International Civil Aviation Organization

The Twenty-First Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/21)

Bangkok, Thailand, 14-17 June 2016

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

ANALYSIS OF HOT SPOTS

(Presented by MAAR)

SUMMARY

This paper presents a separate analysis of each hot spot area in the Bay of Bengal, Arabian Sea, and Indian Ocean (BOBASIO) area and in the Western Pacific/South China Sea (WPAC/SCS) area.

1. INTRODUCTION

1.1 Based on vertical airspace safety analysis of BOBASIO (abbreviated as BOB in this paper) and WPAC/SCS regions in the recent years, a few areas have been identified as hot spots, where risks caused by Large Height Deviations (LHDs) are relatively higher than the other areas. These areas are:

- the western boundary of the Mumbai FIR, which interfaces with Mogadishu, Sana, and Muscat FIRs;
- the TCPs along Kolkata-Chennai FIRs and Yangon-Kuala Lumpur FIRs; and
- the boundary of Manila FIR interfacing its surrounding FIRs.

1.2 Due to the different nature of LHDs in these hot spots, this paper presents a more detailed analysis of each hot spot in order to understand the situations and find appropriate remedial actions.

2. DISCUSSION

The western boundary of the Mumbai FIR

2.1 2015 BOB traffic sample data (TSD) and LHDs occurred in Mumbai FIR were used in the risk calculation. Risk in this assessment is in the unit of fatal accident per BOB flight hours and, therefore, could be directly compared to BOB risk. The total risk in Mumbai FIR accounted for **19 x 10^{-9}** FAPFH or **61%** of total operational risk in BOB.

2.2 **Figure 1** shows this newly emerged hot spot area – the western boundary of the Mumbai FIR, which interfaces with Mogadishu, Sana, and Muscat FIRs. The area is mostly remote oceanic airspace and therefore, has poor communication coverage.

- the navy dotted line represents the frequency of occurrences at the labeled waypoint,
- the color of each circle represents the sum of minutes at incorrect flight level and the number of flight levels crossed without clearance (darker orange represents higher value) associated with LHDs occurring at or near the labeled waypoint, and the area of the circle represents the sum of operational risk associated with LHDs occurring at or near the labeled waypoint, calculated based on 2015 BOB TSD.

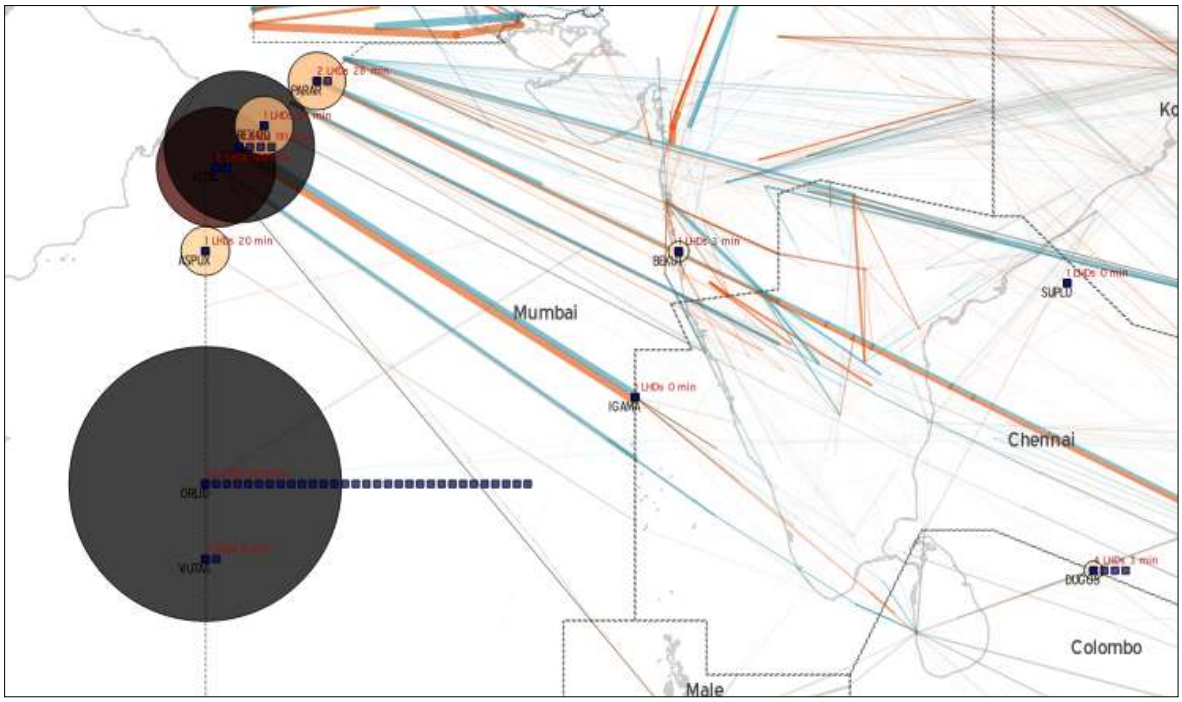

Figure 1: LHDs on the western boundary of Mumbai FIR in 2015

2.3 **Figure 2** depicts monthly risk of this hot spot in the unit Fatal Accident Per [BOB] Flight Hour (FAPFH). Each block corresponds to each LHD event in Mumbai FIR and the height of each block shows the risk associated with the event. The red line indicates the risk level of 0.4167 x 10^{-9} FAPFH, which is the average monthly risk corresponding to annual risk of 5.0 x 10^{-9} FAPFH.

