



## INTERNATIONAL CIVIL AVIATION ORGANIZATION

### ASIA/PACIFIC OFFICE

#### SEMINAR ON TESTING OF NAVIGATION AND SURVEILLANCE FACILITIES AND VALIDATION OF FLIGHT PROCEDURES

(BANGKOK, 5 – 7 AUGUST 2009)

#### REPORT ON OUTCOME

### 1. INTRODUCTION

1.1 In response to APANPIRG Conclusion 19/32, the Seminar on *Testing of Navigation and Surveillance Facilities and Validation of Flight Procedures*, jointly organized by ICAO ASIA/PAC Regional Office and Aeronautical Radio of Thailand (AEROTHAI) was held in Bangkok, Thailand from 5 to 7 August 2009.

1.2 The Seminar was attended by 85 participants from 17 Administrations, ICASC, IFALPA and industries partners. The list of participants is provided in the **Attachment 1** to this Summary Report.

1.3 In his welcome remarks, Mr. Mokhtar A. Awan, ICAO Regional Director, Asia and Pacific Regions highlighted the need for periodic inspection of navigation and surveillance facilities and Mr. Siri Pichiensoon, Senior Executive Vice President (Operations), Aerothai in his opening address extended welcome to participants and wished all success for the Seminar. The secretariat provided introduction to the Seminar.

1.4 Mr. Glenn Bissonnette, from flight Inspection Policy department, FAA & Executive Secretariat, ICASC and Mr. Gordon Young, GBAS Project Manager, Airservices Australia were the facilitators of the Seminar. Messer Li Peng and Sujana Saraswati, Regional Officers for Communications, Navigation, and Surveillance (CNS), acted as Secretaries for the seminar. The Seminar was also assisted by Capt. Dave VanNess, PBN Implementation and Resource Development Co-ordinator, ATM Section ICAO Headquarters.

### 2. DISCUSSIONS

2.1 List of presentations is provided in **Attachment 2** to this Summary Report. 27 presentations, 2 working papers and 1 information paper were presented to the Seminar under the adopted agenda items listed below:

#### **Agenda Item 1: Performance Based Navigation (PBN) procedure**

Flight procedure validation, database design, integrity, distribution, in-flight data recording and data sharing

**Agenda Item 2: Ground and Air calibration**

Ground maintenance of Conventional Navigation/Surveillance systems: Evolution of maintenance techniques, remote maintenance, maintenance of records, protection areas (ILS)

Flight Inspection of Conventional Navigation Aids: evolution of flight calibration systems and techniques, data recording and maintenance

Nav aids, SSR, Multilateration: performance monitoring and commissioning practices

**Agenda Item 3: Changes in ICAO Provision**

New inclusions in Annex 10 and Doc 8071

**Agenda Item 4: Satellite based systems**

Maintenance, calibration and flight validation of GNSS augmentation systems (GBAS & SBAS), performance monitoring and data recording for investigation

**Agenda Item 5: Regulators' Perspective**

Regulators' role in validation/testing of navigation and surveillance systems

**Agenda Item 6: Any other business**

**3. RECOMMENDATIONS**

3.1 As a result of discussions, the Seminar developed following recommendations for consideration by APANPIRG. These recommendations are to be addressed by ICAO and States, as appropriate:

- 1) That, APANPIRG carry out a study to assess whether there is a need to develop guidance material for flight inspection/validation of ADS-B ground stations noting that ICASC technical group concluded that flight inspection of ADS-B is currently limited to coverage;
- 2) That, ICAO - Navigation System Panel (NSP)
  - consider developing guidance material on the use of DGPS as a position reference system for flight inspection;
  - review those areas of possible misinterpretations in ICAO Doc 8071 such as the ones shown in the **Appendix A** to this summary report and provide necessary guidance on the interpretation of the ICAO requirements in order to avoid inconsistency of interpretations and to harmonize application of ICAO standards and recommended practices.
  - review information on flight validation as contained in ICAO Doc 8071 Vol. II when the new Doc 9906 Vol. V becomes operational.

- 3) That, ICAO coordinate for developing a template for flight validation report for PBN IFPs including RNP APCH procedures noting that ICASC is working on this to be included in the Flight Validation guidance manual (proposed Doc 9906 Vol V). A sample template developed by Aerothai for RNP APCH is provided in the **Appendix B** to this summary report for reference.
- 4) That, States be urged to update the information in the Flight Inspection Catalogue and the new edition of the Catalogue be published by end of October 2009.
- 5) That, States be reminded of contents of State letter on ILS maintenance procedure as contained in **Appendix C**.
- 6) That, States consider to upgrade their FIS to include the flight inspection requirements of GNSS, Interference, ADS-B, Multi-lateration etc. as necessary.
- 7) That, ICAO be invited to provide guidelines for selecting GP reference point for flight inspection.

3.2 ICASC offered to consider the feasibility of developing a list of Frequently Asked Questions and provide an avenues for submitting the issues related to flight inspection/validation to the appropriate ICAO forum.

3.3 In the concluding session, participants expressed their appreciation for the format and content of the Seminar, which demonstrated the importance of the testing of navigation and surveillance facilities including flight inspection and validation of procedures. The Seminar called upon ICAO to organize similar seminars in future to facilitate implementation of PBN in the Region and encourage information exchange in the fields of flight inspection and validation. The secretariat thanked the facilitators and speakers for their contribution and attendees for their interest in the Seminar and active participation. The Seminar also expressed appreciation for Aerothai and ICAO for hosting the Seminar and for the visit arranged to the flight inspection centre of Aerothai.

SEMINAR ON TESTING OF NAVIGATION AND SURVEILLANCE FACILITIES  
AND VALIDATION OF FLIGHT PROCEDURES

Appendix A to the Report

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**Review areas of possible misinterpretations in ICAO Doc 8071**

It was noted that certain areas of recommendations contained in ICAO Doc8071 not explicitly or conclusively stated, can be misinterpreted from their true intention. Although such cases may not have an effect on safety, they may lead to unnecessary delay and cost.

Same cases of possible inconsistent interpretation were identified as follows:

- Case 1, Alignment Monitor for Localizer procedure. Section 4.3.38 a) describes recommendation on Alignment monitor procedure during Localizer course alignment and displacement sensitivity monitors, which is carried out toward the end after having performed Course Alignment Accuracy procedure in Section 4.3.26 already. Confirmation of the Alignment at normal operating condition can mean comparison and checking of the concerned parameters to be within tolerance, or repeating flight procedure for Course Alignment Accuracy in Section 4.3.26 again.
- Case 2, Modulation Level of 9960 Hz Subcarrier for VOR procedure. Section 2.3.17 describes recommendation on VOR Modulation and recommend Modulation of 9960 Hz Subcarrier to be  $30 \pm 2\%$ . In practice, the Modulation level can be obtained by flying an 8 NM radius orbit around VOR Transmitter, and sampling reading at every  $10^\circ$  for the mean value of Modulation level. However, multipath of signal may be occurred from reflection/absorption from surrounding obstacles or terrain, resulting in over tolerance of the subcarrier in some radial or sector; while the mean value is within the recommended range ( $30 \pm 2\%$ ). No specific guideline is currently available in Doc 8071 to such case and consequently how to evaluate the VOR facility.
- Case 3, Applicability of 95% Probability. Section 2.3.13 describes recommendation on roughness and scalloping error to be within 3.0" from the average course for inspecting VOR which is considered non-precision navaid. On the hand, Annex 10 Attachment C Figure C-2 points out the precision navaid ILS example and states recommendation to take the principle on 95% probability into consideration before evaluating course/path bend amplitude and whether the facility status to be restricted or not.
- Case 4, Use of Uncertainty Value. In various places of Doc 8071, "uncertainty" is referred to together with "tolerance". Uncertainty value is often associated with measurement of equipment, but no application of such value for flight inspection is stated in relation to tolerance limit.

