV MODE was selected at the time of observation of the error?			
Which comms system was in use at the time of observation of the error?			
Aircraft registration and model/series			
Was the aircraft operating according to PBN requirements?		☐Yes ☐ No	

NAVIGATION ERROR INVESTIGATION FORM

PART 3 – Detailed description of incident (To be completed by owner/operator – use separate sheet if required)
Please give your assessment of the actual track flown by the aircraft, and the cause of the deviation:
Corrective action proposed:

PART 4 – To be completed by owner/operator, only in the event of partial or total navigation equipment failure.			
Nav System Type	**INS**	**IRS/FMS**	**Others (Please specify)**
Indicate the number of units of each type which failed			
Indicate position at which failure(s) occurred			
Give an estimate of the duration of the equipment failure(s)			
At what time were ATC advised of the failure(s)?			

NAVIGATION ERROR INVESTIGATION FORM

PART 5 – To be completed by investigating agency		
Have all required data been supplied?	□ Yes	□ No
Is further investigation warranted?	□ Yes	□ No
Will this incident be the subject of a separate report?	□ Yes	□ No

General comments:

Classification: (please circle) A B C D E F G H I

CLASSIFICATION OF GROSS NAVIGATION ERRORS

Class	**Cause**
A	Aircraft not approved to PBN requirements
B	ATC system loop error
C	Waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position
D	Other navigation errors, including equipment failure notified to ATC in time for action
E	Other navigation errors, including equipment failure notified to ATC too late for action
F	Other navigation errors, including equipment failure of which notification was not received by ATC
G	Mode select error
H	Weather deviation (other than approved)
I	Other (please specify):

Procedures for the Assessment of Aircraft Navigation Errors In Support of the Implementation of Reduced Horizontal Separation Minima In the South China Sea Area

1. Introduction

1.1 This document provides guidance on the methodology to be adopted in the assessment of navigation errors associated with the implementation of reduced horizontal separation minima in the South China Sea Area.

1.2 This document should be read in conjunction with the Letter of Agreement between States of the South China Sea Area, entitled *"Letter of Agreement for the Monitoring of Aircraft Navigation Errors in the South China Sea Area"*.

2. Data Gathering Responsibility

2.1 The States responsible for the gathering and onwards forwarding of data relating to the monitoring letter of agreement, and the monitoring areas identified in paragraph 4, shall be Hong Kong China, the Philippines, and Singapore.

2.2 Data gathering requirements are detailed in paragraph 5.

3. Monitoring Authority

3.1 Civil Aviation Authority of Singapore (CAAS) shall be responsible for the collection and reporting of navigation error.

4. Designated Monitoring Areas

4.1 In order to validate the monitoring requirements supporting the reduction in horizontal separation minima, it is necessary to assess the track keeping ability of aircraft operating on the route structure, whilst they have been using on-board RNAV navigation systems only, for a maximum period of time, relative to the route being flown.

4.2 It is also essential that observation of the navigation of the aircraft, using radar, occurs before the on-board navigation systems have been able to "up-date" using ground-based navigation aids, such as DME/DME, or VOR/VOR.

4.3 In assessing navigation errors on the 6 core routes – ie L642, M771, N892, L625, N884 and M767 – there are only six appropriate areas at which the required monitoring may be undertaken, given the extensive ground-based navigation aid coverage in the South China Sea Area.

4.4 These areas are the route segments between:

a) DULOP and DUMOL on M771
b) AKOTA and AVMUP on L625
c) LULBU and LEGED on N884
d) MELAS and MABLI on N892
e) ESPOB and ENREP on L642
f) TEGID and BOBOB on M767

4.5 Monitoring of aircraft on these route segments should be undertaken as soon as possible after the aircraft enters radar coverage.

4.6 It should be noted that navigation error reports relating to areas other than those stated above, should also be processed and reported on, in order to support data gathering for future reductions in lateral and longitudinal separation. Details on the processing of these reports are given at paragraph 7.

5. Collection and Forwarding of Data

5.1 Those States identified in Paragraph 2, are required, at the end of each month, to collect the following data:

a) Recorded navigation errors at the required monitoring areas, by way of the "Navigation Error Investigation Form", as detailed in the Letter of Agreement on the Monitoring of Navigation Errors; and

b) Total monthly movement statistics relating to air traffic passing the designated monitoring areas within the designated monitoring height band.

Note: The recording of monthly traffic movement statistics in the monitoring areas should be auditable – in other words, some formal method of recording the movements – eg copies of flight progress strips or data from Flight Data Processing Systems – should be available for audit if required.

5.2 After collection, the required data should be forwarded to the Monitoring Authority (CAAS), for assessment, to arrive not later than 15 days from the end of the month within which the data was collected. This will allow time for the Navigation Error Investigation Forms relating to occurrences near the end of a month, to be processed and returned as detailed in that form.

5.3 In respect of paragraph 5.1.a), if there have been no error reports submitted, a "Nil Return" should be submitted to the Monitoring Authority.

6. Assessing of Navigation Errors

6.1 The monitoring requirements associated with the introduction of the reduced horizontal separation minima will be in accordance with the requirements for RNP10 / RNP4 PBN, i.e. aircraft navigation performance shall be such that the standard deviation of lateral track errors shall be in accordance with the PBN requirement.