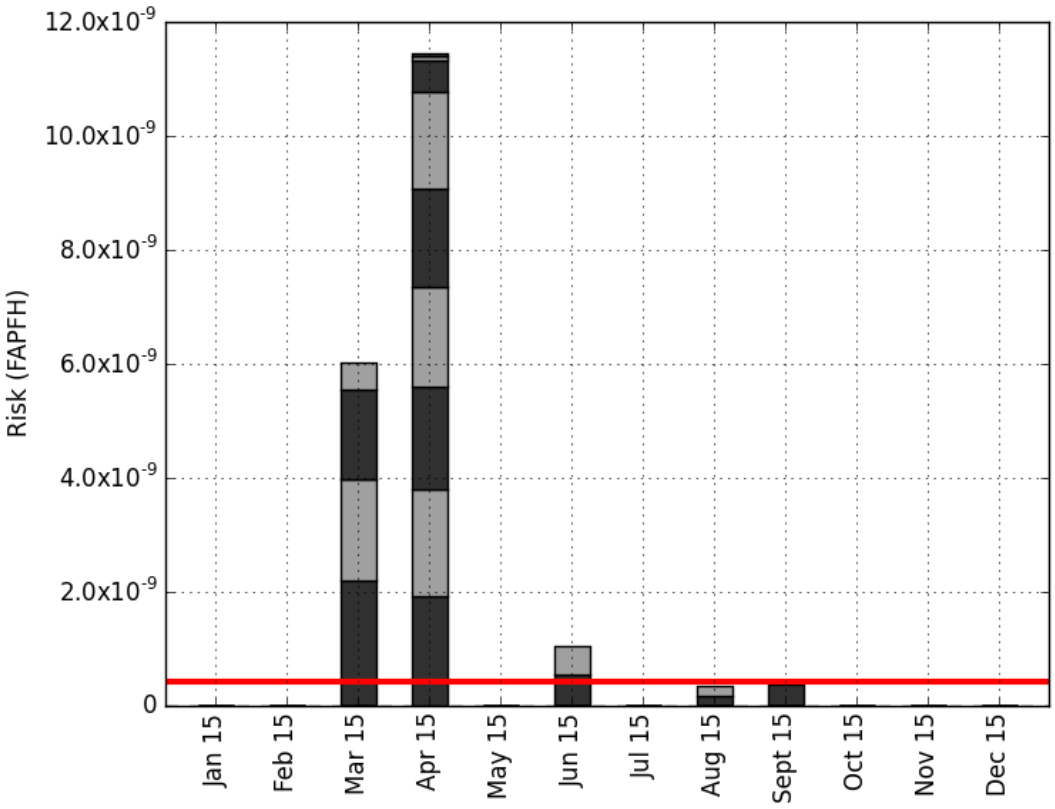

Figure 2: Monthly risk per LHD on the western boundary of Mumbai FIR

2.4 Almost all of LHDs in this hot spot were the result of error in communication between ATC and ATC due to human factor issue (Cat E LHD). They either have zero/short duration or very long duration. Although there were 47 non-nil LHD events, operational risk in 2015 was a result of only 18 LHDs with long duration, mostly occurred in March and April.

2.5 All these long-duration LHDs are breakdowns in coordination between Mogadishu and Mumbai FIR or Muscat and Mumbai FIR. The absence of transfer message together with the lack of surveillance and poor communication service in the area resulted in aircraft traversing the whole Mumbai FIR without Mumbai OCC's knowledge. The LHD with the highest risk spanned 2 hours and accounted for 2.21×10^{-9} FAPFH or 45 % of TLS for the whole year.

2.6 Upon the receipt of these LHD reports in July, MAAR raised the issue to the attention of AFI Regional Monitoring Agency (ARMA) who oversees Mogadishu FIR and the Middle East Regional Monitoring Agency (MIDRMA) who oversees Muscat FIR. Airport Authority of India (AAI) also sent written complaints to the concerned ACCs.

2.7 To investigate the events, ARMA worked with Flight Information Service for Somalia (FISS), who was providing the area control service from ICAO Eastern and Southern African (ESAF) Regional Office, Nairobi, for Mogadishu FIR's upper airspace. Further investigation revealed that Sanaa FIR was closed on the 26th of March 2015, and traffic was rerouted through Mogadishu FIR. The re-route timeline was consistent with LHD spike in March and April, and therefore, might be attributed to an increase in ATC workload from re-directed traffic through Mogadishu FIR. However, a few of such long-duration LHDs were still being reported in the first quarter of 2016 even with the reopening of Sana FIR.

2.8 MIDRMA notified Muscat ACC of the situation. However, MAAR has not received any further information regarding the issue yet. The MAAR will also keep trying to gain some response from the MIDRMA regarding this issue.

The TCPs along Kolkata-Chennai FIRs and Yangon-Kuala Lumpur FIRs

2.9 2015 BOB TSD and LHDs occurred in Kolkata, Dhaka, Kuala Lumpur and Yangon FIRs were used in the risk calculation. Risk in this assessment is in the unit of fatal accident per BOB flight hours and, therefore, could be directly compared to BOB risk. The total risk in this hot spot area accounted for **7.66×10^{-9}** FAPFH or **24%** of all operational risk in the BOB.

2.10 **Figure 3** shows the LHDs in the area where Kolkata and Chennai FIRs interface with Yangon and Kuala Lumpur FIRs in 2015. A total of 310 occurrences in this hot spot area accounted for 7.66 x10-9 FAPFH, a slight decrease from 10.44×10^{-9} FAPFH in 2014.

2.11 Nonetheless, the number of occurrences increased from 2014. The reported LHDs seemed to concentrate in the upper part near Dhaka FIR and the lower part around IGOGU.