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Appendix B to the Report



**FLIGHT INSPECTION AND SERVICES DEPARTMENT  
AIR TRAFFIC SERVICES PLANNING AND STANDARDS BUREAU  
AERONAUTICAL RADIO OF THAILAND LIMITED**

<b>FLIGHT INSPECTION REPORT – PERFORMANCE BASED NAVIGATION</b>								<b>FM-AV.PS-50</b>
1. RUNWAY <b>[AIRPORT / RUNWAY]</b>				2. AIRCRAFT <b>[CALL SIGN]</b>		3. DATE OF FLIGHT VALIDATION <b>[DD-MMMM-YYYY]</b>		
4. TYPE OF PROCEDURE <b>RNAV (GNSS) APPROACH</b>				5. GUIDANCE LNAV LNAV / VNAV		6. NAVIGATION SPECIFICATION <b>[NAV SPEC]</b>		
7. OWNER		DCA	USAF		OTHER (INDICATE ACTUAL OWNER)			
		RTAF	INTERNATIONAL					
8. PRE-FLIGHT VALIDATION								
A. RUNWAY COORDINATE SURVEY							C. SUPPORT DOCUMENTS	
WAYPOINT	COORDINATE	COMPUTED BEARING (TRUE)	MAGNETIC VARIATION	COMPUTED BEARING (MAG)	DESIGNED BEARING (MAG)	COMPUTED DISTANCE (NM)	RUNWAY DISTANCE (NM)	CHECKLISTS
								APPROACH PLATE
THRESHOLD	N							TOPOGRAPHIC MAP
	E							WEATHER FORECAST
DEPARTURE END	N							D. PREDICTION
	E							RAIM OUTAGE
B. WAYPOINT VERIFICATION BY PROCEDURE DESIGNER							NO.OF AVAILABLE SATS	
LEG	SAT / UNSAT	COMPUTED BEARING (TRUE)	MAGNETIC VARIATION	COMPUTED BEARING (MAG)	DESIGNED BEARING (MAG)	COMPUTED DISTANCE (NM)	RUNWAY DISTANCE (NM)	HDOP
								E. NAV DATABASE
IAWPL-IWP								FMS PROGRAMMED
IAWPR-IWP								AFIS PROGRAMMED
IAWPC-IWP								ACCURATE WP / TRACKS
IWP-SDWP								NO WP REPEATED
IWP-FAWP								F. COORDINATION
FAWP-SDWP								ATC COORDINATION
FAWP-MAWP								APPENDIX 1 COMPLETED
MAWP-MATWP								APPENDIX 2 COMPLETED
MATWP-								OTHERS (IF ANY)

MAHWP									
REMARK									
[NOTES / "SEE ATTACHMENT" / "NONE"]									
9. IN-FLIGHT VALIDATION									
A. WAYPOINT VERIFICATION BY FMS AVIONICS							B. WAYPOINT VERIFICATION DURING FLIGHT		C. OBSTACLE VERIFICATION DURING FLIGHT
LEG	SAT / UNSAT	WPTS	ACTUAL DIST	DESIGNED DIST	ACTUAL TK	DESIGNED TK			
INITIAL L							IAWPL	INITIAL L	
INITIAL R							IAWPR	INITIAL R	
INITIAL C							IAWPC	INITIAL C	
INTERMEDIATE							IWP	INTERMEDIATE	
FINAL							SDWP	FINAL	
MISSED APPROACH							FAWP	MISSED APPROACH	
							MAWP	CIRCLING	
D. MISSED APPROACH WAYPOINT VERIFICATION							REMARK		
COORDINATE	N		E		XTD NM		[NOTES / "SEE ATTACHMENT" / "NONE"]		
10. POST-FLIGHT VALIDATION									
A. INTERFERENCE VALIDATION					B. SUITABILITY OF PROCEDURE				
LEG	HDOP	NO.OF SAT	RAIM STATUS	DESCENT GRADIENT					
INITIAL L				SEGMENT LENGTH					
INITIAL R				ALIGNMENT ON FINAL					
INITIAL C				GRADIENT / ALIGNMENT COMBO					
INTERMEDIATE				ACCEPTABLE PILOT WORKLOAD					
FINAL				REMARK [NOTES / "SEE ATTACHMENT" / "NONE"]					
MISSED APPROACH									
DEPARTURE									
11. CERTIFIED FOR		LNAV APPROACH TO				FEET ABOVE RUNWAY			
		LNAV / VNAV APPROACH TO				FEET ABOVE RUNWAY			
12. VALIDATION SUMMARY		COORDINATE SURVEY		OBSTACLE CLEARANCE		SIGNAL COVERAGE		OPERATIONAL SUITABILITY	
		WAYPOINT VERIFICATION		MAWP VERIFICATION		INTERFERENCE VALIDATION		AFIS PRINTOUT	
13. FLYABILITY			15. DISCREPANCIES AND/OR REMARKS			14. NOTAM			CORRECTED
[NOTES / "SEE ATTACHMENT" / "NONE"]								YES	NO
FLIGHT INSPECTOR			PANEL OPERATOR			PROCEDURE DESIGNER			
ENGINEERING MANAGER, FLIGHT INSPECTION AND SERVICES DEPARTMENT							[DD-MMM-YYY]		
APPROVED BY DEPARTMENT OF CIVIL AVIATION THAILAND									



INTERNATIONAL CIVIL AVIATION ORGANIZATION  
ORGANISATION DE L'AVIATION CIVILE INTERNATIONALE  
ORGANIZACIÓN DE AVIACIÓN CIVIL INTERNACIONAL  
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ГРАЖДАНСКОЙ АВИАЦИИ  
منظمة الطيران المدني الدولي  
国际民用航空组织

999 UNIVERSITY STREET, MONTREAL, QUEBEC, CANADA H3C 5H7

Tel.: (514) 954-8219  
Fax: (514) 954-6077

Internet: icao@icao.org  
Sitatex: YULCAYA

Telex: 05-24513  
Cables: ICAO MONTREAL

Appendix C to the Report

Tel.: +1 (514) 954-6712

Ref.: AN 7/5-01/52

11 May 2001

**Subject:** Incidents caused by operational use of ILS signals radiated during testing and maintenance procedures

**Action required:** To note information and guidelines provided hereunder, and take action as appropriate

Sir/Madam,

1. I have the honour to draw your attention to a number of incidents which have occurred in recent years resulting from the operational use of instrument landing system (ILS) signals being radiated during ILS testing and maintenance procedures, specifically for phasing and modulation balance testing. Such signals may be perceived onboard aircraft as "on-course" and/or "on-glide-path" indications regardless of the actual position of an aircraft within the ILS coverage and with no flag or alarm indication in the cockpit. The use of ILS localizer and/or glide path signals for approach guidance during these testing and maintenance procedures can therefore result in false indications to the flight crew and has the potential to cause a controlled flight into terrain (CFIT) accident.

