INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

ASIA/PACIFIC REGIONAL

RVSM MONITORING STATEMENT

REDUCED VERTICAL SEPARATION MINIMUM (RVSM)

GLOBAL LONG TERM HEIGHT MONITORING REQUIREMENTS

EFFECTIVE FROM NOVEMBER 2010

Version 1.0 – August 2012

Issued by the ICAO Asia/Pacific Regional Office, Bangkok

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FOREWORD

Since the initial operational implementation of Reduced Vertical Separation Minimum (RVSM) in the North Atlantic in 1997, implementation of RVSM in all global airspace has been completed. In the Asia/Pacific Region, implementation commenced as a result of the output of the Third Asia/Pacific Regional Air Navigation Meeting (RAN/3, Bangkok, Thailand, 19 April – 7 May 1993) which called for an ICAO RVSM Task Force to progress RVSM implementation in the Pacific. The Ninth meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG 9, August 1998) established the Asia/Pacific RVSM Implementation Task Force (RVSM/TF) under the terms of Decision 9/4 and simultaneously adopted Conclusion 9/3 requiring actions to establish an RVSM implementation schedule for the Asia region, in addition to the programme for the Pacific region.

Under the capable stewardship of the RVSM/TF, Asia/Pacific RVSM implementations went forward smoothly commencing with the Pacific area in 2000 and followed by the Western Pacific and South China Sea area during 2002, the Bay of Bengal area in 2003, Japan and the Republic of Korea during 2005, China in 2007, DPR Korea in 2009 and Mongolia and Afghanistan in 2011.

Recognising the significance of the step from a 2000 ft vertical separation minimum to a 1000 ft vertical separation minimum, intensive monitoring arrangements were put in place to ensure the continued safety of RVSM operations. Such monitoring considers RVSM safety performance in terms of two components. Technical risk relates to the technical performance of equipment, including altimetry systems. Operational risk relates to human performance error and, in simple terms, considers errors made by pilots and air traffic controllers.

To be approved for operation in RVSM airspace, States must ensure that aircraft comply with technical requirements that enable the actual height cleared by air traffic services to be accurately maintained. The RVSM monitoring programmes around the world have collected extensive height keeping data to determine the stability of Altimetry System Error (ASE) in airframes used for RVSM operations. The results show that ASE drift is worse than anticipated. Accordingly, provisions have been included in Annex 6 – *Operation of Aircraft* that require the global long term monitoring of altimetry systems used for RVSM operations.

APANPIRG/20 (September 2009) adopted an Asia/Pacific Regional Impact Statement, prepared by the Regional Airspace Safety Monitoring Advisory Group (RASMAG), under the terms of Conclusion 20/23 to provide general guidance to States. Additionally, specific guidance was provided to assist in identifying the ground-based monitoring infrastructure necessary for the regional RVSM monitoring programme.

This Implementation Statement provides an update to the Impact Statement of 2009, specifically identifying the activities undertaken by States and RMAs in establishing monitoring infrastructure and implementing monitoring activity to meet the Annex 6 long-term height-keeping monitoring requirements.

1. Introduction

1.1 At the broadest level, Annex 11 – *Air Traffic Services* requires States to establish a safety programme in order to achieve an acceptable level of safety in the provision of Air Traffic Services (ATS). More specific requirements exist for the implementation of safety management systems by Air Navigation Services Providers (ANSPs) that identify hazards, ensure remedial action and provide for the continuous monitoring and regular assessment of the safety level achieved.

1.2 In the specific case of the implementation and on-going operation of reduced vertical separation minimum (RVSM), Annex 11 requires that for all airspace where a RVSM of 300 m (1 000 ft) is applied between FL 290 and FL 410 inclusive, a programme shall be instituted, on a regional basis, for monitoring the height-keeping performance of aircraft operating at these levels, in order to ensure that the implementation and continued application of this reduced vertical separation minimum meets the safety objectives. Annex 11 also requires that the coverage of the height-monitoring facilities provided under this programme shall be adequate to permit monitoring of the relevant aircraft types of all operators that operate in RVSM airspace. Arrangements shall be put in place, through interregional agreement, for the sharing between regions of data from RVSM monitoring programmes.