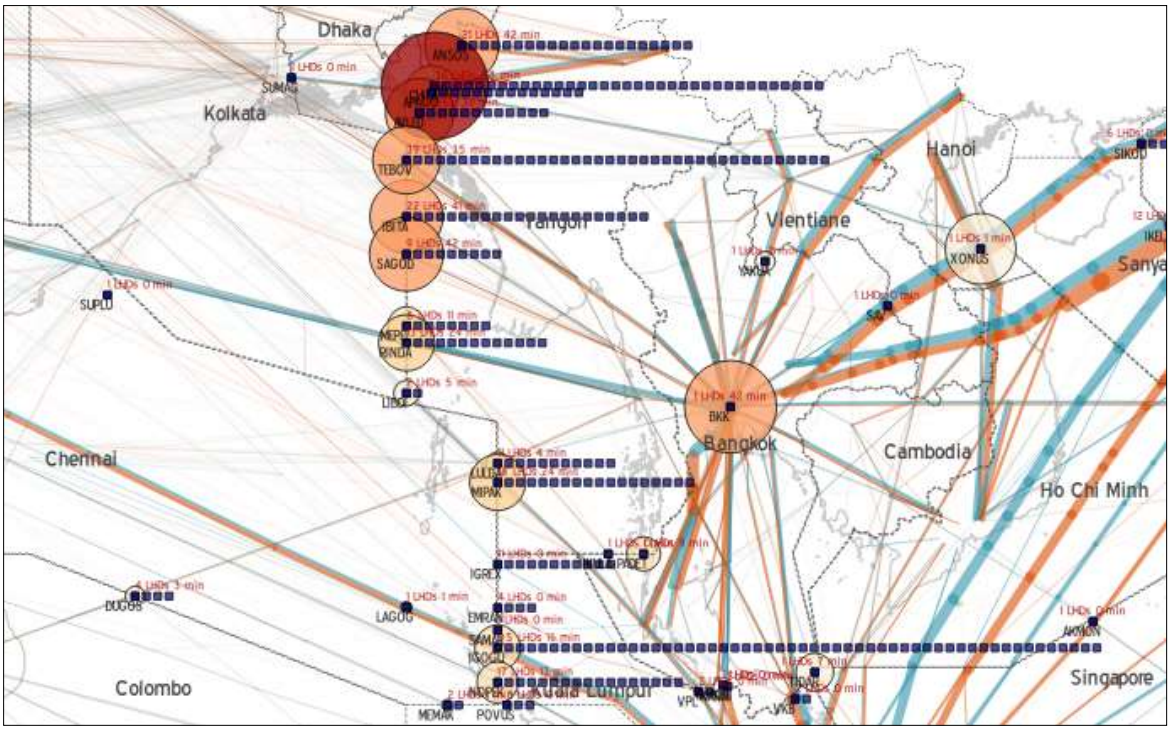

Figure 3: LHDs along Kolkata-Chennai FIRs and Yangon-Kuala Lumpur FIRs in 2015

2.12 **Figure 4** depicts monthly risk of this hot spot in the unit Fatal Accident Per [BOB] Flight Hour (FAPFH). Each block corresponds to each LHD event in this hot spot area and the height of each block shows the risk associated with the event.

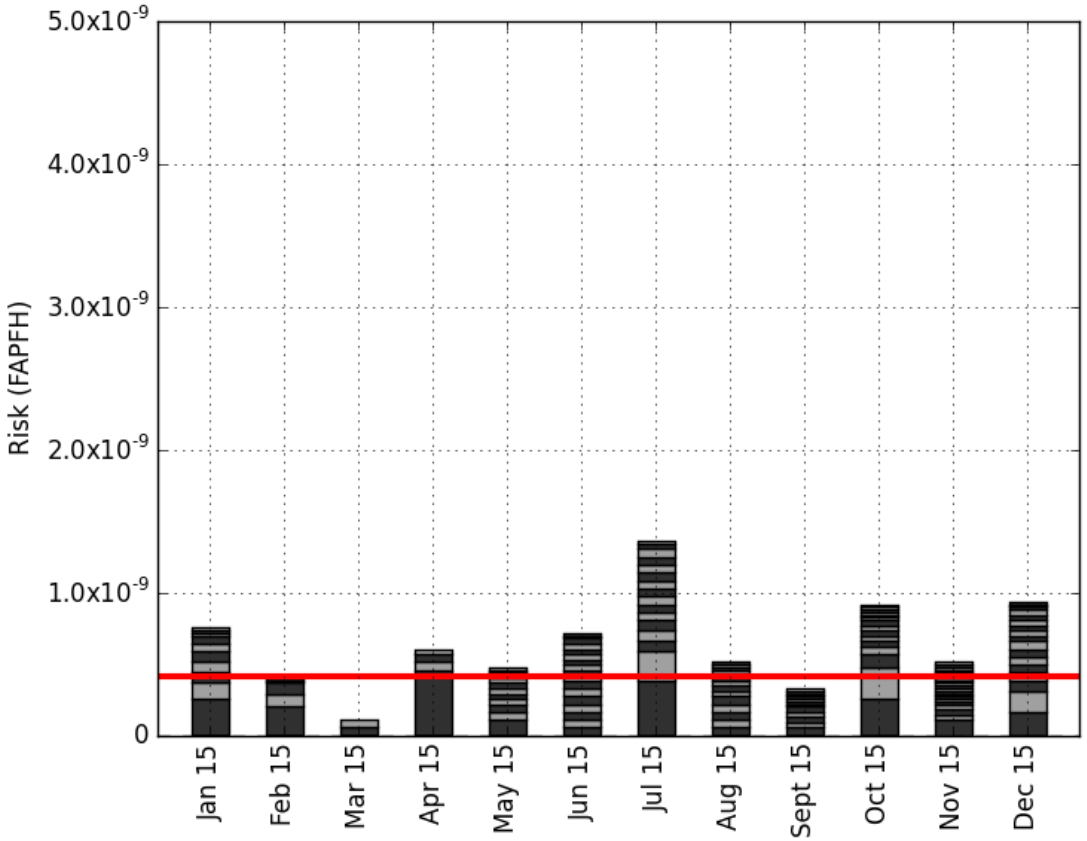

Figure 4: Monthly risk per LHD along Kolkata-Chennai FIRs and Yangon-Kuala Lumpur FIRs

2.13 Risk in this hot spot was driven by several short duration Category E LHD occurrences, which could be further classified into sub-categories. **Figure 5** shows contribution of each sub-category in term of number of occurrences and **Figure 6** shows contribution in term of risk.