2. Standards in Annex 15 — *Aeronautical Information Services* (Chapter 5, paragraph 5.1.1.1) and Annex 11 — *Air Traffic Services* (Chapter 3, paragraph 3.7 and Chapter 4, paragraph 4.3.8), and guidance material in the *Manual on Testing of Radio Navigation Aids* (Doc 8071), Volume I (Fourth Edition, Chapter 1, paragraphs 1.6 and 1.8) provide for a notification of the ILS facility status in order to prevent the operational use of an "unusable/unserviceable" facility. There have been, however, occurrences when the facility status notification has not reached the flight crew or the air traffic control unit concerned, or this notification has not been complied with due to shortcomings in the notification procedures or human error.

3. In order to address the aforementioned issue through improvements to the current practices of testing and maintenance of ILS, an amendment to Doc 8071, Volume I, which was developed with the assistance of the Testing of Radio Navaids Study Group (TRNSG), is being processed. It draws particular attention to testing and maintenance procedures involving test signals that can result in false indications to the flight crew. It also emphasizes the need for coordination of these procedures with air traffic control (ATC) and for the timely promulgation and distribution of relevant information by a NOTAM before the procedures commence.

4. However, full prevention of the type of incidents in question involves a combination of measures which would protect the system from single points of failure. May I therefore request you to invite the appropriate authority(ies) and/or organization(s) in your State, as well as operators under your jurisdiction, to review current practices and procedures as necessary to ensure that ILS will not be used for normal flight operations when test signals are being radiated or the executive monitoring function of the facility is inhibited for testing/maintenance purposes.

5. It is highly desirable to eliminate the possibility for any operational use to be made of the ILS guidance during the testing by administratively removing (e.g. by a NOTAM) the localizer and the glide path from service simultaneously. If this is not feasible for operational reasons, a deferral of testing should be considered. However, in case the localizer needs to remain in service while the glide path undergoes testing and the testing cannot be delayed, sufficient measures should be implemented to ensure that users are aware of the potential for false indications from the glide path facility.

6. In all circumstances, the basic protective measures should include as a minimum:

- a) NOTAM phraseology that is specific about the possibility of false indications to the flight crew from the radiated test signals and clearly prohibits their use (suggested NOTAM wording - "RUNWAY XYZ ILS NOT AVBL DUE MAINTENANCE (or TESTING); DO NOT USE; FALSE INDICATIONS POSSIBLE");
- b) confirmation by maintenance personnel that such a NOTAM has been issued by the Aeronautical Information Services before the testing procedures begin;
- c) prior to beginning the tests, suspension or alteration to an unusual tone/sequence of the transmission of the unique Morse Code facility identification on the localizer, if the localizer should radiate solely for testing purposes; and
- d) a requirement that ATC advise, by automatic terminal information service (ATIS) and/or by a voice advisory, each pilot on an approach to the affected runway, emphasizing the possibility of false indications.

7. Additional protective measures may be appropriate, especially during phasing and modulation balance conditions for the localizer or the glide path (Doc 8071, Volume I, paragraphs 4.2.15, 4.2.37, 4.3.14, 4.3.39, 4.3.62 and 4.3.63 refer). Accordingly, when the phasing and modulation balance tests are being performed the following options may be exercised :

- a) when the tests are being performed on the localizer, remove the glide path from service by turning the signals off (to provide a glide path flag indication to the pilot); and

- b) when the tests are being performed on the glide path, remove the localizer from service by turning the signals off (to provide a localizer flag indication to the pilot).

*Note. — If the b) option is exercised, the ATC voice advisories required in 6 d) above become redundant.*

8. In addition, it is essential to ensure that protective measures (in addition to the coordination and promulgation process) are put in place to guard against single points of failure. One highly desirable measure is the installation of remote ILS status-indicating equipment such that it is visible to the air traffic controller issuing approach clearances.

9. It is imperative that all personnel directly engaged in the flight inspection, maintenance or installation of aeronautical navigation aids should be adequately qualified, trained, and experienced for their job functions. Accordingly, management systems should include written procedures for ensuring the continued competence of such personnel through regular assessment. Initial and recurrent training programmes for aeronautical navigation aid specialists should include a detailed explanation of maintenance procedures and their effect on the integrity of the radiated signal.

10. Finally, aircraft operating manuals should strictly prohibit the use of a radio navigation facility which is notified to be out of service even though its cockpit indications might appear to be normal. The facility identification check by the flight crew is an essential means for achieving this purpose.

11. It would be appreciated if you also remind the national accident investigation authority of the need to report to ICAO, in accordance with Annex 13 — *Aircraft Accident and Incident Investigation*, any serious incidents, particularly those which had the potential of developing into a CFIT accident.

Accept, Sir/Madam, the assurances of my highest consideration.

  
R.C. Costa Pereira  
Secretary General

**Seminar on Testing of Navigation and Surveillance Facilities and  
Validation of Flight Procedure  
Bangkok, Thailand  
5-7 August 2009**