1.3 The increasing complexity of requirements and the necessary State interactions led the Fourteenth meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/14, August 2003) to establish the Regional Airspace Safety Monitoring Advisory Group (RASMAG) to provide oversight of airspace safety monitoring requirements, including the monitoring of the height keeping performance of the airframes used in RVSM operations, thereby providing a regional basis for RVSM monitoring in Asia/Pacific. In further addressing its responsibilities in this regard, APANPIRG adopted a Target Level of Safety (TLS) for en-route airspace in the Asia/Pacific region of 5×10^{-9} fatal accidents per flight hour in each dimension i.e. vertical, lateral and longitudinal. APANPIRG also continues to encourage cooperative arrangements between States to undertake airspace safety assessments and to provide airspace safety assessment and monitoring for the introduction of airspace changes and reduction in aircraft separation minima (vertical and horizontal), as well as for on-going operations.

2. The need for RVSM Monitoring

2.1 Aircraft use a barometric altimeter to determine height and follow common pressure levels (flight levels) using a QNH of 1013 in RVSM airspace. The errors in the aircraft altimetry sensing systems are not apparent during routine operations as the altimeter displays to the aircrew and air traffic services (ATS) a level that includes these altimetry system errors (ASE). As such, the presentation to the pilot and/or ATS is often different to the actual height of the aircraft. During routine calibration the aircraft systems are maintained on the ground while at rest, so the dynamic nature of ASE is not able to be seen. Aircraft altimetry systems also utilize parts that:

- wear over time (such as the pitot-static probe and portions of internal plumbing); and/or
- are subject to damage (such as skin flexing/deformation during operations); and/or
- are affected by modification of airframes (such as the application of paint, decals and branding marks or mounting of accessories or repairs such as boiler plating in the vicinity of the static pressure ports).

2.2 All these activities are capable of producing significant error in true height. Other factors seen in normal operations of high-speed flight such as aerodynamic loading and exposure to ranges of temperature, moisture and contaminants, are also capable of producing significant variation in the sensed pressure.

2.3 ASE can vary over the population of operational aircraft of the same type and within each specific aircraft this error can vary with time in service. **Figure 1** below details the variations observed in true altitude over a period of five years for a single airframe. Note the increased rate of deterioration in the last 10 months of the sample period.

