INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA AND PACIFIC OFFICE

REPORT OF THE TWENTY-SEVENTH MEETING OF THE ICAO RVSM IMPLEMENTATION TASK FORCE (RVSM/TF/27)

BANGKOK, THAILAND

27 February – 1 March 2006

The views expressed in this Report should be taken as those of the Task Force and not the Organization

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1.1 Introduction

1.1.1 The 27th Meeting of the ICAO Reduced Vertical Separation Minimum Implementation Task Force (RVSM/TF/27) was held at Kotaite Wing of ICAO Asia and Pacific Office, Bangkok, Thailand from 27 February to 1 March 2006.

1.1.2 The Terms of Reference for the Task Force is as follows:

- To develop strategic, benefits-driven implementation plans (based on cost benefit studies), in concert with airspace users, for RVSM operations within selected areas and airspace of the Asia/Pacific Region, ensuring inter-regional harmonization;

- To consider any amendments to RVSM guidance material that may be proposed by States and international organizations;

- To address any other matters as appropriate and relevant to the implementation of RVSM;

- The Task Force will include participation from States and International Organizations that are considering or involved with the implementation of RVSM; and

- The Task Force will report to the ATS/AIS/SAR Sub-Group.

(Adopted by the 10th Meeting of the ATS/AIS/SAR Sub-group, 2000)

1.2 Attendance

1.2.1 RVSM/TF/27 was attended by 32 participants from China, Hong Kong China, Japan, the Philippines, the Republic of Korea, Singapore, Thailand, IATA, IFALPA and IFATCA. A complete list of participants is at **Appendix A** to the Report.

1.3 Officers and Secretariat

1.3.1 Mr. Kuah Kong Beng, Chief Air Traffic Control Officer, Civil Aviation Authority of Singapore (CAAS) served as Chairperson of the Task Force. Mr. Kyotaro Harano, Regional Officer, Air Traffic Management (ATM), ICAO Asia and Pacific Office served as the Secretary for the meeting.

1.4 Opening of RVSM/TF/27

1.4.1 Mr. Kuah Kong Beng informed the meeting that Mr. Sydney Maniam had retired from the Civil Aviation Authority of Singapore and had requested Mr. Kuah to convey his thanks and appreciation to the Task Force for their cooperation and tireless efforts to ensure the successful implementation of RVSM operations in the areas concerned. Mr. Kuah also thanked the Task Force for their confidence in him to provide the leadership during the final stages of the work of the Task Force. He congratulated the States, ATS providers and international organizations concerned for the successful implementation of RVSM operations in the Japan and the Republic of Korea airspace. He said that seamless RVSM operations from Asia to Europe could be a reality.

1.4.2 Mr. Kyotaro Harano, on behalf of Mr. L.B. Shah, Regional Director, ICAO Asia and Pacific Office, welcomed the delegates to RVSM/TF/27. He congratulated all parties involved for the outstanding results of the RVSM implementation project for the domestic airspace of the Naha and Tokyo FIRs and the whole Incheon FIR (hereinafter "Japan and the Republic of Korea airspace"), under which RVSM was implemented on 29 September 2005. The implementation of the RVSM in the airspace has resulted in the greater enhancement of capacity, safety and efficiency.

1.4.3 Mr. Harano informed the meeting that the Council of ICAO, on reviewing the APANPIRG/16 Report on 7 February 2006, congratulated APANPIRG on the successful implementation of RVSM in the Japan and the Republic of Korea airspace. Also, the Air Navigation Commission (ANC) recognized in their review that there would be considerable safety, operational, economic, environmental and passenger service benefits accrued as a result of RVSM implementation.

1.4.4 With regard to the arrangement of the regional monitoring agency (RMA) in the particular airspace, Mr. Harano drew to the attention of the meeting that the Pacific Airspace Registry and Monitoring Organization (PARMO), which is responsible for the safety assessment and monitoring for the airspace, had been busy with the US Domestic RVSM (DRVSM) implementation project in January 2005. Consequently, the Task Force had requested the Monitoring Agency for Asia Region (MAAR) to conduct the safety assessment for Japan and the Republic of Korea, and MAAR had generously provided the pre-implementation safety assessment for the introduction of RVSM and continued to provide the post-implementation safety monitoring until the 90-day review meeting. Mr. Harano expressed appreciation to Thailand for the generous, competent and complete works provided for Japan and the Republic of Korea.

1.4.5 Mr. Harano remarked that there was a well known and respected face missing from the head table at this meeting. The Chairman of the Task Force, Mr. Sydney Maniam, had stepped down from the chairmanship as a result of his retirement from Civil Aviation Authority Singapore (CAAS) at the end of last year. Unfortunately, as events transpired the 26th meeting in Tokyo in July last year had turned out to be Mr. Maniam's last meeting and, regretfully, the opportunity for the Task Force to say a formal thank you to Mr. Sydney Maniam had consequently been missed. Under his leadership, the Task Force convened more than 20 meetings including special coordination meetings and succeeded in the introduction of RVSM in the Western Pacific/South China Sea (WPAC/SCS) areas in 2002, the Bay of Bengal in 2003 and in the Japan and the Republic of Korea airspace in 2005.

1.4.6 The meeting recognized that what had been achieved by the Task Force under Mr. Maniam's leadership was tremendous. All participants at the meeting recalled the wisdom and guidance that had been provided by Mr. Maniam and requested that the delegation from Singapore convey the appreciation and warm regards of the Task Force to him, along with best wishes for his retirement.