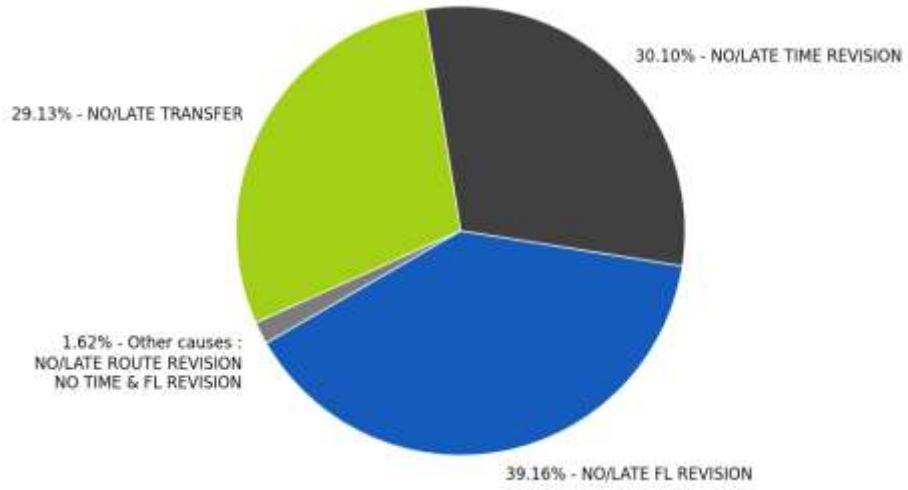

Figure 5 Cat E LHDs by sub-category (number of occurrences)
along Kolkata-Chennai FIRs and Yangon-Kuala Lumpur FIRs in 2015

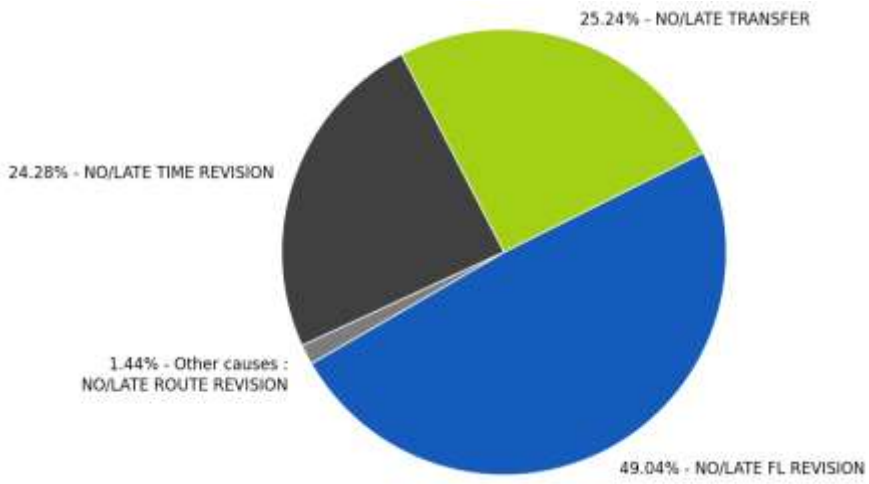

Figure 6 Cat E LHDs by sub-category (risk)
along Kolkata-Chennai FIRs and Yangon-Kuala Lumpur FIRs in 2015

2.14 The three predominant sub-categories were no/late transfer, no/late flight level revision, and no/late time revision. Although the number of occurrences was approximately the same for these three sub-categories, no/late flight level revision accounted for almost half of the risk in this hot spot area.

Updated Action Plan for BOBASIO Hot Spots

2.15 There have been initiatives in the attempt to reduce LHDs since the situation came into light in 2013. The States concerned initiated plans to share ADS-B data and to implement AIDC on the problematic interfaces.

2.16 In late August 2015, MAAR had an opportunity to attend the Fifth ATS Coordination meeting of Bay of Bengal, Arabian Sea and Indian Ocean Region (BOBASIO/5) with the intention to

raise the issue to the concerned parties. MAAR presented a safety assessment paper to the meeting and also proposed that BOBASIO took up the role of the scrutiny group for the region since the delegates already consisted of ATS specialists from the concerned units and IATA. The proposal was well received by the meeting. The first task of the scrutiny group was to set up a uniform procedure to handle cross-boundary LHDs for all BOBASIO States. The scrutiny group's initial action plan was submitted to ICAO APAC Regional Office in December 2015. The plan also includes initiatives mentioned in 2.15.

2.17 MAAR has continuously queried States involved for the status of the procedure's implementation. MAAR has received no feedback from any State except India and Myanmar.

2.18 Airport Authority of India (AAI) informed MAAR that the LHD handling procedure has been implemented; AAI's Corporate Head Office issued an Air Traffic Management Circular to all controllers in India. The ATM Circular emphasizes the need to strictly follow the Coordination Procedures and the Letter of Agreement that exist between two different ATS units.