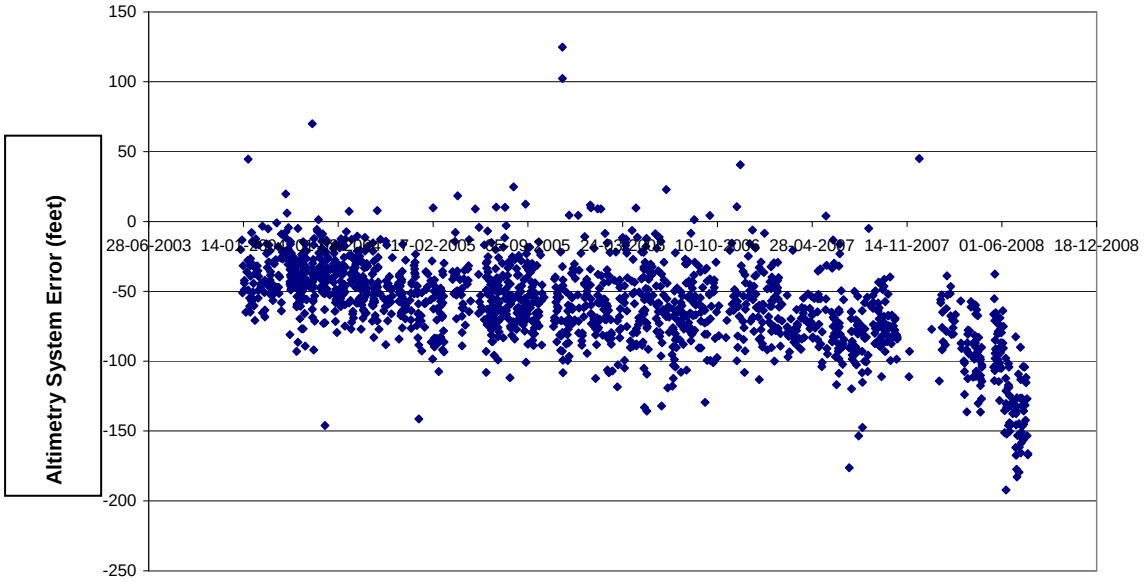

Figure 1: Example of single airframe Altimetry System Error (ASE) degradation over 5 years.

2.4 As well as the ASE variations that occur within a single airframe (as shown above), **Figure 2** below demonstrates the variation in ASE over a fleet of 15 airframes of the same type at a similar point in time.

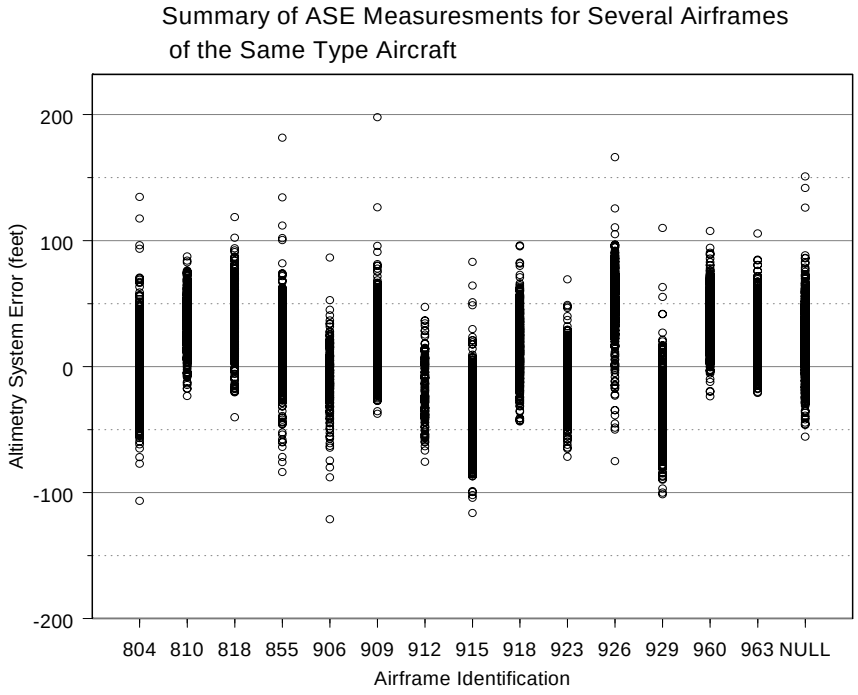

Figure 2: Variation of ASE over 15 airframes of same type at a similar point in time.

2.5 The collision risk model applied for RVSM is globally recognized by ICAO and uses an empirical basis coupled with robust mathematical methodologies to exclude height deviations of less than 300 feet for the assessment of operational errors (i.e. pilot and air traffic controller errors). However, the technical risk component of the collision risk model considers all errors in its assessment and therefore any adverse performance of individual altimetry systems must be included in the model. In an attempt to balance the need, on the one hand, for continuous assessment of the altimetry system performance of each airframe to meet mathematical principles with, on the other hand, the real-world pragmatic difficulties in actually achieving monitoring at this rate, the Annex 6 provision have been drafted accordingly. As such, in generic terms Annex 6 essentially provides for a monitoring rate of two airframes per type per operator per two years in the expectation that this will provide adequate data whilst not imposing excessively onerous requirements on operators.

2.6 Continued safe RVSM operations demand continuous high accuracy from altimetry systems, however RVSM Regional Monitoring Agencies (RMAs) globally have evidence that ASE can vary within a population of the same aircraft type at any point in time and by individual aircraft over any period of time. These concerns were identified early on in the global RVSM implementation programme and, as a consequence, monitoring requirements were incorporated in the RVSM Manual (*Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum between FL290 and FL410 Inclusive- Doc 9574)* and Annex 11. Subsequently, because the data that became available from the monitoring clearly identified the technical problems in altimetry systems and lack of ASE stability, additional provisions were included in Annex 6 effective November 2010 to ensure that global monitoring requirements were clearly defined. Additionally, amendments to Annex 11 have also been made that clarify regional monitoring responsibilities.