1.4.7 Japan expressed gratitude for the success of RVSM implementation in their domestic airspace on 29 September 2005, in conjunction with the implementation in the Incheon FIR of the Republic of Korea, as planned. This would have been impossible without cooperation and support of civil aviation authorities of the Republic of Korea, and other neighboring countries, airlines, international organizations, such as IATA, IFALPA and IFATCA. Japan was thankful for the leadership of ICAO Asia and Pacific Office, and the Task Force Chairman, Secretariat, and all members.

1.4.8 Japan expressed appreciation especially to Mr. Sydney Maniam for having served as the Task Force Chairman, leading to the safe implementation of RVSM in Asia, and was wishing his happy retirement. Japan requested Singapore delegates to pass their words to Mr. Maniam.

1.4.9 The Republic of Korea appreciated States concerned, MAAR, IATA, IFALPA and IFATCA for their support to introduce RVSM in the Incheon FIR. The Republic of Korea reported that the operation of RVSM was smooth and had enhanced the safety and efficiency of the air traffic flow within the Incheon FIR and to/from North America, Japan and the Southeast Asia. Republic of Korea also expressed appreciation to MAAR for their tremendous efforts in the safety assessment and monitoring.

1.5 Documentation and Working Language

1.5.1 The working language of the meeting as well as all documentation was in English.

1.5.2 Eight Working Papers and thirteen Information Papers were presented to RVSM/TF/27. A list of papers is included at **Appendix B** to the Report.

Agenda Item 1: Adoption of Agenda

1.1 To support the activities of the Task Force, Singapore had generously nominated Mr. Kuah Kong Beng, Chief Air Traffic Control Officer, CAAS to act in the role of Chairman. Japan seconded the nomination by Singapore. The meeting unanimously elected Mr. Kuah Kong Beng as Chairman of the Task Force.

1.2 The meeting reviewed the provisional agenda proposed by the Secretariat for RVSM/TF/27, and adopted the following agenda.

Agenda Item 1: Adoption of Agenda

Agenda Item 2: Operational Considerations

Agenda Item 3: Issues Relating to Airworthiness and Approval of Aircraft

Agenda Item 4: Safety and Airspace Monitoring Considerations

Agenda Item 5: Implementation Management Considerations

Agenda Item 6: Review of Action Items

Agenda Item 7: Future Work – Meeting Schedule

Agenda Item 8: Any Other Business

Agenda Item 2: Operational Considerations

90-Day Review by Japan

2.1 Japan reported that RVSM was implemented in the Japanese domestic airspace on 29 September 2005 as planned. The transition from the conventional vertical separation minimum to RVSM commenced at 1900 UTC on 29 September 2005 (0400 local time on 30 September 2005).

Overview of Pre-Implementation Activities

2.2 The meeting was informed that in order to implement RVSM in their domestic airspace, an amendment to the Japan Civil Aeronautics Law and associated regulations was required, which would provide legislative foundations for Japan Civil Aviation Bureau (JCAB) to enforce various requirements for safety reasons. The amendment to the law passed the National Diet on 30 June 2005.

2.3 The meeting recalled that JCAB had hosted RVSM/TF/26. At this meeting, the Task Force agreed that RVSM should be implemented in the Japan and the Republic of Korea airspace after reviewing readiness status reported by both States.

2.4 Japan reported the details of pre-implementation activities up to 29 September 2005 as below.

a) Single alternate flight level orientation scheme (FLOS) had been agreed to be used for domestic RVSM operations and non-standard levels would not be used:

b) Transition areas were not required at or near the FIR boundaries with Russia and China where metric system was in use. Level changes occurred within domestic radar coverage.

c) Flight Data Processing (FDP) and Radar Data Processing (RDP) systems required program modification to cater for ATC operational requirements. Program was changed on the implementation date.

d) The number of those controllers who needed training was more than 400 mainly at four ACCs. The training commenced in July and continued until the day before the implementation.

e) ATC Operation Standards were amended to incorporate RVSM operations in the domestic airspace in addition to the oceanic airspace in September.

f) JCAB and ACCs concerned actively coordinated the implementation plan and necessary changes with adjacent ACCs, such as Incheon, Manila, Taipei, Shanghai, Yuzhnoi-Sakhalinsk and Vladiostok.

g) JCAB held regular meetings with Japan Self Defense Forces and agreed on principles for safe operations in the RVSM airspace. Similarly, JCAB and US Forces in Japan reached an agreement on safeguard procedures for RVSM operations.

h) An amendment to the existing AIP relating to RVSM operations to cover the domestic RVSM operations with effective from 1900 UTC on 29 September 2005 was published on 4 August. Trigger NOTAM was issued on 22 September, seven days prior to the implementation date.

i) JCAB developed the Domestic RVSM Transition Manual to be used by ATC during the transition period, and distributed the manual to all ATC facilities on 16 September 2005.

Transition on 29 September 2005

2.5 JCAB developed the Domestic RVSM Transition Manual, which specified points of contact of relevant facilities, communication/reporting procedures, roles and responsibilities of the headquarters and ATC facilities, transition concepts, transition timeline, transition readiness check-lists, and contingency plans. Transition went very smoothly and safely, and was completed within 20 minutes by 1920 UTC.

Post-Implementation

2.6 An initial study to analyze the effectiveness of the RVSM implementation in the Japanese domestic airspace indicated various positive results as follows:

a) More opportunities to select and assign optimum (or next to optimum) altitudes (ATC);

b) More opportunities to obtain optimum (or next to optimum) altitudes (pilots/dispatchers);

c) Less time to respond to pilot's request for in-flight altitude changes (ATC); and

d) Less ground departure delays (ATC/pilots).

2.7 The meeting, in particular IATA and IFALPA, were very pleased with the overall results of the implementation, noting that operators were able to operate much closer to the optimum flight levels. As a result of the above, pilots and dispatchers were able to make better flight planning thus ground delays were significantly reduced.