**ATTACHMENT 1**

**LIST OF PARTICIPANTS**

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
<b>AUSTRALIA (4)</b>		
Mr. Paul H. Taylor	Senior Air Safety Inspector Civil Aviation Safety Authority GPO Box 2005 Canberra ACT 2601 <b><u>AUSTRALIA</u></b>	Tel: +61 (2) 6217 1244 Fax: +61 (2) 6217 1500 E-mail: <a href="mailto:paul.taylor@casa.gov.au">paul.taylor@casa.gov.au</a>
Mr. Richard Dudley	General Manager, Corporate Affairs Airservices Australia GPO Box 367 Canberra ACT 2601 <b><u>AUSTRALIA</u></b>	Tel: +61 (2) 6268 4479 Fax: +61 (2) 6268 4233 E-mail: <a href="mailto:richard.dudley@airservicesaustralia.com">richard.dudley@airservicesaustralia.com</a>
Mr. Gordon Young	GBAS Project Manager Airservices Australia GPO Box 367 Canberra ACT 2601 <b><u>AUSTRALIA</u></b>	Tel: +61 (2) 6268 4496 Fax: +61 (2) 6268 4621 E-mail: <a href="mailto:gordon.young@airservicesaustralia.com">gordon.young@airservicesaustralia.com</a>
Mr. Stefan Jerga	Chief Representative, South East Asia Airservices Australia Singapore Office 25 Napier Road <b><u>SINGAPORE</u></b> 258507	Tel: +65 6836 4145 Fax: +65 6735 7490 E-mail: <a href="mailto:stefan.jerga@airservicesaustralia.com">stefan.jerga@airservicesaustralia.com</a>
<b>BANGLADESH (2)</b>		
Mr. Md. Abu Taher Sarkar	Deputy Director ATS Civil Aviation Authority of Bangladesh Headquarters Office Kurmitola Dhaka 1229 <b><u>BANGLADESH</u></b>	Tel: +880 (2) 891 4715 Fax: +880 (2) 891 3322 E-mail: <a href="mailto:abusarker123@yahoo.com">abusarker123@yahoo.com</a>
Mr. A.K.M. Ataul Islam	Deputy Director Communication Engineering Civil Aviation Authority of Bangladesh Kurmitola Dhaka 1229 <b><u>BANGLADESH</u></b>	Tel: +880 (2) 891 5291 Fax: +880 (2) 891 3322 E-mail: <a href="mailto:ataulis2003@yahoo.com">ataulis2003@yahoo.com</a>
<b>CHINA (4)</b>		
Mr. Li Ziji	Engineer CNS Division Air Traffic Management Bureau of CAAC 12# East San-huan Road Middle Chaoyang District Beijing 100022 <b><u>CHINA</u></b>	Tel: +86 (10) 8778 6919 Fax: +86 (10) 8778 6910 E-mail: <a href="mailto:liziji@atmb.net.cn">liziji@atmb.net.cn</a> <a href="mailto:liziji017@163.com">liziji017@163.com</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Liu Lujiang	Engineer Airspace Division Air Traffic Management Bureau of CAAC 12# East San-huan Road Middle Chaoyang District Beijing 100022 <b><u>CHINA</u></b>	Tel: +86 (10) 8778 6839 Fax: +86 (10) 8778 6830 E-mail: <a href="mailto:liulujiang@atmb.net.cn">liulujiang@atmb.net.cn</a>
Mr. Zhu Shuyong	Engineer AIS Centre Air Traffic Management Bureau of CAAC 12# East San-huan Road Middle Chaoyang District Beijing 100022 <b><u>CHINA</u></b>	Tel: +86 (10) 8736 5602 Fax: +86 (10) 8736 5602 E-mail: <a href="mailto:zhushuyong@atmb.net.cn">zhushuyong@atmb.net.cn</a>
Mr. Liu Tong	Flight Inspector, Director of Research & Development Department Flight Inspection Center of CAAC No. 23, Tianzhu Street Airport Industrial Zone Shunyi District Beijing 101312 <b><u>CHINA</u></b>	Tel: +86 (10) 6454 3598 Fax: +86 (10) 6454 3592 E-mail: <a href="mailto:ltzhism@sina.com">ltzhism@sina.com</a> Website: <a href="http://www.chinacfi.net/english">www.chinacfi.net/english</a>
<b><i>Hong Kong, China (3)</i></b>		
Mr. Honig Alexander Ben	Evaluation Officer Hong Kong Civil Aviation Department Room 438a, 4/F Air Traffic Control Complex Hong Kong International Airport, Lantau <b><u>HONG KONG, CHINA</u></b>	Tel: +852 2910 6413 Fax: +852 9646 1172 E-mail: <a href="mailto:abhonig@cad.gov.hk">abhonig@cad.gov.hk</a>
Mr. Chi – yun Ho, Joseph	Electronics Engineer Hong Kong Civil Aviation Department 3/F Dragonair House, 11 Tung Fai Road Hong Kong International Airport <b><u>HONG KONG, CHINA</u></b>	Tel: +852 2591 5081 Fax: +852 2845 7160 E-mail: <a href="mailto:jcyho@cad.gov.hk">jcyho@cad.gov.hk</a>
Ms. On Ki Kwan, Angel	Electronics Engineer Hong Kong Civil Aviation Department 3/F Dragonair House, 11 Tung Fai Road Hong Kong International Airport <b><u>HONG KONG, CHINA</u></b>	Tel: +852 2591 5023 Fax: +852 2845 7160 E-mail: <a href="mailto:aokkwan@cad.gov.hk">aokkwan@cad.gov.hk</a>
<b><i>Macao, China (2)</i></b>		
Mr. Sun Shabo	Consultant Civil Aviation Authority Aladeda Dr. Carlos D'Assumpção, 336-342 Centro Comercial Cheng Feng, 18 andar <b><u>MACAO, CHINA</u></b>	Tel: +853 2851 1213 Fax: +853 2833 8089 E-mail: <a href="mailto:sbsun@aacm.gov.mo">sbsun@aacm.gov.mo</a> <a href="mailto:airportinfrastructure@aacm.gov.mo">airportinfrastructure@aacm.gov.mo</a>
Mr. Lam Tat Ming	Senior Safety Officer Civil Aviation Authority Aladeda Dr. Carlos D'Assumpção, 336-342 Centro Comercial Cheng Feng, 18 andar <b><u>MACAO, CHINA</u></b>	Tel: +853 2851 1213 Fax: +853 2833 8089 E-mail: <a href="mailto:taftlam@aacm.gov.mo">taftlam@aacm.gov.mo</a> <a href="mailto:airportinfrastructure@aacm.gov.mo">airportinfrastructure@aacm.gov.mo</a>
<b>CAMBODIA (2)</b>		