3. Asia/Pacific RVSM Monitoring arrangements

3.1 Assessment of the safety performance of RVSM airspace is undertaken by specialist assessment bodies known as Regional Monitoring Agencies (RMAs), which are specifically established to undertake the on-going monitoring of RVSM operations in order to meet ICAO Standards. The work of the global ICAO RMAs is facilitated and standardised through the Regional Monitoring Agency Coordination Group (RMACG). For the APAC Region, RASMAG coordinates the work of the APANPIRG-endorsed RMA services provided by:

- The Australian Airspace Monitoring Agency (AAMA), operated by Airservices Australia.
- The China RMA, operated by the Air Traffic Management Bureau (ATMB) of the Civil Aviation Administration of China (CAAC).
- The Japan Airspace Safety Monitoring Agency (JASMA), operated by the Japan Civil Aviation Bureau.
- The Monitoring Agency for the Asia Region (MAAR), operated by Aeronautical Radio of Thailand (AEROTHAI).
- The Pacific Approvals Registry and Monitoring Organization (PARMO), operated by the United States Federal Aviation Administration.

4. Long term RVSM height monitoring requirements

4.1 The ICAO Separation and Airspace Safety Panel (SASP) has identified that height-keeping performance monitoring results for RVSM approved aircraft had, in some cases, demonstrated long-term adverse trends in ASE stability. The likely results of this trend, if not reversed, would be aircraft becoming non-compliant with RVSM requirements. Accordingly, to ensure that adverse trends in ASE stability were detected, it was recognised by SASP that globally applicable RVSM long-term height monitoring requirements would be necessary.

4.2 As a result of proposals made by the SASP, during 2007 the ICAO Air Navigation Commission (ANC) agreed to amendments to Annex 6 – *Operation of Aircraft* that detail global RVSM long-term monitoring requirements that became effective in November 2010. These requirements state as follows:

> *7.2.7 The State of the Operator that has issued an RVSM approval to an operator shall establish a requirement which ensures that two aeroplanes of each aircraft type grouping of the operator have their height keeping performance monitored, at least once every two years or within intervals of 1 000 flight hours per aeroplane, whichever period is longer. If an operator aircraft type grouping consists of a single aeroplane, monitoring of that aeroplane shall be accomplished within the specified period.*

4.3 Although Annex 11 has required regional RVSM monitoring programmes since 2001, as a result of the adoption of the Annex 6 requirements above, during May 2009 the SASP proposed a revision to Annex 11 that clarifies the regional component of RVSM monitoring. The SASP proposal intended to retain the original long standing Annex 11 monitoring provisions whilst placing greater responsibilities on regional monitoring programmes to assist in delivering the ASE stability and aircraft group performance required by the *Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum between FL290 and FL410 Inclusive (Doc 9574)*. The amended provisions in Annex 11 now state:

> *3.3.5.1 For all airspace where a reduced vertical separation minimum of 300 m (1 000 ft) is applied between FL 290 and FL 410 inclusive, a programme shall be instituted, on a regional basis, for monitoring the height-keeping performance of aircraft operating at these levels, in order to ensure that the continued application of this vertical separation minimum meets the safety objectives The scope of regional monitoring programmes shall be adequate to conduct analyses of aircraft group performance and evaluate the stability of altimetry system error.*
>
> *3.3.5.2 Arrangements shall be put in place, through inter-regional agreement, for the sharing between regions of data from monitoring programmes.*