2.8 The meeting was further informed that since implementation in the Japanese domestic airspace, RVSM had been operating safely and efficiently. JCAB continued consultation with ACCs, aircraft operators including from general aviation, and the defense authority, through the established RVSM Working Group (WG), in order to collect feed-back and traffic data, with a view to further improving RVSM operations in Japan. RVSM/TF/27 was presented with results of benefits analysis by Japan, and an extract is attached as **Appendix C** to the Report.

2.9 The meeting noted that the average FLs actually flown by aircraft between pre-implementation and post-implementation had increased by approximately 400 ft as a result of RVSM implementation on 29 September 2005. In this analysis, this 400 ft hike of average FLs was considered to lead to 0.6% fuel saving based on the assumption that an increase of cruise altitude by 2 000 ft in RVSM environment would generally save fuel burn by approximately 3%.

2.10 Japan advised the meeting that figures shown in the analysis should not be considered as "final" or "agreed by all parties concerned", but merely as "initial study results". In this regard, Japan also advised that they would continue the study for the one-year review and report the results to the Task Force.

2.11 Japan informed the meeting that in the US, the DRVSM Programme was implemented on 20 January 2005, and the *Benefits Analysis and Report for Domestic Reduced Vertical Separation Minimum* (14 September 2005) was available at the website of the US FAA. The meeting noted that the result of the study by the FAA indicated that average FL went up by 380 ft from FL 346.5 to FL 350.3. The meeting also noted that the fuel saving of three (3) lb per minute at cruise was reported in the US.

2.12 IATA stated that the benefits of the RVSM implementation in the WPAC/SCS areas were significant compared to a few hundred feet indicated by Japan's study. IATA recognized the differences of situation in the WPAC/SCS and in the domestic Japan airspace, where traffic density was quite higher and under radar control.

90-Day Review by Republic of Korea

2.13 The meeting recalled that RVSM/TF/26 was provided with the result of safety assessment carried out by MAAR, Task Lists and readiness status prepared by Japan and the Republic of Korea. According to the result of safety assessment and review of the readiness status, the Task Force agreed to implement RVSM on 29 September 2005 within the Japan and the Republic of Korea airspace.

2.14 The meeting noted that the tendency of traffic movement after RVSM implementation was as follows:

a) The total of traffic volume had not much changed comparing that of prior to RVSM implementation.

b) Although traffic volume in a specific time period had been increased as the result of RVSM implementation, operational environment between Incheon and Southeast Asia/United State/Japan had been significantly improved and delay had been significantly reduced.

c) However, operational environment for traffic flows toward China/Democracy of Republic of Korea had not been changed. Because of the different altitude system and non-RVSM environment, the traffic flows towards these areas were as same as what was before RVSM implementation.

d) With regard to the RVSM implementation, it should be noted that the general operational environment had been successfully improved.

2.15 The Republic of Korea informed the meeting of the traffic volume statistics for before and after the RVSM implementation as **Appendix D** to the Report. The Republic of Korea would continuously maintain close cooperation with Japan and other States/organizations concerned.

IATA

2.16 IATA drew attention to the operational environment for the traffic flows toward China/Democratic People's Republic of Korea, and urged States concerned to implement harmonized implementation of RVSM to increase the capacity. The benefits of RVSM would be nullified by choke points leading into non-RVSM areas.

IFALPA

2.17 IFALPA thanked Japan and the Republic of Korea for the successful implementation of RVSM in the Japan and the Republic of Korea airspace. However, IFALPA urged the States concerned to seriously look into operational and technical issues on A593 with the objective to enhance flexibility and capacity.

IFATCA

2.18 IFATCA also expressed their appreciation for the efforts made by Japan and the Republic of Korea. IFATCA drew attention of the meeting to a bunching effect as a result of the RVSM implementation, which could be observed before entering terminal control area, and requested the States concerned to study the effect.

Agenda Item 3: Issues Relating to Airworthiness and Approval of Aircraft

Review by Japan

3.1 The meeting noted that airworthiness regulations had been amended, incorporating new requirements set forth by the amended Aeronautics Law. The meeting recalled the outcome of RVSM/TF/26 that statistically 76.5% of aircraft being operated in the Japanese domestic airspace between FL 290 and FL 410 inclusive were confirmed to be RVSM approved while Korean national carriers, i.e. Korean Air and Asiana Airlines, had already obtained RVSM approval for all fleets. All Japanese operators who wished to operate in the RVSM airspace received operational approvals for their fleets by 29 September; as a result, 100% of IFR flights in the domestic RVSM airspace were conducted by RVSM certified aircraft after the implementation.

<u>RVSM Approval Data Verification by Japan</u>

3.2 The meeting was reminded that aircraft intending to operate within RVSM airspace were required to obtain RVSM operational approval from its State of Registry, and make registration in an RVSM approval database. JCAB had crosschecked the RVSM approval status of aircraft flying within the RVSM airspace (domestic and oceanic) against the RVSM approval database of PARMO and MAAR, using a one-day sample data of 15 February 2006.

RVSM Approval Status of Aircraft Registered in Japan

3.3 The numbers of Japanese RVSM approved aircraft are shown on Table 1 below (Note: This list indicates only aircraft with performance to fly above FL 290).

Table 1: RVSM approval status of aircrafts registered in Japan (as of 20 February 2006)

Operator	Registered	RVSM approved	percentage
Operated by air carriers (100 or more passenger seats / MTOW 50 000 kg or more)	445	443	99.6%
Operated by other air carriers	14	14	100%
Operated by general aviation	14	14	100%
Total	473	471	99.6%

Verification of RVSM Approval Data

3.4 It was noted that Japan used a program to search flight plans with “W” in the Field 10, and compared them with RMA lists regularly provided from both RMAs and lists available on websites as well.