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Kao Lim	Deputy Director State Secretariat of Civil Aviation #62, Norodom Blvd Phnom Penh <b><u>CAMBODIA</u></b>	Tel: +855 (23) 427141 Fax: +855 (23) 211 019 E-mail: <a href="mailto:lim_kao@yahoo.com">lim_kao@yahoo.com</a>
Mr. Sokheng Chea	Deputy Director State Secretariat of Civil Aviation #62, Norodom Blvd Phnom Penh <b><u>CAMBODIA</u></b>	Tel: +855 (23) 427 141 Fax: +855 (23) 224 259 E-mail:
<b>INDIA (1)</b>		
Mr. Vijay Panwar	Executive Director ED, Radio Construction & Development Units Airports Authority of India Safdarjung Airport New Delhi 110003 <b><u>INDIA</u></b>	Tel: +91 (11) 2461 1077 Fax: +91 (11) 2469 7211 E-mail: <a href="mailto:ed_rcdu_fiu@aai.aero">ed_rcdu_fiu@aai.aero</a>
<b>INDONESIA (4)</b>		
Mr. Dadang Indranegara	Chief of Flight Operation Department of Civil Aviation Directorate General of Civil Aviation Merdeka Barat No. 8, Jakarta <b><u>INDONESIA</u></b>	Tel: +62 (21) 547 2942 Fax: +62 (21) 547 3086 E-mail: <a href="mailto:dadang.indra@yahoo.com">dadang.indra@yahoo.com</a>
Mr. Munadi	Flight Inspector Department of Transportation Directorate General of Civil Aviation Merdeka Barat No. 8, Jakarta <b><u>INDONESIA</u></b>	Tel: +62 (21) 547 2942 Fax: +62 (21) 547 3086 E-mail: <a href="mailto:bocahjawa@gmail.com">bocahjawa@gmail.com</a>
Mr. Maruli Tua Edison Saragih	Assistant Deputy Director of Surveillance Facilities Directorate General of Civil Aviation Karya Building 23 <sup>rd</sup> Floor Jl. Medan Merdeka Barat No. 8 Jakarta 10110 <b><u>INDONESIA</u></b>	Tel: +62 (21) 350 5006 Ext. 5147 Fax: +62 (21) 350 7569 E-mail: <a href="mailto:edisonsaragih@yahoo.com">edisonsaragih@yahoo.com</a>
Mr. Mohamad Hasan Bashory	Assistant Deputy Director of Air Navigation Standard Directorate General of Civil Aviation Karya Building 23 <sup>rd</sup> Floor Jl. Medan Merdeka Barat No. 8 Jakarta 10110 <b><u>INDONESIA</u></b>	Tel: +62 (1) 350 5550 Ext. 5162 Fax: +62 (21) 350 7569 E-mail: <a href="mailto:bashory@aviasi.org">bashory@aviasi.org</a>
<b>JAPAN (6)</b>		
Mr. Eiji Nakamura	Special Assistant to the Director Flight Procedure and Airspace Programme Office 2-1-3 Kaumigaseki, Chiyoda-ku Tokyo <b><u>JAPAN</u></b>	Tel: +81 (3) 5253 8750 Fax: +81 (3) 5253 1664 E-mail: <a href="mailto:nakamura-e2kf@mlit.go.jp">nakamura-e2kf@mlit.go.jp</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Shinsuke Yamuchi	Flight Inspector Flight Inspection Division Japan Civil Aviation Bureau 1-8-7, Hanedakuko, Ota-ku, Tokyo <b><u>JAPAN</u></b>	Tel: +81 (3) 3747 0558 Fax: +81 (3) 3747 0568 E-mail: <a href="mailto:yamauchi-s09iz@fc.mlit.go.jp">yamauchi-s09iz@fc.mlit.go.jp</a>
Mr. Kazuyoshi Keboushi	Flight Inspector Flight Inspection Division Japan Civil Aviation Bureau 1-8-7, Hanedakuko, Ota-ku, Tokyo <b><u>JAPAN</u></b>	Tel: +81 (3) 3747 0558 Fax: +81 (3) 3747 0568 E-mail: <a href="mailto:keboushi-k09dd@fc.mlit.go.jp">keboushi-k09dd@fc.mlit.go.jp</a>
Mr. Masashi Nagasaki	Flight Inspector Flight Inspection Division Japan Civil Aviation Bureau 1-8-7, Hanedakuko, Ota-ku, Tokyo <b><u>JAPAN</u></b>	Tel: +81 (3) 3747 0558 Fax: +81 (3) 3747 0568 E-mail: <a href="mailto:nagasaki-m2mg@mlit.go.jp">nagasaki-m2mg@mlit.go.jp</a>
Mr. Shinji Hara	Observer with JCAB Officer (Deputy Manager, Airspace Group, NTT Data i Corporation) NTT Data i Corporation K1 Building, 1-6-6 Haneda Airport Ota-ku, Tokyo, 144-0041 <b><u>JAPAN</u></b>	Tel: +81 (3) 6808 1651 Fax: +81 (3) 5708 0885 E-mail: <a href="mailto:harasnj@nttd-i.co.jp">harasnj@nttd-i.co.jp</a>
Mr. Yoshinobu Nakanishi	Observer with JCAB Officer (Manager, Airspace Group, NTT Data i Corporation) NTT Data i Corporation K1 Building, 1-6-6 Haneda Airport Ota-ku, Tokyo, 144-0041 <b><u>JAPAN</u></b>	Tel: +81 (3) 6808 1651 Fax: +81 (3) 5708 0885 E-mail: <a href="mailto:nakanishiysn@nttd-i.co.jp">nakanishiysn@nttd-i.co.jp</a>
<b>MALAYSIA (2)</b>		
Capt. Tan Mong Loong	Flight Inspection Pilot/PANS-OPS Pilot Flight Calibration Division Department of Civil Aviation SAAS Airport 47200 Subang, Selangor <b><u>MALAYSIA</u></b>	Tel: +603 7846 4193 Fax: +603 7846 9510 E-mail: <a href="mailto:tanml@dca.gov.my">tanml@dca.gov.my</a>
Mr. Mohd Dan Ibrahim	Flight Inspection Officer Flight Calibration Division Department of Civil Aviation SAAS Airport 47200 Subang, Selangor <b><u>MALAYSIA</u></b>	Tel: +603 7846 4193 Fax: +603 7846 9510 E-mail: <a href="mailto:dangi@dca.gov.my">dangi@dca.gov.my</a>
<b>NAPAL (2)</b>		
Mr. Narendra Raj Sayami	Manager ATS Civil Aviation Authority of Nepal Babar Mahal Kathmandu <b><u>NEPAL</u></b>	Tel: +977 (1) 411 3259 Fax: +977 (1) 426 2516 E-mail: <a href="mailto:narendrasayami@hotmail.com">narendrasayami@hotmail.com</a> <a href="mailto:cnsatm@mos.com.np">cnsatm@mos.com.np</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Birendra Joshi	Manager - TSD Civil Aviation Authority of Nepal Manager Lalitpur District Post Office P.O. Box 299, Lalitpur <b><u>NEPAL</u></b>	Tel: +977 (1) 421 8513 Fax: +977 (1) 426 2516 E-mail: <a href="mailto:bjoshi61@hotmail.com">bjoshi61@hotmail.com</a> <a href="mailto:cnsatm@mos.com.np">cnsatm@mos.com.np</a>
<b>NEW ZEALAND (1)</b>		
Mr. Richard M. Thompson	Executive Director Radiola Aerospace Ltd. P.O. Box 50243 Porirua City 5240 <b><u>NEW ZEALAND</u></b>	Tel: +64 (4) 238 0113 Fax: +64 (4) 237 9231 E-mail: <a href="mailto:richardt@radaero.com">richardt@radaero.com</a>
<b>PHILIPPINES (2)</b>		
Mr. Joseph M. Intal	Acting Chief Flight Inspection & Calibration Group (FICG) Office of the Director General Civil Aviation Authority of the Philippines MIA Road, Pasay City, Metro Manila 1300 <b><u>PHILIPPINES</u></b>	Tel: +63 (2) 852 3013 Mobile: +630 920 540 2551 Fax: +63 (2) 852 3013 E-mail: <a href="mailto:chiefjo_intal@ymail.com">chiefjo_intal@ymail.com</a>
Mr. Arnel E. Alanes	CNS Flight Inspector Flight Inspection & Calibration Group (FICG) Office of the Director General Civil Aviation Authority of the Philippines MIA Road, Pasay City, Metro Manila 1300 <b><u>PHILIPPINES</u></b>	Tel: +63 (2) 852 3013 Fax: +63 (2) 852 3013 E-mail: <a href="mailto:nox2y32@gmail.com">nox2y32@gmail.com</a>
<b>REPUBLIC OF KOREA (2)</b>		
Mr. Hyun Taick Kim	Assistant Director Office of Civil Aviation Ministry of Land, Transport and Maritime Affairs 1-8, Byeolyang-dong, Gwacheon-si Gyeonggi-do, 427-040 <b><u>REPUBLIC OF KOREA</u></b>	Tel: +82 (2) 2669 6437 Fax: - E-mail: <a href="mailto:hunters@korea.kr">hunters@korea.kr</a> <a href="mailto:hunter1@mltm.go.kr">hunter1@mltm.go.kr</a>
Mr. Ki Hyoun Kim	244-2 Flight Inspection Center in Gimpo International Airport Okoc-dong, Gangseo-gu Seoul 157-711 <b><u>REPUBLIC OF KOREA</u></b>	Tel: +82 (2) 2660 2162, 2166 Fax: +82 (2) 2662 0881 E-mail: <a href="mailto:kimhwalove@korea.kr">kimhwalove@korea.kr</a> <a href="mailto:kimhwalove@mltm.go.kr">kimhwalove@mltm.go.kr</a>
<b>SINGAPORE (5)</b>		
Ms. Ng Mei Chin	Engineer (Surveillance) Civil Aviation Authority of Singapore Singapore Changi Airport 4 <sup>th</sup> Storey, Terminal 2, P.O. Box 1 Singapore 918141 <b><u>SINGAPORE</u></b>	Tel: +65 6541 2042 Fax: +65 6542 2447 E-mail: <a href="mailto:ng_mai_chin@caas.gov.sg">ng_mai_chin@caas.gov.sg</a>
Mr. Gao Shu	Engineer (Communications/Nav aids) Civil Aviation Authority of Singapore Singapore Changi Airport 4 <sup>th</sup> Storey, Terminal 2, P.O. Box 1 Singapore 918141 <b><u>SINGAPORE</u></b>	Tel: +65 6595 6073 Fax: +65 6542 2447 E-mail: <a href="mailto:gao_shu@caas.gov.sg">gao_shu@caas.gov.sg</a> <a href="mailto:caasgaoshu@gmail.com">caasgaoshu@gmail.com</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Tian Seng Aw Yong	Principal Engineer ST Electronics Ltd. 24 Ang Mo Kio Street 65 Singapore 569061 <b><u>SINGAPORE</u></b>	Tel: +65 6546 2097 Fax: +65 9363 1608 E-mail: <a href="mailto:awyongts@stee.stengg.com">awyongts@stee.stengg.com</a>
Mr. Boon Ghee Terry Tan	Engineer ST Electronics Ltd. 24 Ang Mo Kio Street 65 Singapore 569061 <b><u>SINGAPORE</u></b>	Tel: +65 6546 2097 Fax: +659683 4830 E-mail: <a href="mailto:terrytan@stee.stengg.com">terrytan@stee.stengg.com</a>
Mr. Patrick Goh Kew Cher	Engineer NCS Engineering Communications Pte. Ltd. c/o Singapore Changi Airport #047-023, 4 <sup>th</sup> Storey, Singapore Changi Airport Terminal 2, P.O. Box 2838 Singapore 918199 <b><u>SINGAPORE</u></b>	Tel: +65 6541 1695 Fax: +65 6545 7126 E-mail: <a href="mailto:gkcr@ncs.com.sg">gkcr@ncs.com.sg</a> <a href="mailto:goh05894@singnet.com.sg">goh05894@singnet.com.sg</a>
<b>THAILAND (28)</b>		
Mr. Surasit Jitourtrakul	Electrical Engineer Airport Standards Bureau Department of Civil Aviation 71 Soi Ngamduplee, Rama IV Road Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 286 2918 Fax: +66 (2) 286 1013 E-mail: <a href="mailto:jsurasit@aviation.go.th">jsurasit@aviation.go.th</a>
Ms. Pattaraporn Leedumrongwattagul	Electrical Engineer Airport Standards Bureau Department of Civil Aviation 71 Soi Ngamduplee, Rama IV Road Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 287 3194 Fax: +66 (2) 286 1013 E-mail: <a href="mailto:pattaraporn@aviation.go.th">pattaraporn@aviation.go.th</a>
Ms. Tawika Huayhongtong	Transport Technical Officer Airport Standards Bureau Department of Civil Aviation 71 Soi Ngamduplee, Rama IV Road Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 287 0320-9 Ext. 1402 Fax: +66 (2) 286 8159 E-mail:
Mr. Suchart Huayhongtong	Electrician Airport Standards Bureau Department of Civil Aviation 71 Soi Ngamduplee, Rama IV Road Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 286 2911 Fax: +66 (2) 286 1013 E-mail: <a href="mailto:FIS-DCA@hotmail.com">FIS-DCA@hotmail.com</a>
Mr. Thongchai Sawatpanich	Electrician Airport Standards Bureau Department of Civil Aviation 71 Soi Ngamduplee, Rama IV Road Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 286 2911 Fax: +66 (2) 286 1013 E-mail: <a href="mailto:thongchai@aviation.go.th">thongchai@aviation.go.th</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Capt. Apiluk Permhol	Deputy Manager International Flight Safety and Operations Development Department Thai Airways International Public Co., Ltd. 89 Vibhavadee Rungsit Road Bangkok 10900 <b><u>THAILAND</u></b>	Tel: +66 (2) 545 2665 Fax: +66 (2) 545 3849 E-mail: <a href="mailto:apiluk.p@thaiairways.com">apiluk.p@thaiairways.com</a>
Plt. Off. Panom Chotichong	Chief, Aircraft Engineer Thai Airways International Public Co., Ltd. 333/2 Moo 1, Nong Prue Bangphli, Samutprakarn 10510 <b><u>THAILAND</u></b>	Tel: +66 (2) 137 6215 Fax: +66 (2) 137 9640 E-mail: <a href="mailto:panom.c@thaiairways.com">panom.c@thaiairways.com</a>
Mr. Channarong Leevarawat	Aircraft Engineer Thai Airways International Public Co., Ltd. 333/2 Moo 1, Nong Prue Bangphli, Samutprakarn 10510 <b><u>THAILAND</u></b>	Tel: +66 (1) 137 6208 Fax: +66 (1) 137 6940 E-mail: <a href="mailto:channarong.l@thaiairways.com">channarong.l@thaiairways.com</a>
Squadron Leader Somchanok Tiamtiabrat	Senior Aerodrome Safety Officer 6 Aerodrome Standardization and Safety Office Airports of Thailand Public Co. Ltd. Don Mueang International Airport 333 Cherdwutagard Road Don Mueang, Bangkok 10210 <b><u>THAILAND</u></b>	Tel: +66 (2) 977 8296 Fax: +66 (2) 977 8298 E-mail: <a href="mailto:somchanokt@yahoo.com">somchanokt@yahoo.com</a>
Ms. Uthaiwan Sanyamoon	Airports Operations Officer 3 Ground Operations Control Sub-division Airside Service Division Suvambhumi Airport Office Airports of Thailand Public Co. Ltd 999 Moo 1, Nong Prue, Bang Phli Samutprakarn 10540 <b><u>THAILAND</u></b>	Tel: +66 (2) 132 6826 Fax: +66 (2) 132 6846 E-mail: <a href="mailto:aiwjaa@hotmail.com">aiwjaa@hotmail.com</a>
Mr. Chutintorn Pongpairoj	Director, Air Traffic Surveillance Engineering Department Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9448 Fax: +66 (2) 285 9145 E-mail: <a href="mailto:chutin@aerothai.co.th">chutin@aerothai.co.th</a>
Mr. Surapol Kongpool	Director International Business Services Department Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9561 Fax: +66 (2) E-mail: <a href="mailto:surapol@aerothai.co.th">surapol@aerothai.co.th</a>
Mr. Cholavut Anamarn	Air Traffic Control Manager Standard & Safety Department Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9642 Fax: +66 (2) 287 8229 E-mail: <a href="mailto:cholavut.an@aerothai.co.th">cholavut.an@aerothai.co.th</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Wisanu Supanunt	Engineering Manager Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 287 8521 Fax: +66 (2) 285 9516 E-mail: <a href="mailto:wisanu.supanunt@gmail.com">wisanu.supanunt@gmail.com</a>
Mr. Sirinan Kuhsook	Engineering Manager Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9777 Fax: +66 (2) 285 9778 E-mail: <a href="mailto:sirinan.ku@aerothai.co.th">sirinan.ku@aerothai.co.th</a>
Mr. Noppadol Pringvanich	Engineering Manager Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 287 8041 Fax: +66 (2) 287 8639 E-mail: <a href="mailto:npringvanich@gmail.com">npringvanich@gmail.com</a>
Lt. JG. Pisai Itthirutanachot	Engineering Manager Air Traffic Surveillance Systems Engineering Department Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9134 Fax: +66 (2) 285 9145 E-mail: <a href="mailto:pisai.it@aerothai.co.th">pisai.it@aerothai.co.th</a>
Sub. Lt. Vatchara Kuekul	Engineering Manager Air Traffic Surveillance Systems Engineering Department Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9146 Fax: +66 (2) 285 9145 E-mail: <a href="mailto:vatchara.ku@aerothai.co.th">vatchara.ku@aerothai.co.th</a>
Ms. Prapasara Kongsawat	Senior Administrative Officer Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (086) 688 6678 Fax: +66 (2) 287 8645 E-mail: <a href="mailto:prapasara@aerothai.co.th">prapasara@aerothai.co.th</a>
Mr. Chaiwat Pittapundu	General Administrative Officer Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) Fax: +66 (2) E-mail: <a href="mailto:chaiwat1@aerothai.co.th">chaiwat1@aerothai.co.th</a>
Mr. Chanchai Rattanopath	Senior Systems Engineer Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) Fax: +66 (2) E-mail: <a href="mailto:chanchai.ra@aerothai.co.th">chanchai.ra@aerothai.co.th</a>
Mr. Pongabha Abhakara	Senior Systems Engineer Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 287 8518 Fax: +66 (2) 285 9516 E-mail: <a href="mailto:pongabha.abhakara@sasin.edu">pongabha.abhakara@sasin.edu</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Mitree Nimsuk	Senior Systems Engineer Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9777 Fax: +66 (2) 285 9778 E-mail: <a href="mailto:nmitree@aerothai.co.th">nmitree@aerothai.co.th</a>
Mr. Yutthana Tairat-Apiban	Executive Officer, Systems Engineering Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9777 Fax: +66 (2) 285 9778 E-mail: <a href="mailto:yutthana.ta@aerothai.co.th">yutthana.ta@aerothai.co.th</a>
Mr. Uthit Zongchom	Aircraft Commander Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (2) 285 9773 Fax: +66 (2) 285 9778 Mobile : +66 80 997 7778 E-mail: <a href="mailto:uthit.zo@aerothai.co.th">uthit.zo@aerothai.co.th</a>
Mr. Sayan Pitak	Aircraft Commander Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: Fax: E-mail: <a href="mailto:sayan.pi@aerothai.co.th">sayan.pi@aerothai.co.th</a>
Mr. Visut Dechpokket	Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 81 821 3427 Fax: +6 (2) 285 9778 E-mail: <a href="mailto:visut.de@aerothai.co.th">visut.de@aerothai.co.th</a>
Mr. Atit Jumpasri	Engineer Aeronautical Radio of Thailand Ltd. 102 Ngamduplee, Tungmahamek Sathon, Bangkok 10120 <b><u>THAILAND</u></b>	Tel: +66 (084) 108 6336 Fax: +66 (2) 287 8645 E-mail: <a href="mailto:Atit_Jumpasri@hotmail.com">Atit_Jumpasri@hotmail.com</a>
<b>USA (1)</b>		
Mr. Glenn R. Bissonnette	Manager, Flight Inspection Policy Federal Aviation Administration Mike Monroney Aeronautical Center P.O. Box 25082 Oklahoma City, OK 73125 <b><u>USA</u></b>	Tel: +1 (405) 954 2479 Fax: +1 (405) 954 3385 E-mail: <a href="mailto:Glenn.R.Bissonnette@faa.gov">Glenn.R.Bissonnette@faa.gov</a> <a href="mailto:bissonnet@gmail.com">bissonnet@gmail.com</a>
<b>INTERNATIONAL ORGANIZATION</b>		
<b>IFALPA (1)</b>		
Capt. Ajmer Singh Ajit Singh	Chairman SilkAir Branch Air Line Pilots Association Singapore (ALPA-S) 720 Upper Changi Road East SIA Training Centre (SIN-STV-02-A) Singapore 486852 <b><u>SINGAPORE</u></b>	Tel: +65 6542 0207 Fax: +65 6542 6949 Mobile: +65 9369 3163 E-mail: <a href="mailto:ajmer@alpas.org">ajmer@alpas.org</a>
<b>ICASC (1)</b>		
Mr. Franck Buffon	ICASC Member – C & P working group International Committee for Airspace and Calibration (ICASC) SAGEM 27, rue Leblanc 75512 Paris Cedex 15 <b><u>FRANCE</u></b>	Tel: +33 (1) 5812 4177 Fax: +33 91) 5812 4198 E-mail: <a href="mailto:franck.buffon@sagem.com">franck.buffon@sagem.com</a>