4.4 In relation to the Annex 6 and Annex 11 requirements, APANPIRG had agreed (Conclusion 20/20) that the RVSM Minimum Monitoring Requirements (MMRs) that had previously been adopted for use by RMAs in the Asia/Pacific Region should continue in use for the time being. In recommending this conclusion to APANPIRG, RASMAG recognised that monitoring was a significant burden to operators and should be kept to the minimum necessary. Subsequently, the RMACG considered how best to 'operationalise' the Annex 6 and Annex 11 requirements. To that end it agreed to standardise on the MMR as the means by which the minimum requirements of Annex 6 and the need for a robust monitoring program with sufficient data for analysis. As a result, the Asia/Pacific RMAs advised States that the MMR as amended from time to time, would form the basis of monitoring requirements to specifically meet the Annex 6 requirements in relation to long term height-keeping monitoring. The current MMR is available on Asia/Pacific RMA web sites.

4.5 APANPIRG/18 recognized that the 2010 implementation of Annex 6 global long-term monitoring requirements for airframes used in RVSM operations would have significant impacts in the way regional monitoring was managed, including the need for widespread regional height monitoring infrastructure capability to be made available.

5. Monitoring of Airframes

5.1 The implementation of long-term height monitoring requirements has placed significant additional responsibilities on operators, State approval authorities and RMAs alike. Within the Asia/Pacific Region, the RMAs in conjunction with the RMACG, RASMAG and APANPIRG have standardised on a set of RVSM MMRs that reflect the Annex 6 minimum requirements for long term monitoring, and support the intent of the Annex 11 requirements for the establishment of adequate monitoring programs.

5.2 The Asia/Pacific RMAs assess the monitoring burden imposed by the Annex 6 requirements on an on-going basis and routinely report this information to States and RASMAG. The RMAs have determined that the number of airframes still to be monitored for the 2 year period ending November 2012 is approximately 546 airframes. **Table 1** provides a breakdown of this analysis.

	Resultant Monitoring Burden	**Number of Airframes to be Monitored by Nov 2012**
AAMA (Australia + Indonesia + Nauru + Papua New Guinea + Solomon Islands + Vanuatu)	**249**	**140**
China RMA (China + DPR Korea)	**257**	**100**
JASMA (Japan)	**97**	**35**
MAAR (Afghanistan + Bangladesh + Bhutan + Brunei Darussalam + Cambodia + Hong Kong, China + India + Lao PDR + Macao, China + Malaysia + Maldives + Mongolia + Myanmar + Nepal + Pakistan + Philippines + Singapore + Sri Lanka + Taiwan + Thailand + Vietnam)	**505**	**220**
PARMO (Cook Islands + Fiji + Kiribati + Marshall Islands + Micronesia + New Zealand + Palau + Republic of Korea + Samoa + Tonga)	**114**	**51**
Asia/Pacific Region - Grand Total (AAMA + China RMA + JASMA+ MAAR + PARMO)	**1222**	**546**

Table 1: Monitoring Burden Analysis

6. Ground-Based Monitoring Infrastructure

6.1 The implementation of long-term height monitoring has required different types of monitoring infrastructure to best ensure the Region meets the requirements of Annex 6. Prior to 2010,airframe monitoring within the Region was undertaken by means of either a ground-based system established outside of the Region, or by a portable unit temporarily mounted in the aircraft. Since 2010, ground-based systems have been established within the Region in Japan and Australia.

6.2 In the case of ground-based systems, monitoring is undertaken by aircraft flying in proximity to the Height Monitoring Unit (HMU) established at Setouchi in Japan to estimate aircraft ASE. Alternatively aircraft flying in Europe or in North America (where the ground-based systems are known as Aircraft Geometric Height Measurement Elements -AGHMEs), may be monitored by one of the three HMUs managed by Eurocontrol, one by the North Atlantic Central Monitoring Agency (NAT CMA), or any six AGHMEs managed by the Pacific Approvals Registry and Monitoring Agency (PARMO) - four in the United States and two in Canada.

6.3 Until recently, ground-based monitoring could only occur when an aircraft overflies – in level flight - a ground-based monitoring unit or transits the local airspace specifically associated with the unit. This is not convenient in all cases as operators may have to vary flight patterns to overfly an HMU. Therefore ground-based monitoring units are ideally located at points that are routinely overflown by aircraft engaged in normal scheduled operations, rather than at locations that require aircraft to divert from normal flight paths in order to overfly the ground monitoring unit.