Results of Verification

3.5 The meeting was advised that with regard to a one day sample taken on 15 February 2006, verification resulted as follows:

a) There were 2,202 aircraft that flew in the RVSM airspace on the day;

b) There were 68 aircraft that had “W” in the plan but were NOT found in either PARMO or MAAR database;

c) There were six aircraft that did NOT have “W” in the plan and were NOT found in either PARMO or MAAR databases;

d) There were no aircraft that did NOT have “W” in the plan but was found in the PARMO or MAAR databases.

3.6 It was confirmed that more than 99.7% of aircraft that flew in the RVSM airspace had filed “W” in the flight plan. It was also confirmed that more than 96% of aircraft flying within the Japanese RVSM airspace (domestic and oceanic) on 15 February 2006 were registered in the RMA databases of either PARMO or MAAR.

Review by the Republic of Korea

3.7 Republic of Korea informed the meeting of their RVSM approval status as in **Appendix E** to the Report.

Agenda Item 4: Safety and Airspace Monitoring Considerations

Review by MAAR

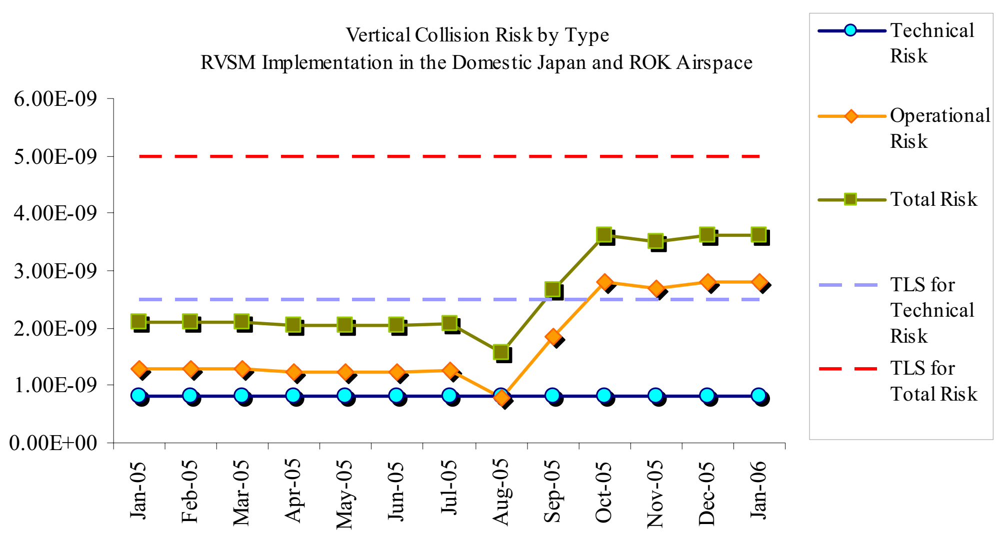
4.1 The meeting was updated with the results of 90-day airspace safety oversight for the RVSM implementation in the Japan and the Republic of Korea airspace of 29 September 2005. Table 2 summarized the results of the risk assessment in terms of technical, operational, and total risks for the RVSM implementation in the Japan and the Republic of Korea airspace.

Table 2: Risk estimates for the RVSM implementation in the Japan and the Republic of Korea Airspace

Source of Risk	Lower Bound Risk Estimation	TLS	Remarks
Technical Risk	8.08×10^{-10}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.80×10^{-09}	-	-
Total Risk	3.60×10^{-09}	5.0×10^{-9}	Below Overall TLS

4.2 The trends of collision risk estimates for each month using the appropriate 12-month interval of LHD reports since January 2005 were presented in Figure 1.

Figure 1: Trends of risk estimates for the RVSM implementation in the Japan and the Republic of Korea airspace



4.3 Based on the provided collision risk modeling input and estimated collision risks, both technical and total risks satisfy the agreed TLS value of no more than 2.5×10^{-9} and 5.0×10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 1 000 ft and to all causes, respectively. The complete review of the 90-day airspace safety oversight for the RVSM implementation in the Japan and the Republic of Korea airspace is given in the **Appendix F** to the Report.

Post-Implementation RVSM Safety Assessment by Japan

4.4 Japan conducted a post-implementation RVSM safety assessment for their domestic airspace in coordination with MAAR and with the assistance of the Electronic Navigation Research Institute (ENRI) of Japan. Table 3 summarizes the result of the assessment in terms of technical, operational and overall risks for the latest 12 month period (February 2005 - January 2006). The meeting recognized that the JCAB's assessment also indicated that the regionally agreed TLS was met for the Japanese domestic airspace, and that their findings were consistent with MAAR's results. Details of JCAB's assessment results are in **Appendix G** to the Report.

Table 3: Risk estimates for the latest 12 months of the Japanese domestic RVSM airspace

Source of Risk	Lower Bound Risk Estimation [accidents / flight hour]	TLS [accidents / flight hour]	Remarks
Technical Risk	4.8×10^{-10}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.9×10^{-9}		
Overall Risk	3.4×10^{-9}	5.0×10^{-9}	Below Overall Risk

Plan for the Transfer of RMA Responsibilities for the Japan and the Republic of Korea airspace from MAAR to PARMO

4.5 The meeting recalled that, as a result of workload on PARMO, the implementation of RVSM in Japan and the Republic of Korea was supported by MAAR in regard to safety-related matters. The *Manual on Implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive* (Doc 9574) calls for a functioning RMA to support both the introduction and also the continued safe use of the RVSM.