2.19 Myanmar informed MAAR that they have implemented the LHD handling procedure, and also re-sectorized their airspace from 2 sectors into 4 sectors from May 26th onwards, which should help reduce controllers' workload.

2.20 Full details and updates of the action plan are appended in **Appendix A**.

Additional Recommendation regarding Long-Duration LHDs

2.21 Due to its high risk nature, the MAAR would recommend concerned parties to conduct a thorough investigation on each long-duration LHD to find out defects in each of their safety barriers. For example:

- Why was the transfer not sent to the accepting unit?
- Did the aircraft have ADS-C capability? If so, why was the aircraft not logged-on to Mumbai OCC's service?
- Why did/could the flight crew not contact Mumbai OCC during the entire flight time in the Mumbai FIR?

The boundary of Manila FIR

2.22 2015 Manila's TSD and LHDs occurred in Manila FIR were used in the risk calculation. Risk is calculated by using Manila FIR flight hours, and therefore, Manila risk **could not** be directly compared to WPAC/SCS risk.

2.23 **Figure 7** shows a total of 95 non-nil LHDs reported near Manila FIR boundary. Out of 95 LHDs, 60 occurred inside Manila FIR boundary, where 19 were non-zero-duration LHDs contributing to the risk. These 19 non-zero-duration LHDs concentrated on the transfer-of-control points where there were surveillance gaps, such as the Manila-Hong Kong and Manila-Ho Chi Minh interfaces.

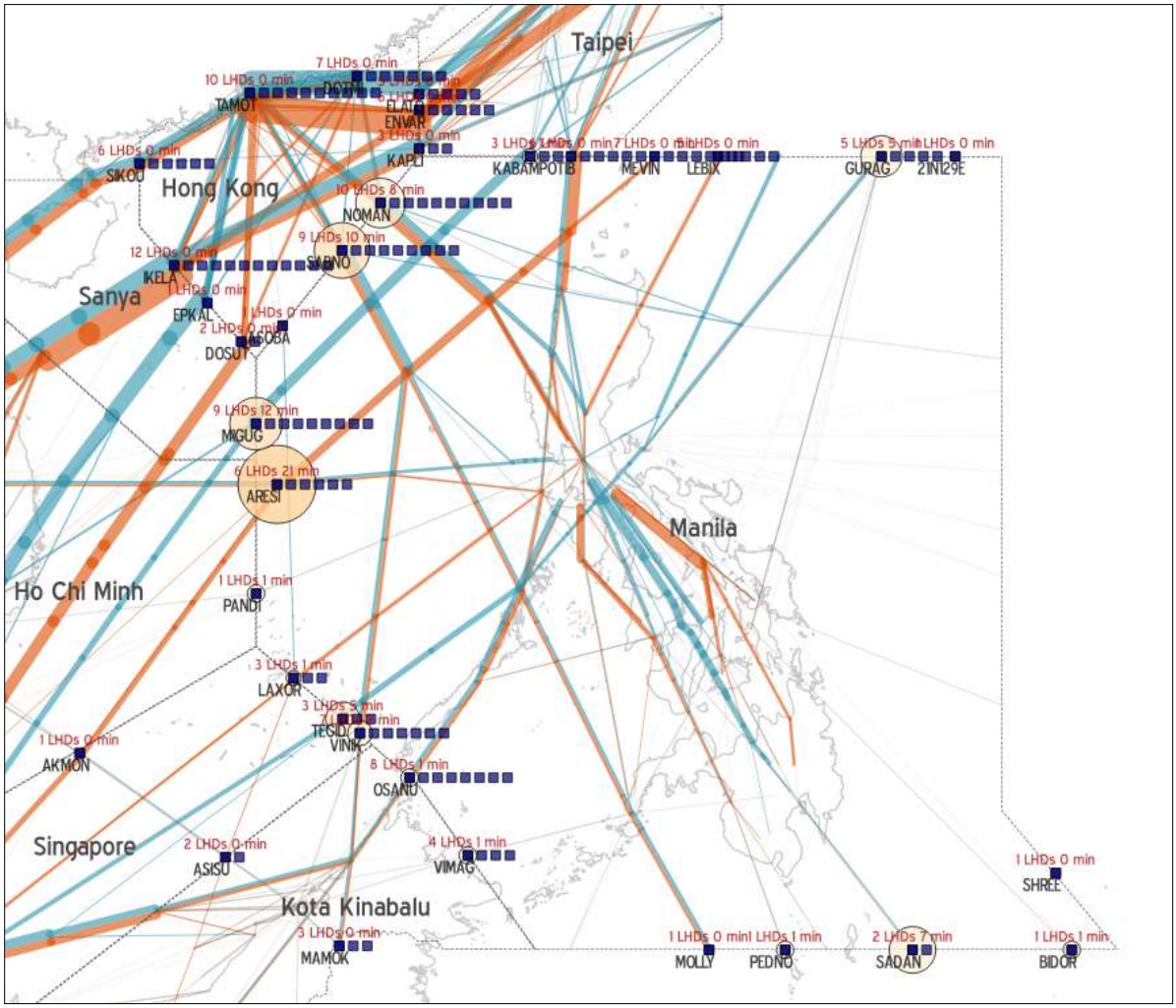

Figure 7: LHDs around the boundary of Manila FIR in 2015

2.24 The resulting risk in Manila FIR is 4.55 x 10^{-9} Fatal Accident Per [Manila FIR] Flight Hour (FAPFH), which **meets** the Target Level of Safety (TLS) as detailed in **Table 1**.