6.4 In early 2011 the AAMA, operated by Airservices Australia, obtained ICAO endorsement of a methodology for height-keeping monitoring that utilises geometric height data available from automatic dependant surveillance – broadcast (ADS-B) equipped aircraft. The ADS-B Height Monitoring System (AHMS) resulted from a cooperative project between the AAMA and the Federal Aviation Administration (FAA) of the United States. Operators wishing to utilise the system are only required to hold an RVSM approval and be equipped with an ADS-B that sources geometric data provided by GNSS. Monitoring in airspace where a wide-area ADS-B network is available will not require an aircraft to specifically overfly any specific AHMS site as normal flight operations can be monitored on a continuous basis with no operational impact.

6.5 AHMS has been implemented in Australian airspace and trials have recently been undertaken by MAAR leading to planned implementation within the Bangkok FIR. Further expansion of the use of AHMS within Asia/Pacific Region is planned for the near future.

6.5 The portable GPS Monitoring Unit (GMU) is a carry-on system installed in an aircraft for a single flight. Its main advantage is the ability to monitor an individual aircraft during normal operations without the need to fly over a ground-based monitoring system in a particular portion of airspace. Data files from a GMU must be post-processed to extract aircraft geometric height which must then be combined with other information in order to produce height keeping performance data. GMUs are used by the US FAA, AEROTHAI, ATMB of CAAC and one or two other approved service providers. GMU monitoring is coordinated by RMAs or State approval authorities; it is widely used and effective. However, it can be costly and inconvenient to operators: there are charges for the use of the unit, and its installation and subsequent removal may involve time out of service for the aircraft.

6.7 The advantage of ground-based monitoring systems (HMUs, AGHME or AHMS) is that they provide large volumes of data and information about the aircraft population and permit repeated measurements on individual airframes, which is highly beneficial in detecting trends in ASE performance. The location of ground-based monitoring systems is very important, as it determines the number of aircraft for which ASE estimates will be produced. RASMAG in conjunction with APANPIRG and Asia/Pacific States, continues to review the Region's height-keeping monitoring infrastructure to ensure adequate coverage.

6.8 The advantage of a portable airborne system (GMU) is that it provides the ability to target specific portions of the airspace population to meet immediate needs, however GMU monitoring does not provide the continuous data streams necessary to determine aircraft group performance and ASE stability. Therefore although GMU monitoring addresses the basic MMR, it should be considered only as supplementary to ground-based monitoring.

6.9 The currently implemented monitoring programme for the Asia/Pacific region a combination of ground-based monitoring systems such as the HMU, AGHME and AHMS, as well as airborne systems such as the GMU. However, recognising the cost of installing, operating and maintaining such systems, regional investment should be kept at the absolute minimum necessary to meet the operational requirements, any future additional deployment of these systems needs to be closely coordinated with APANPIRG, RASMAG and the Asia/Pacific RMAs. Such coordination will ensure effective monitoring within the Region whilst avoiding unnecessary investment in dedicated monitoring infrastructure.

7. Impacts on the Asia/Pacific Region

Objectives of height monitoring

7.1 In considering both the impact of the Annex 6 provisions and the proposed strengthening of Annex 11 regional provisions on the Asia/Pacific Region, an understanding of the objectives to be achieved by height monitoring is necessary. At the broadest level, the monitoring programme must ensure that the continued operational application of RVSM meets the established safety requirements.

7.2 In order to achieve this primary objective, three subsidiary objectives must be met for the performance monitoring of RVSM. The first is to ensure compliance with the MMR which serves as a check that operators have initially made any required airframe changes and then continue to maintain aircraft in accordance with manufacturer's recommendations for airworthiness. For this purpose, only a sample of observations from each of the operators' fleets is required and Annex 6 provisions require the monitoring at intervals of no more than two years.