4.6 The meeting was advised that the *Handbook for a Regional Monitoring Agency Supporting Implementation and Continued Safe Use of the Reduced Vertical Separation Minimum* (in draft form) noted that the RMA associated with Japan and Republic of Korea was PARMO. The plan for transition for the monitoring agency responsibilities from MAAR to PARMO was presented.

4.7 A plan for the return of RMA responsibilities from MAAR to PARMO for the Japanese and the Republic of Korea airspace and associated international airspace was presented. A condensed list of the principal duties and responsibilities related to post-implementation activities for an RMA was provided as follows:

a) Establish and maintain a database of RVSM approvals,

b) Monitor aircraft height-keeping performance and the occurrence of LHD, and report results appropriately,

c) Collect periodic samples of traffic movements within RVSM airspace,

d) Initiate checks of the "approval status" of aircraft operating in the relevant RVSM airspace, identify non-approved operators and aircraft using RVSM airspace and notify the appropriate State of Registry/State of the Operator accordingly;

e) Conduct safety assessments and report results appropriately, and

f) Initiate necessary remedial actions if RVSM requirements are not met

4.8 With regard to establishing and maintaining a database of State RVSM approvals, the meeting noted that MAAR and PARMO had been exchanging approval information regularly. This exchange would help to ensure that PARMO would begin conducting RMA activities in support of the newly implemented Northeast Asia RVSM with a full complement of approval information. The meeting recognized that PARMO had established initial relations with the State approval authorities in Japan and the Republic of Korea in late 1990s in preparation for the February 2000 implementation of the RVSM in all FIRs of the Pacific.

4.9 The meeting was informed that PARMO was able to monitor an aircraft's height-keeping performance using either one of two methods: global positioning system (GPS) based monitoring unit (GMU) or a ground based monitoring system consists of a constellation of five or more Aircraft Geometric Height Monitoring Elements (AGHMEs). PARMO also collects reports of LHD from the FIRs for which PARMO is the responsible RMA on a monthly basis. It was noted that these data were summarized by PARMO and included in the RVSM Safety Monitoring Report. This report is distributed on a quarterly basis to all appropriate ATS providers in RVSM airspace. A summary of the LHD data collected from the Incheon FIR would be included in the RVSM Safety Monitoring Report, beginning with the 4th Quarter 2005 report.

4.10 The meeting noted that PARMO collected a specified one-month Traffic Sample Data (TSD) from each FIR during the calendar year. In addition to the one-month TSD received from the Tokyo and Naha FIRs in year 2005, PARMO also received a one-month TSD from the Incheon FIR in year 2005. As to the TSD required for the one-year review, a question was raised whether Japan and the Republic of Korea should provide TSD of December 2005 to PARMO and MAAR, in accordance with the APANPIRG Conclusion 16/4 even though the preceding month TSD had been provided. In this regard, MAAR advised that they would confirm with PARMO whether the November TSD already provided would suffice for the one-year review, and would inform the decision to Japan, the Republic of Korea and ICAO.

4.11 The meeting was informed that PARMO checked the "approval status" of aircraft operating in RVSM airspace and identified the operator-aircraft pairs who present themselves as RVSM approved (showing /W in Field 10 of the ICAO flight plan) but, for which a record of the RVSM approval was not found in the combined RVSM approvals database. If such operator-aircraft pairs are found, PARMO notifies the appropriate State of Registry/State of the Operator accordingly.

4.12 The meeting also noted that PARMO updated the vertical collision risk estimate for RVSM airspace regularly. The vertical collision risk estimate is provided in the RVSM Safety Monitoring Report.

4.13 The aircraft height-keeping performance monitoring activities and the quarterly review of LHD reports allow PARMO to initiate remedial actions to remove causes of systematic problems associated with factors affecting safe use of the RVSM.

4.14 The meeting examined the readiness of PARMO to assume the duties and responsibilities of RMA to support the continued safe use of RVSM in the Japanese and the Republic of Korea airspace In light of the foregoing, the meeting concluded that the responsibilities of RMA for the Japan and the Republic of Korea airspace be reverted to PARMO as previously agreed. MAAR requested Japan and the Republic of Korea to continue to provide them with the LHD data from both States, and Japan and the Republic of Korea accepted the request by MAAR to continue to provide the data.

4.15 The meeting expressed appreciation to MAAR for the airspace safety assessment and monitoring provided and their excellent services carried out to date.

Review of the Fourth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/4)

4.16 The meeting reviewed the relevant sections of the Report of RASMAG/4 (October 2005, Bangkok). The meeting noted, *inter alia,* that IATA had expressed concern at RASMAG/4 about the role of operators in providing Large Height Deviation (LHD) reports to the ATS provider of the airspace concerned (in addition to the normal pilot report via radio). Australia had drawn the attention of RASMAG/4 to two sources of LHD;

a) From operators due to weather deviation or TCAS deviation etc; and

b) From ATC errors.

4.17 The meeting noted that RASMAG/4 considered that the cases of the weather deviation should be reported by operators as ATC may not be aware of the deviation. RASMAG/4 agreed that the matter should be reviewed by RVSM/TF/27.

4.18 RASMAG/4 had been informed that for the SCS/WPAC area, both technical and total risks satisfied the agreed Target Level of Safety (TLS) values. During RASMAG/4, IFALPA was concerned that the number of vertical operational errors identified in the Arabian Sea and WPAC/SCS area were not consistent with the actual number of LHD occurrences, as some pilot reports received by IFALPA did not appear to be recorded in the LHD statistics.