6.2 The requirements will be met, if the number of navigation errors by approved flights, measured in the monitoring area, divided by the total number of approved flights over those monitoring points, is less than the required parameters, over a period of time for the PBN requirement. (See Appendix B).

6.3 The assessments for each month should be recorded separately, and also cumulatively, on a month-to month basis. If the assessment in any particular month exceeds the required parameter, a check should be made to ensure that the cumulative assessment does not also exceed the required parameter.

6.4 If a trend is identified, which indicates that the required parameter is being exceeded regularly, or the cumulative assessment indicates a upwards trend, the Monitoring Authority should notify, though the ICAO Bangkok Office, the APANPIRG ATM/AIS/SAR Sub-Group, which should then investigate the need for a review of the applicable procedures.

6.5 An example of an assessment schedule is shown at Appendix B.

7. Processing of Navigation Error Reports Relating to Areas Other Than Required Monitoring Areas

7.1 The Letter of Agreement on the Monitoring of Navigation Errors required all participating States to notify all appropriate navigation errors to the Monitoring Authority. This data should be collated and assessed in the following manner.

7.2 If the navigation error report relates to aircraft tracking on RNAV routes L625, L642, M767, M771, N884, or N892, the error should be assessed and processed in accordance with paragraph 6 above.

7.3 If the report relates to aircraft tracking on other routes, the errors should be assessed, and recorded separately. This information should be assessed by the APANPIRG ATM/AIS/SAR Sub-Group meeting, for appropriate action.

8. Reporting Procedures

8.1 The Monitoring Authority should prepare an assessment schedule (refer to Appendix B), and forward a copy of this schedule, at least every 6 months, to:

a) All signatory States to the Monitoring Letter of Agreement; and

b) The Chairman of the APANPIRG ATM/AIS/SAR Sub-Group, through the ICAO Bangkok Office.

8.2 In addition, a report should be prepared on those errors reported in accordance with paragraph 7.3 above.

9. Attachments

Appendix A – Assessment Schedule Process
Appendix B – Sample Assessment Schedule

Appendix A

Assessment Schedule Process For Designated Monitoring Areas

STEP 1.

Hong Kong, Philippines and Singapore carry out a total monthly traffic count for approved traffic at FL290 and above, over the points:

a) DULOP and DUMOL on M771
b) AKOTA and AVMUP on L625
c) LUBLU and LEGED on N884
d) MELAS and MABLI on N892
e) ESPOB and ENREP on L642
f) TEGID and BOBOB on M767

STEP 2.

Hong Kong, Philippines and Singapore collate all Navigation Error Investigation Forms.

STEP 3.

Not later than the 15th day of each month, send the statistics gathered in Steps 1 and 2, to the Monitoring Authority (CAAS).

STEP 4.

The Monitoring Authority collates the information into an assessment schedule.

STEP 5.

Each 6 months, the assessment schedule is sent to:

a) All signatory States to the Monitoring Letter of Agreement; and

b) The Chairman of the APANPIRG ATM/AIS/SAR Sub-Group, through the ICAO Bangkok Office.

STEP 6 (if required).

If the trend in errors is increasing, notify, through the ICAO Bangkok Office, the APANPIRG ATM/AIS/SAR Sub-Group, for appropriate action.

Appendix B

Example of Navigation Error Assessment Schedule For Designated Monitoring Areas

a. Example of Monthly Total – Single Area

Month/ 2007	Total traffic at DULOP/DUMOL	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	3105	1	0	3.22×10^{-4}	0
May	3042	2	0	6.57×10^{-4}	0
June	2810	0	0	0	0
July	2995	1	1	3.34×10^{-4}	3.34×10^{-4}

Category 1 => 30NM Category 2 = 50 – 70NM

b. Example of Cumulative Monthly Total – Single Area

Month/ 2007	Total traffic at DULOP/DUMOL	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	3105	1	0	3.22×10^{-4}	0
May	6147	3	0	4.88×10^{-4}	0
June	8957	3	0	3.35×10^{-4}	0
July	11952	4	1	3.34×10^{-4}	8.36×10^{-3}

Category 1 => 30NM Category 2 = 50 – 70NM

c. Example of Monthly Total – All Six Areas

Month/ 2007	Total traffic at Areas	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	7852	2	0	2.55×10^{-4}	0
May	8311	2	0	2.41×10^{-4}	0
June	8263	1	0	1.21×10^{-4}	0
July	7678	1	1	1.30×10^{-4}	1.30×10^{-4}

Category 1 => 30NM Category 2 = 50 – 70NM

d. Example of Cumulative Monthly Total – All Six Areas

Month/ 2007	Total traffic at Areas	Errors Category 1	Errors Category 2	Error Rate Category 1	Error Ratio Category 2
April	7852	2	0	2.55×10^{-4}	0
May	16163	4	0	2.47×10^{-4}	0
June	24426	5	0	2.05×10^{-4}	0
July	32104	6	1	1.87×10^{-4}	3.11×10^{-3}

Category 1 => 30NM Category 2 = 50 – 70NM