7.3 The second objective is to conduct analyses of aircraft group performance, where a group consists of aircraft with nominally identical design (including nominally identical static systems and RVSM-related avionics units) as defined in Chapter 3 of the *Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum between FL290 and FL410 Inclusive (Doc 9574)* and recognised in the strengthened Annex 11 provisions. In achieving this objective, a much larger data sample adequate to determine ASE performance is required. Accordingly, enough ASE monitoring data should be captured to be able to assess every monitoring group against RVSM performance requirements routinely throughout the two-year period.

7.4 The final objective requires that in order to fulfil the system performance monitoring required by Chapter 6 of the *Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum between FL290 and FL410 Inclusive (Doc 9574)*, and as recognised in the strengthened Annex 11 provisions, the monitoring process should also aim to provide evidence of ASE stability. Sufficient ASE performance data must be available to show that, for the bulk of airframes circulating in the RVSM environment, ASE performance does not vary substantially from the beginning to the end of the two-year monitoring period. Such data is obtained from repeated samples on individual airframes throughout the two-year period.

Portable and ground-based monitoring

7.5 In terms of meeting the MMR, monitoring completed using a portable GMU is acceptable. However, to assess aircraft group performance and long-term ASE stability, large volumes of data are necessary, including results of monitoring of the same airframes over a period of time. Such large volumes of data are only obtainable from ground-based monitoring installations that obtain data on relevant airframes on a regular basis. Accordingly, a regional monitoring infrastructure that provides the ability to meet the MMR requirements as well as the group performance and ASE stability monitoring requirements is necessary. This involves a mixture of portable GMU and ground-based monitoring capability used in a continuous and well coordinated manner.

Current Asia/Pacific monitoring capabilities

7.6 Ground-based monitoring systems have been implemented in Australia and Japan with future deployments planned for China and Thailand, and possibly further installations of HMUs in Japan. Additionally, the planned implementation of ADS-B surveillance systems in many Asian States will provide a significant source of monitoring data for the Regional RMAs to use for ASE calculations and other height-keeping monitoring activity.

7.7 Limited portable GMU monitoring capability is available via Asia/Pacific RMAs - as described in paragraph 6.5 above.

7.8 Clearly, in a region of the size of the Asia/Pacific it is not at all feasible to provide 100% monitoring capabilities in all areas. However, a review by RASMAG of the major international traffic flows previously identified that appropriate locations for installation of ground-based monitoring systems could include Australia/New Zealand, Southeast Asia, Northeast Asia, China and India/Pakistan. Section 6 of this document identifies that RASMAG in conjunction with the RMAs and States has been successful in implementing the identified infrastructure. The planned availability of additional ground-based monitoring capabilities in the Region will further enhance the current monitoring capability and ensure States and operators can meet monitoring obligations.

7.9 The implementation of the ground-based infrastructure, current or planned, should mean that existing regional portable GMU capability is adequate.

Coordination arrangements

7.10 In an effort to minimise duplications of effort whilst still ensuring compliance with monitoring provisions, effective coordination between RMAs globally, and between RMAs and the States they are serving, is essential. Each Asia/Pacific RMA examines on an ongoing basis, monitoring results accumulated by all other authorized global RMAs, regardless of region, in order to utilize those results to avoid duplication and reduce the actual monitoring burden faced by each RMA and operator.

7.11 APANPIRG has already recognised the importance of coordination between RMAs and States, with APANPIRG/19 (September 2008) promulgating the following Conclusion:

> ***Conclusion 19/15 – Enhanced communications between States and RVSM RMAs***
>
> *That, noting the Annex 6 provisions for the global long term monitoring of airframes used in RVSM operations and the critical role of Asia/Pacific RVSM Regional Monitoring Agencies (RMAs) in monitoring the safety of RVSM operations, the Regional Office draw the attention of States to the Long Term Height Monitoring Actions promulgated by RASMAG. In particular, States are encouraged to immediately strengthen relationships with their respective RMAs to ensure that information in relation to RVSM approval status is continuously available to RMAs.*

7.12 Despite Conclusion 19/15, Asia/Pacific RMAs continue to experience difficulties in receiving timely and accurate information (including routine large height deviation [LHD] reporting) from States. In order to enable RMAs to assist States to fulfil their monitoring obligations, it is necessary that States:

a) continuously update RMA databases of operators and aircraft holding State RVSM approvals;

b) assist RMAs by providing data, such as ADS-B data, that will enable timely and effective monitoring within the Region;

c) enable the expeditious forwarding of all LHD and related reports to RMAs, and

d) ensure availability of current details for State RVSM Point of Contact (POC) officials.