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
<b>INDUSTRY</b>		
<b>AERODATA (5)</b>		
Ms. Mareile Langhorst	Director Competence Center Flight Inspection Systems Germany Aerodata AG, Braunschweig Herman-Blenk-Strasse 34-36 38108 Braunschweig <b><u>GERMANY</u></b>	Tel: +49 (531) 235 9134 Fax: +49 (531) 235 9158 E-mail: <a href="mailto:langhorst@aerodata.de">langhorst@aerodata.de</a>
Dr. Manfred Haverland	Director Strategic Business Development Germany Aerodata AG, Braunschweig Herman-Blenk-Strasse 34-36 38108 Braunschweig <b><u>GERMANY</u></b>	Tel: +49 (531) 235 3125 Fax: +49 (531) 235 9158 E-mail: <a href="mailto:haverland@aerodata.de">haverland@aerodata.de</a>
Mr. Peter Kriening	Director Business Development and Sales Germany Aerodata AG, Braunschweig Herman-Blenk-Strasse 34-36 38108 Braunschweig <b><u>GERMANY</u></b>	Tel: +49 (531) 235 9124 Fax: +49 (531) 235 9158 E-mail: <a href="mailto:kriening@aerodata.de">kriening@aerodata.de</a>
Mr. Thorsten Heinke	Project Manager Flight Inspection Systems Germany Aerodata AG, Braunschweig Herman-Blenk-Strasse 34-36 38108 Braunschweig <b><u>GERMANY</u></b>	Tel: +49 (531) 235 9118 Fax: +49 (531) 235 9158 E-mail: <a href="mailto:heinke@aerodata.de">heinke@aerodata.de</a>
Mr. Andreas Kleffmann	Software Engineer Flight Inspection Systems Germany Aerodata AG, Braunschweig Herman-Blenk-Strasse 34-36 38108 Braunschweig <b><u>GERMANY</u></b>	Tel: +49 (531) 235 9196 Fax: +49 (531) 235 9158 E-mail: <a href="mailto:kleffmann@aerodata.de">kleffmann@aerodata.de</a>
<b>AEROPEARL PTY LTD (1)</b>		
Mr. Thomas Schachtner	Technical Services Manager Aeropearl Pty Ltd. P.O. Box 884, Hamilton Central Brisbane, QLD 4007 <b><u>AUSTRALIA</u></b>	Tel: +61 (7) 3860 0607 Fax: +61 (7) 3216 3164 E-mail: <a href="mailto:tschachtner@aeropearl.com.au">tschachtner@aeropearl.com.au</a>
<b>AIRFIELD TECHNOLOGY, INC (1)</b>		
Mr. Larry D. Brady	President Airfield Technology, INC 12897 West 151 Street, Suite A Olathe, KS 66062 <b><u>USA</u></b>	Tel: +1 (913) 780 9800 Fax: +1 (913) 780 9803 E-mail: <a href="mailto:lbrady@airfield.com">lbrady@airfield.com</a>
<b>NORWEGIAN SPECIAL MISSION AS (1)</b>		
Mr. Sigurd A. Bjelkarøy	Product Manager Norwegian Special Mission P.O. Box 110 2061 Gardermoen <b><u>NORWAY</u></b>	Tel: +47 6481 9300 Fax: +47 6481 9320 E-mail: <a href="mailto:sigurd.nsm@unifis.no">sigurd.nsm@unifis.no</a>
<b>RADIOLA AEROSPACE (1)</b>		