4.19 In considering this issue, RASMAG/4 had noted that it was the responsibility of the States under ICAO safety management provisions to comply with the requirement of MAAR to report all LHD that occurred in their airspace and urged States to review existing processes to ensure that this was the case. In addition, a robust and reliable reporting methodology needed to be implemented to ensure that the missing events were thoroughly captured. The meeting requested that the Regional Office include this matter on the agenda of RVSM/TF/27 for further study.

4.20 RASMAG/4 was informed that APANPIRG/16 had recognized an urgent need to develop feasible and sustainable funding solutions for regional safety monitoring. The meeting noted that the Study Group was tentatively scheduled from 31 May – 2 June 2006. This meeting may be deferred if the ALLPIRG/5 meeting in March 2006 elects to formulate a global funding strategy.

4.21 During RASMAG/4, MAAR, Airservices Australia and PARMO had met at a tripartite meeting with an aim to standardize their work methods and to harmonize “different values being used in the [collision risk] modeling,” with special emphasis regarding the way that Airborne Collision Avoidance System (ACAS) reports were being included [in the risk assessment process].

4.22 The tripartite meeting considered three topics in respect of standardizing Asia/Pacific regional monitoring agency procedures:

a) common values for risk model parameters used in safety assessments;

b) treatment of ACAS; and

c) operational errors

4.23 In respect of a) above, the RMA representatives had agreed that the value for model parameters should not necessarily be fixed for use everywhere within the Region; rather the value appropriate to a particular safety assessment should reflect the range of aircraft types and speeds characteristic of the airspace under study.

4.24 In addition, the tripartite meeting agreed to consider two additional topics of relevance:

a) an alternative term for "large height deviations", and

b) long-term requirements for monitoring aircraft height-keeping performance.

4.25 All RMA representatives had agreed that the term "vertical operational errors" was widely understood to mean the sort of events about which the RMAs seek monthly reports from air traffic service providers and other organizations.

4.26 The tripartite meeting recalled further the change, with effect from 24 November 2005, added the following paragraph to Annex 11:

> "3.3.4.1 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 implementation and continued application of this vertical separation minimum meets the safety objectives. 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 who operate in RVSM airspace.
>
> *Note. – The number of separate monitoring programmes should be restricted to the minimum necessary to effectively provide the required services for the region."*

4.27 The meeting noted that the tripartite meeting reviewed the region's current monitoring infrastructure which, it was agreed, consisted of GPS Monitoring Units and associated processing centers. However, the tripartite meeting agreed that there were no comparable ground-based facilities within the Region which would produce large numbers of monitoring results on a sustained basis.

Review of LHD Reporting Procedures

4.28 The meeting recalled that at RASMAG/4, concern was expressed about the role of operators in providing LHD reports, noting that if both operators and ATS service providers reported the same occurrence, there was a duplication of reporting. RASMAG/4 agreed that the matter should be reviewed by the RVSM/TF/27.

4.29 The meeting was advised that RVSM/TF/6 (April 2000, Singapore) recognized the importance of information concerning large height deviations in conducting a comprehensive safety assessment. RVSM/TF/6 had recalled that the ICAO Asia and Pacific Regional Office issued State Letter T 3/10.1.7 − AP-ATM0586 on 23 September 1998, which requested that States, operators and flight crews report instances of large height deviations within Pacific airspace where the RVSM would be applied. A companion International NOTAM requested the same information. Both documents contained as an attachment a form, reproduced as Appendix K to the RVSM/TF/6 report, which detailed the information required and specified the APARMO as its recipient. (Paragraph 4.12 of the *Report of the Sixth Meeting of the ICAO RVSM/TF* refers). Appendix K to the Report of RVSM/TF/6 is reproduced as **Appendix H** to the report of this meeting.

4.30 The meeting recalled that RVSM/TF/8 (September 2000, Hong Kong) once again emphasized the importance of information concerning large altitude deviations when conducting a comprehensive safety assessment. In this regard, RVSM/TF/8 foresaw that the time was opportune for the ICAO Asia and Pacific Regional Office to issue an analog of State Letter T 3/10.1.7 − AP-ATM0586 of 23 September 1998, which requested that States, operators and flight crews report instances of large altitude deviations within Pacific airspace where the RVSM would be applied. (Paragraph 4.17 of the *Report of the Eight Meeting of the ICAO RVSM/TF* refers).

4.31 The meeting further recalled that RVSM/TF/12 (September 2001, Denpasar, Indonesia) again confirmed the need for regular reporting of large height deviations and directed that the APARMO coordinate with the Chairperson of ATC/WG with the intent of improving the regularity of the reporting process among all ATS providers. In making this confirmation, RVSM/TF/12 added that a monthly report stating that no large height deviations had been observed was as useful in supporting safety assessment and safety oversight as a report containing instances of large height deviations. In this regard, States were urged to provide required information to the APARMO using the large altitude deviation report format at Appendix J to the Report. RVSM/TF/12 further directed that the "APARMO intensify its efforts to obtain such reports from operators and **flight crews** [stress added] using the Western Pacific/South China Sea airspace where the RVSM will be applied." (Paragraph 4.3.5 of the *Report of the Twelfth Meeting of the ICAO RVSM/TF* refers).

4.32 The meeting was advised that at RASMAG/4, IFALPA was concerned that the numbers of vertical operational errors identified in the Arabian Sea and the WPAC/SCS airspace were not consistent with the actual number of LHD occurrences. In considering this issue, the RASMAG/4 meeting noted that it was the responsibility of the States under RVSM safety monitoring provisions to make sure to comply with the requirement of an RMA to report all LHD that occurred in their airspace. RASMAG/4 requested that the Regional Office include this matter on the agenda of RVSM/TF/27 for further study.