7.13 To highlight the importance of data provision, APANPIRG/20 adopted Conclusion 20/22 calling for States to provide an update of RVSM approvals data in conjunction with the annual December traffic sample data submission required by Conclusion 16/4. In the event that adequate compliance with coordination arrangements is not achieved, RASMAG recommends that APANPIRG place non-compliant States on the APANPIRG List of Deficiencies in the ATM/AIS/SAR Fields.

8. Conclusions

8.1 The Annex 6 requirements for RVSM long-term height monitoring that took effect in November 2010 have had a significant impact on the way in which such monitoring is undertaken in the Asia/Pacific region. The RASMAG, in conjunction with the Asia/Pacific RMAs, has determined a monitoring burden of approximately 1222 airframes as at August 2012 with 544 airframes still to be monitored before end of November 2012. Work continues to have the remaining airframes monitored in accordance with the Annex 6 requirements.

8.2 Three primary objectives need to be achieved in terms of RVSM height monitoring:

a) Compliance with the Annex requirements for long term height-keeping monitoring through the globally standardised Minimum Monitoring Requirement (MMR - e.g. two aircraft per type, per operator, per two years),

b) Conduct of analyses of aircraft group performance, and

c) Evaluation of the stability of altimetry system error.

8.3 Achievement of the first objective is via sampling of relatively few airframes at relatively long intervals. Achievement of the other two objectives requires large volumes of data obtained via repeated sampling of airframes over extended periods of time using ground-based monitoring equipment.

8.4 A new monitoring infrastructure has been deployed in the Asia/Pacific Region. A range of proven monitoring systems is currently available, including ground-based systems such as HMUs, AGHMEs and AHMS, and portable airborne GMUs. Additional HMUs and wider access to AHMS is planned for the short-term.

8.5 States retain responsibility for compliance with Annex provisions, including those relating to RVSM height monitoring. An extensive system of APANPIRG approved RMAs has been established in the Asia/Pacific region to assist States in this regard, provided States make the necessary data continuously available to RMAs and comply with relevant RMA requirements. Arrangements have been implemented between global RMAs to enable sharing of monitoring data.

8.6 However, within the Asia/Pacific Region, present coordination activities by States with their respective RMAs are in some cases inadequate. States will be required to comply with related APANPIRG Conclusions, including Conclusions 19/15 and 20/22, and immediately strengthen relationships with their respective RMAs to ensure that information in relation to RVSM approval status is continuously available to RMAs. Should voluntary compliance not be effective, RASMAG will recommend to APANPIRG that non-compliant States are placed on the APANPIRG List of Deficiencies in the ATM/AIS/SAR Fields.

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References:

- The RVSM Manual – *Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum between FL290 and FL410 Inclusive (Doc 9574);*
- The ICAO Regional Monitoring Agency (RMA) Manual - *Manual of Operating Procedures and Practices for Regional Monitoring Agencies in relation to the use of a 300 m (1 000 ft) Vertical Separation Minimum above FL 290;*
- Annex 11 – *Air Traffic Services;*
- Annex 6 – *Operation of Aircraft;*
- PANS-ATM, Doc 4444 - *Procedures for Air Navigation Services – Air Traffic Management;*
- APANPIRG Conclusions 17/4, 18/2, 18/3, 18/4, 19/15, 20/22 and 20/23;
- Regional Office State Letter AP018/8 of 31 January 2008; and
- Reports of the Regional Airspace Safety Monitoring Advisory Group of APANPIRG (RASMAG/9 – May 2008, RASMAG/10 – December 2008, RASMAG/11 – June 2009