STATE/NAME	DESIGNATION/ADDRESS	TEL/FAX/-EMAIL
Mr. Evan Shipe	Manager Flight Validation Services Radiola Aerospace Pty. Ltd. 116 Crawford Street Queanbeyan, NSW 2620 <b><u>AUSTRALIA</u></b>	Tel: +61 (2) 6284 2736 Fax: +61 (2) 6299 6213 E-mail: <a href="mailto:evans@radaero.com">evans@radaero.com</a>
<b>ICAO (3)</b>		
Capt. David VanNess	ICAO PBN Programme ICAO Headquarters 999 University Street Montréal, Quebec H3C 5H7 <b><u>CANADA</u></b>	Tel: +1 (514) 954 8219 Ext. 9370 Fax: E-mail: <a href="mailto:dvanness@icao.int">dvanness@icao.int</a>
Mr. Li Peng	Regional Officer CNS International Civil Aviation Organization 252/1, Vibhavadee Road Ladyao, Chatuchak Bangkok 10900 <b><u>THAILAND</u></b>	Tel: +66 (2) 537-8189 Ext. 158 Fax: +66 (2) 537-8199 E-mail: <a href="mailto:pli@bangkok.icao.int">pli@bangkok.icao.int</a>
Mr. Sujan Saraswati	Regional Officer CNS International Civil Aviation Organization 252/1, Vibhavadee Road Ladyao, Chatuchak Bangkok 10900 <b><u>THAILAND</u></b>	Tel: +66 (2) 537-8189 Ext. 155 Fax: +66 (2) 537-8199 E-mail: <a href="mailto:ssaraswati@bangkok.icao.int">ssaraswati@bangkok.icao.int</a>