Manila FIR RVSM Airspace – estimated annual flying hours = 357,413 hours *(note: estimated hours based on December 2015 Manila traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.75 x 10^{-9}	2.5 x 10^{-9}	Below Technical TLS
Operational Risk	3.80 x 10^{-9}	-	-
Total Risk	**4.55 x 10^{-9}**	**5.0 x 10^{-9}**	**Below Overall TLS**

Table 1: Risk Estimates for Manila FIR RVSM Airspace

2.25 **Figure 8** depicts risk from each of the 19 non-zero-duration LHDs. Each block corresponds to each LHD event inside Manila FIR boundary and the height of each block shows the risk associated with the event.

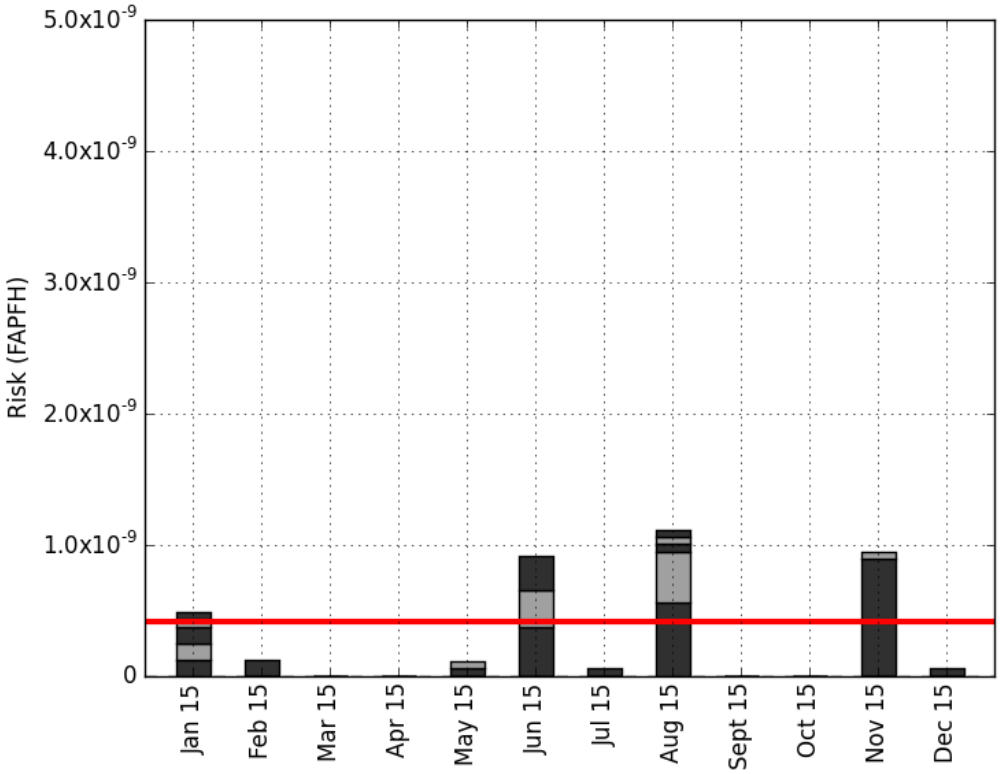

Figure 8: Monthly risk per LHD event inside Manila FIR boundary

2.26 Good surveillance coverage in the WPAC/SCS airspace can be attributed to lower risk relative to the other hot spots. The number of occurrences, on the other hand, still seems to remain unchanged over the years. This may due to the fact that all coordination around the Manila FIR is performed by voice communication while the volume of traffic is constantly increasing.

Updated Action Plan for Manila FIR Hot Spot

2.27 The initial action plan regarding this hot spot was sent to ICAO APAC Regional Office in December 2015, which mostly consisted of AIDC implementation. The Philippines put its AIDC implementation on a high priority. Several technical tests were conducted with adjacent ACC units. However, many technical problems were discovered and needed to be resolved by the system supplier.

2.28 Full details and updates of the action plan are appended in **Appendix B**.

Additional Recommendation regarding Manila FIR Hot Spot

2.29 The theoretical surveillance coverage in **Figure 9** presents an opportunity to further reduce LHD duration and risk by sharing surveillance data among Vietnam, Malaysia, and the Philippines. In **Figure 9**, a purple circle represents radar coverage and a green circle represents ADS-B coverage. MAAR produced this theoretical surveillance coverage on the request from the ICAO South China Sea Major Traffic Flow Review Group (SCS-MTFRG) with data provided by the member States in late February 2016. Please note that the chart does not include future ADS-B sites in the Philippines such as Palawan, Pangasinan and Zambales.