4.33 The meeting reviewed, upon the request of IATA, the reporting process of LHD in Japan's airspace, which had been in place since the Pacific RVSM implementation in 2000. The meeting recommended that in regard to Japan's requirement, the report of LHD by pilot/operator be sent to the State/ATS provider responsible for the provision of air traffic services in the area where the LHD occurred. When a LHD occurred, the pilot should report to the ATC concerned or, in a situation where the pilot could not inform ATC directly, a report in a written form should be submitted by the pilot or the operator to the State of the occurrence or the ATS provider concerned, as required, as soon as possible. The State/ATS provider should send the LHD report to the RMA responsible for the airspace safety monitoring. The meeting reviewed the reporting process of LHD (**Appendix I** refers) and agreed that the current process should suffice. Japan informed the meeting that it would review the reporting requirements stated in the AIP supplement to reflect the above process.

Agenda Item 5: Implementation Management Considerations.

Outcomes of APANPIRG/16

5.1 The meeting noted that APANPIRG/16 had expressed appreciation for the work that had been accomplished by Japan, the Republic of Korea and the Task Force toward the implementation of RVSM in the Japan and the Republic of Korea airspace on 29 September 2005. Additionally, APANPIRG/16 raised a total of 60 new Conclusions and Decisions for regional action. The meeting reviewed and discussed the Conclusions and Decisions from APANPIRG/16 that were of immediate relevance in the context of the RVSM/TF.

Funding arrangements for regional airspace safety monitoring

5.2 APANPIRG/16, recognizing the urgent need to develop feasible and sustainable funding solutions for Asia/Pacific regional safety monitoring so that safety and efficiency were not compromised agreed to the following Conclusion:

APANPIRG Conclusion 16/2 - Funding Arrangements for Regional Airspace Safety Monitoring

That, a study group be convened to develop a feasible and sustainable proposal to equip States to organize and finance necessary safety monitoring mechanisms for the provision of safety services for the international airspaces in the Asia/Pacific region and that States be represented at that meeting by their appropriate legal, financial and organizational experts who would be best equipped and empowered to resolve any difficulties. The study group should report to RASMAG not later than the end of June 2006.

Large height deviation occurrences in the WPAC/SCS area

5.3 The meeting noted that APANPIRG/16 had agreed with the strong concern that had been expressed by MAAR, RASMAG and the ATM/AIS/SAR/SG/15 (July 2005) in respect of the number of LHD that were occurring in the WPAC/SCS area and formulated the following Conclusion:

APANPIRG Conclusion 16/3 - Large Height Deviations – Western Pacific/South China Sea area

That, in noting the prevalence of RVSM large height deviation occurrences in the Western Pacific/South China Sea area, the Regional Office draw the attention of all States concerned to identify and put in place remedial actions to mitigate such significant errors on an urgent basis."

Annual traffic sample data - December

5.4 Upon reviewing the work of RASMAG, APANPIRG/16 noted that RASMAG had agreed that an annual provision by States of TSD would be sufficient for safety monitoring. As the month of December routinely experienced high traffic levels, RASMAG considered that this should be adopted as the standard sample period for TSD collection, commencing from December 2005. In endorsing the use of a standardized approach to the sampling of traffic data, APANPIRG/16 endorsed the following Conclusion:

APANPIRG Conclusion 16/4 – Traffic Sample Data Collection

That, States be advised by the Regional Office that December every year had been adopted for the routine collection of 30 days of traffic sample data to satisfy airspace safety monitoring requirements.

5.5 The meeting noted that APANPIRG Conclusion 16/4 pertaining to December TSD annual collection should be strictly adhered to.

Action on Safety Deficiencies

5.6 APANPIRG/16 noted that RASMAG had expressed significant concern in respect of the non-provision of data for ongoing the safety assessment/monitoring, raising the following Conclusions:

APANPIRG Conclusion 16/5 - No Implementation of Reduced Separation Unless Compliant with Annex 11

That, recognizing that some States had not adequately complied with safety management provisions, the Regional Office advise States of the Asia/Pacific Region that further regional implementation of reduced separation minima should only proceed in circumstances where implementing States can demonstrate an ability to comply with Annex 11, Chapter 2, safety management provisions for the continuous monitoring and regular assessment of the safety level achieved.

APANPIRG Conclusion 16/6 – Non Provision of Safety Related Data by States

That the Regional Office advise that States not providing safety related data to approved regional safety monitoring agencies, including RMAs, in accordance with the requirements of safety monitoring agencies will be included in the APANPIRG List of Deficiencies in the ATM/AIS/SAR fields.

5.7 The meeting recalled that RASMAG/3 had expressed significant concern in respect of non-provision of data for safety assessment/monitoring. The meeting noted APANPIRG Conclusion 16/6 on the non-provision of safety related data by states and was informed that there were instances where LHD reports were not submitted to RMA. The meeting agreed to recommend to ATM/AIS/SAR/SG to confirm that LHD reports were included in the "safety related data".

Review of SCM A593/B576

5.8 RVSM/TF/26 had noted that Special Coordination Meeting (SCM) in respect of operations on ATS routes A593 and B576 was being considered by the Regional Office, possibly to be convened later in 2005 and, if such SCM was held, the outcome of SCM would be informed at RVSM/TF/27.

5.9 Accordingly, the meeting was informed of the outcome of SCM ATS Route A593 and B576 (SCM A593/B576, December 2005). SCM A593/B576 was attended by 16 participants, comprising high level delegations from China, Japan, Republic of Korea, ICAO and IATA.