*International Civil Aviation Organization*

**SEMINAR ON TESTING OF NAVIGATION  
AND SURVEILLANCE FACILITIES AND  
VALIDATION OF FLIGHT PROCEDURE**



Bangkok, Thailand, 5-7 August 2009

**LIST OF INFORMATION, WORKING AND SEMINAR PAPERS**

<b>IP/ WP/SP No.</b>	<b>Agenda Item</b>	<b>Subject</b>	<b>Presented by</b>
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<b>WORKING PAPERS</b>			
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WP/2	5	Eight Edition of Catalogue of Flight Inspection of Units – Asia and Pacific Regions	Secretariat
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SP/2	2	Flight Inspection ADSB	Aerodata
SP/3	4	GAGAN Signal in Space Testing and Utilization	India
SP/4	4	Flight Inspecting GBAS	Aerodata
SP/5	6	Enhanced Capabilities for Localization of Interference Sources	Aerodata
SP/6	3	Changing Requirements of Flight Inspection	Secretariat
SP/7	1	Testing and Validation of Procedures Design	Australia
SP/8	4	Testing and Validation of Ground and Space Based Augmentation Systems	Australia
SP/9	2	Singapore's Flight Calibration Experience	Singapore

<b>IP/ WP/SP No.</b>	<b>Agenda Item</b>	<b>Subject</b>	<b>Presented by</b>
SP/10	2	Quality Management and New Technology Development	China
SP/11	3	RNP AR Flight Operational Safety Assessment (FOSA)	Secretariat
SP/12		ILS Incident – a Free Lesson	Australia
SP/13	2	Thailand Flight Inspection	Thailand
SP/14	3	Validation: ICAO Requirements	Secretariat
SP/15	1	Instrument Flight Procedure Design Process	Japan
SP/16	1	Flight Validation of RNP APCH Procedures for Phuket International Airport	Thailand
SP/17	2	Indian Commitment to Flight Inspection	India
SP/18	2	Glide Path Flight Inspection Geometric Reference Point and Recommendations for International Standards	Airfield Technology
SP/19	1	The International Committee for Airspace Standards and Calibration (ICASC)	USA
SP/20	1	Technical Operation Services Aviation Systems Standards Gold Standard Process	USA
SP/21	5	The Regulatory Environment for Flight Inspection and Flight Validation at New Zealand	New Zealand
SP/22	4	Flight Inspection of GBAS	Norwegian Special Mission (NSM)
SP/23	6	Requirement for the Next Generation of Flight Inspection	Airfield Technology
SP/24	1	An Introduction into RNP-AR Operations in Australia	Australia
SP/25	1	RNP – Special Lateral Conformance Monitoring – Data Collection and Analysis	Australia
SP/26	1	RNP-AR Conformance Monitoring	Australia
SP/27	1	Procedure Design and Validation in Australia	Australia

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