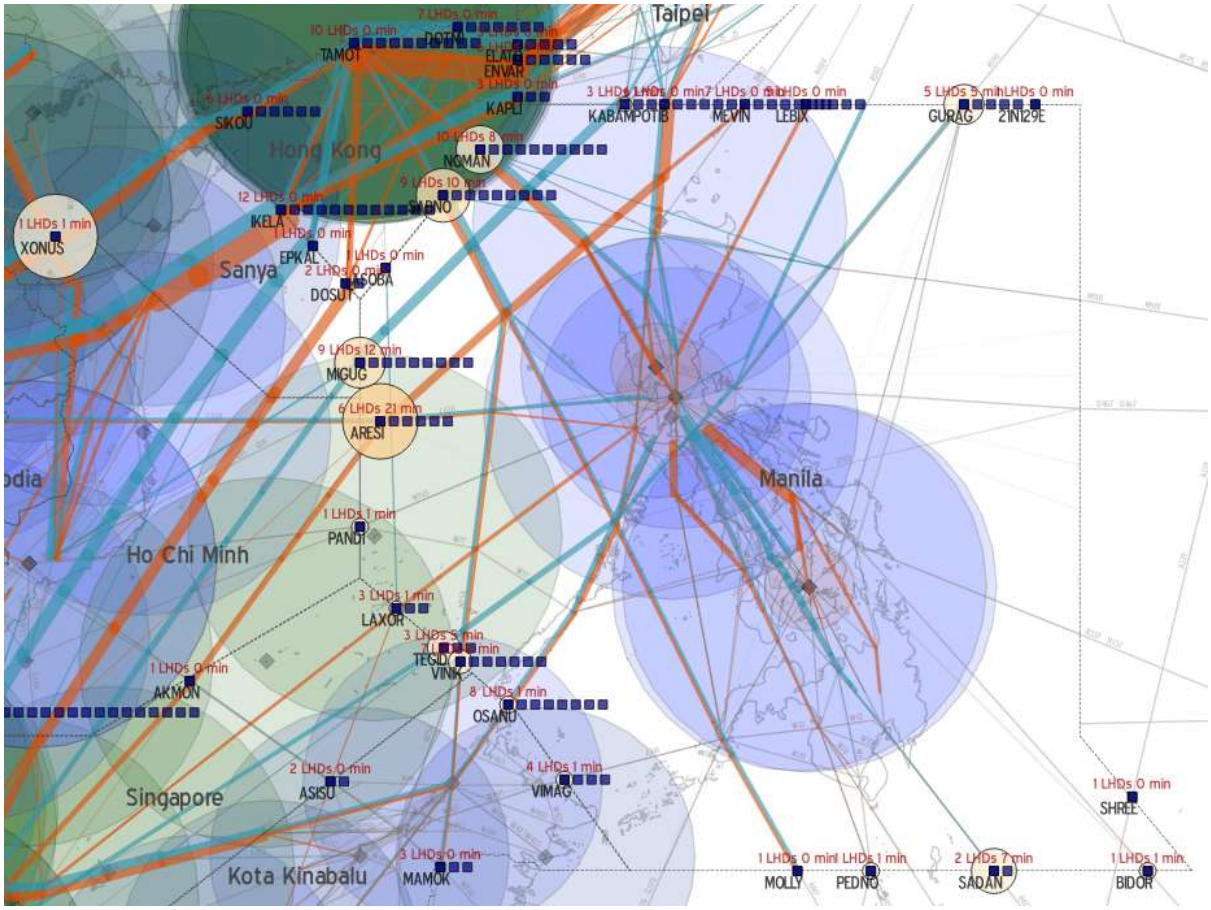

Figure 9: Theoretical surveillance coverage on the western boundary of Manila FIR

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) discuss additional recommendations regarding long-duration LHDs and surveillance data sharing;

c) recommend additional measures to help reduce LHDs; and

d) discuss any relevant matters as appropriate.

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Appendix A

Action Plan to Address High-Risk Area Near Western and Eastern Boundaries of Indian FIRs : Group a)

A. Operational

Code	Task	Responsible Unit(s)	Tentative Timeframe	Status	Remarks
A1	Ensure that an appropriate body takes the role of the scrutiny group for the concerned hot spots	MAAR/BOBASMA	Sep 2015	Completed	The role has been accepted by the ATS Coordination Meeting of Bay of Bengal, Arabian Sea and Indian Ocean Region (BOBASIO)
A2	Present the safety assessment paper to the scrutiny group	MAAR	Sep 2015	Completed	
A3	Notify ARMA and MIDRMA of the high-duration LHDs near the western boundary of Mumbai FIR	MAAR	As soon as possible	Completed	E-mail sent on 14 Aug 2015
A4	Notify Muscat ACC and Mogadishu FISS of the LHD occurrences	India	As soon as possible	Completed	Indicated in BOBASMA's e-mail dated 12 Aug 2015
A5	Establish a procedure for supervisors or controllers on duty of transferring and accepting ATS units to discuss and investigate, in a timely manner, the occurrences relating to the breakdown in coordination, and then report the LHD to the corresponding RMAs (BOBASIO/5 Task)	BOBASIO States	Oct 2015	Completed	
A6	Draft a procedure for States to constitute a mechanism for timely coordination of LHD occurrences between concerned ATS units and collect LHD Point of Contact (POC) and circulate it to BOBASIO States, ARMA, and MIDRMA for comments (BOBASIO/5 Task)	MAAR	31 Oct 2015	Completed	The procedure was also reviewed by APAC RMAs during RASMAG MAWG. The meeting agreed that it could be implemented as a trial within BOBASIO States and the result can be reported to RASMAG/21.

A7	Distribute the final draft cross-boundary LHD coordination procedure and the list of LHD POCs to BOBASIO States to try implementing and give feedback to MAAR	MAAR & BOBASIO States	As soon as possible	Completed	E-mail sent on 11 Dec 2015. In Bangladesh, India, Myanmar, Thailand Coordination Meeting (Conclusion BIMT 3/4), it was concluded that LHD procedure and the timelines prescribed by MAAR will be followed from 1st January 2016. WSOs [FIO in case of Bangladesh] of concerned ATCCs will be the first point of contact. The LHD report will be filed by LHD Point of Contact (POC).
A8	Monitor the cross-boundary LHD coordination procedure's implementation status	MAAR & BOBASIO States	TBD	On-going	Airport Authority of India (AAI) and Myanmar informed MAAR that the LHD handling procedure has been implemented. Follow up at BIMT/4
A9	Adopt the procedure as a common framework	BOBASIO States	TBD	Not started	

B. Technical

Code	Task	Responsible Unit(s)	Tentative Timeframe	Status	Remarks
B1	India & Myanmar ADS-B data sharing (India's Agartala & Port Blair ADS-B data in exchange with Myanmar's Sittwe & Coco Island ADS-B data)	India & Myanmar	To be determined	Site installations were completed. MOU has been signed. Data connectivity is work-in-progress. (Ref. BIMT-ATM/CG/3)	ADS-B Surveillance capability has been integrated in Yangon ACC's new ATM system that should give coverage over the Bay of Bengal Airspace. Myanmar is awaiting response from Kolkata regarding data sharing.
B2	Myanmar to provide to India the gap analysis for the AIDC requirement.	Myanmar	To be determined	Will be updated in BIMT ATM /CG/4 Meeting	
B3	Chennai - Kuala Lumpur AIDC implementation	India & Malaysia	Q1 2016	Trials since 2013	Ref. APA TF/2 (March 2016) & E-mail correspondence Trial operations started between Chennai and Kuala Lumpur AIDC systems since 2013. Full implementation will take place once the LOA is signed. The target date of implementation is December 2016.
B4	Kolkata - Dhaka, Kolkata - Yangon AIDC implementation	India, Myanmar & Bangladesh	To be determined	Planned	Myanmar is ready for AIDC testing and already sent their AIDC ICD to Kolkata.

Appendix B

Action Plan to Address High-LHD Frequency Area around Manila FIR : Group d)

A. Operational

Code	Task	Responsible Unit(s)	Tentative Timeframe	Status	Remarks
A1	Ensure that there currently exists a procedure for supervisors or controllers on duty of transferring and accepting ATS units to discuss and investigate, in a timely manner, the occurrences relating to the breakdown in coordination, and then report the LHD to the corresponding RMAs	MAAR	Jan 2016	On-going	The ATS unit pairs with high Cat E LHD frequencies have existing procedures to handle LHDs as part of their SMS systems.
A2	Clarify the criteria used to determine whether a coordination error is considered an LHD or not to eliminate discrepancies in LHD reporting	MAAR	Dec 2015	On-going	LHD material package has been developed (WP in RASMAG21), which include an LHD FAQ page that helps clarify the matter.
A3	Distribute the final draft cross-boundary LHD coordination procedure and the list of LHD POCs to WPAC/SCS States and give feedback to MAAR	MAAR & WPAC/SCS States	TBD	Not started	RASMAG MAWG decided that the procedure should be tried in BOBASIO region first.
A4	Review cross-boundary LHD coordination procedure and consider adopting it as a common framework	MAAR	Depends on feedback from A3	Not started	
A5	Reassess risk for this hot-spot area and report to RASMAG/21	MAAR, JASMA, and AAMA	RASMAG/21	Completed	WP in RASMAG21

B. Technical

Code	Task	Responsible Unit(s)	Tentative Timeframe	Status	Remarks
B1	Manila ACC's AIDC implementation with Singapore ACC	The Philippines & Singapore	Operational trial with Singapore within Feb 2016	Software tests have been conducted on 7-8 Dec 2015. Further testing will be scheduled when the issues have been rectified.	AIDC component of the ATM System still has some software issues, which requires an FDP software correction and ATMS re-configuration by Thales before further testing and verification.
B2	Manila ACC's AIDC implementation with Taipei ACC	The Philippines & Taiwan	Pending on the op trial's results	Software tests have been conducted, but still requires further testing.	AIDC component of the ATM System still has some software issues, which requires an FDP software fix and ATMS re-configuration by Thales
B3	Manila ACC's AIDC implementation with Ujung Pandang ACC	The Philippines & Indonesia	Pending on the op trial's results	Software tests have been conducted, but still requires further testing.	AIDC component of the ATM System still has some software issues, which requires an FDP software fix and ATMS re-configuration by Thales
B4	Manila ACC's AIDC implementation with Kota Kinabalu ACC	The Philippines & Malaysia	Pending on the op trial's results	Not started	AIDC component of the ATM System still has some software issues, which requires an FDP software fix and ATMS re-configuration by Thales
B5	Manila ACC's AIDC implementation with Hong Kong ACC	The Philippines & Hong Kong	Pending on Hong Kong's ATM System transition	Software tests scheduled for January/February 2016	AIDC component of the ATM System still has some software issues, which requires an FDP software fix and ATMS re-configuration by Thales

B6	Kota Kinabalu ACC's AIDC implementation with Singapore ACC	Malaysia & Singapore	Operational trial with Singapore from 15 Oct - 14 Nov 2015	Software tests have been conducted. Operational trial carried out 15 Oct - 6 Nov 2015.	Tentative implementation Dec 2015 but on hold due some technical issue. Further testing required and will be scheduled when the issues have been rectified.
B7	Kuching ACC's AIDC implementation with Singapore ACC	Malaysia & Singapore	Operational trial with Singapore from 15 Nov - 14 Dec 2015	Software tests have been conducted. Operational trial carried out 9 Nov-13 Nov 2015.	Tentative implementation Jan 2016 but on hold due some technical issue. Further testing required and will be scheduled when the issues have been rectified.
B8	Kuala Lumpur ACC's AIDC implementation with Singapore ACC	Malaysia & Singapore	Operational trial with Singapore from 15 Dec 2015 - 14 Jan 2016	Software tests have been conducted. Operational trial dates to be determined after further testing to rectify issues.	Tentative implementation Feb 2016 but on hold due some technical issue. Further testing required and will be scheduled when the issues have been rectified.
B9	Kota Kinabalu ACC's AIDC implementation with Ujung Pandang ACC	Malaysia & Indonesia	Pending on the op trial's results (end of Dec 2015)	Not started	To replace IDCF.
B10	ADS-B ground stations at Palawan	The Philippines	To be completed by the end of 2016		ATM Center expected to be available in 2016.