5.10 In addressing the operational and technical aspects of ATS operations, SCM A593/B576 reviewed the relevant ICAO provisions pertaining to the establishment of airspace and services necessary to promote a safe, orderly and expeditious flow of air traffic which can be found in Annex 11 – *Air Traffic Services* and the *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444). SCM was referred to matters in relation to:

a) provisions of the 1983 Memorandum of Understanding (MOU) on the Fukue-AKARA Corridor;

b) applicable provisions in Annex 11 and PANS-ATM for routine traffic management arrangements;

c) current traffic levels in comparison to traffic levels at the time the 1983 MOU was signed, and future traffic growth forecasts;

d) adequate availability of communications and surveillance capability by all States in relation to operations on A593 and B576 in the Incheon FIR;

e) need to document night time and day time traffic flows for operations on A593 and B576;

f) considerations of implementing RVSM levels on A593 with transition area west of SADLI,

g) need for implementation of the operational requirement for ATS direct speech circuit between Shanghai ACC and Incheon ACC;

h) inability of many heavy departures from Shanghai eastbound on A593 to meet the requirement to cross 124 East at or above FL 230 and LAMEN at FL 250;

i) assess whether the current operational and technical arrangements for A593 and B576 in the Incheon FIR remain adequate; and

j) possible operational and technical enhancements for traffic management on A593 and B576 in the Incheon FIR.

5.11 SCM A593/B576 acknowledged the cooperative and collaborative approach which had been exhibited by China, Japan and Republic of Korea, in ensuring the safety and efficiency of operations on ATS routes A593 and B576 in the Incheon FIR based on the 1983 MOU arrangements.

5.12 The SCM was of the view that Letters of Agreement (LOA) established as a result of the 1983 MOU were in accordance with the provisions of Annex 11, Paragraphs 3.5.1 and 3.5.2 and reconfirmed that the 1983 MOU continued to be valid in overseeing the current operational arrangements.

5.13 Although the MOU arrangements had proved robust and, in the hands of the respective ATS providers, had resulted in safe and efficient operations for many years, SCM A593/B576 recognized that it was important to consider current circumstances and future changes. The meeting considered it an opportune time to commence a collaborative review of the airspace arrangements under discussion. SCM A593/B576 agreed to continue the work to achieve forward looking outcomes that address future requirements.

Review of Amendments to Annexes 6 and 11, and PAN-ATM

5.14 ICAO Council adopted Amendment 29 to Annex 6 – *Operation of Aircraft* and Amendment 43 to Annex 11 in March 2005. ICAO ANC reviewed proposed Amendment 4 to PANS-ATM in February 2005.

Annex 6

5.15 The Annex 6 amendment introduced new appendices to Parts I and II of Annex 6, containing the height-keeping performance criteria, for approvals for operations in RVSM airspace to be valid globally. Additionally, the amendment introduced new provisions in Parts I and II of Annex 6, specifying the responsibility of the relevant State authority to take prompt and appropriate action if the monitoring results indicated that the height-keeping performance of a particular aircraft or an aircraft type group exceeds the prescribed limits.

Annex 11

5.16 The Annex 11 amendment introduced a Standard that required States to establish a monitoring programme for aircraft height keeping performance in RVSM airspace. Monitoring of aircraft height-keeping performance is one of the underlying assumptions of the safety studies on which RVSM is based. In all regions where RVSM has been implemented, RMA have been established by the appropriate Planning and Implementation Regional Groups (PIRGs) to undertake this function. An amendment to Annex 11 adds a requirement to establish such a monitoring programme.

PANS-ATM

5.17 The nature and scope of the amendments which relates to RVSM operation is as follows:

a) an amendment has been made to unify global and regional communications failure and in-flight contingency procedures, taking advantage of new technologies and current knowledge in the application of these procedures. Simplifying the procedures and securing the highest practical degree of harmonization will facilitate operations and improve the safety of air navigation; and

b) an amendment has been made to include procedures for the use of strategic lateral offsets in oceanic and remote continental airspace, as a safety measure to reduce the risk of collision in the event of loss of vertical separation. These procedures were designed to include offsets to mitigate the effects of wake turbulence of preceding aircraft.

5.18 In this regards, consultation with the States of Informal Pacific ATC Coordinating Group (IPACG) and Informal South Pacific ATS Coordinating Group (ISPACG) was made by the Regional Office, and general agreement was that the AIRAC date of 16 February 2006 would be the date for harmonized implementation of the amended PANS-ATM procedures, as this would allow time for States to prepare and issue AIP amendments and complete necessary formalities. Accordingly, the Regional Office issued a State Letter Ref.: T3/4.9 – AP120/05 (ATM) dated 23 November 2005 and requested States to make suitable arrangements to implement the unified communications failure and contingency procedures, particularly 15 NM lateral offset special procedures for in-flight contingencies, on the AIRAC date of 16 February 2006.

Delay to the Review of FLOS in the WPAC/SCS Area

5.19 During the review by RVSM/TF/22 (September 2004) of the FLOS in the WPAC/SCS areas, affected States had agreed to a work programme aimed at reviewing and amending the modified single alternate FLOS presently in use in the WPAC/SCS areas. This had become necessary due to difficulties being experienced with transition procedures at the interface between the single alternate FLOS arrangements used in the Bay of Bengal after implementation of RVSM in November 2003 and the modified single alternate FLOS arrangements in use in the WPAC/SCS area.

5.20 Subsequently, RASMAG/3 (June 2005) had recognized that the no provision of safety data by some States and consequent delay to completing the safety assessment would lead to a deferment of at least 12 months in the implementation of any proposed changes to the WPAC/SCS FLOS. In recalling the large number of LHD occurring in the WPAC/SCS area, APANPIRG/16 expressed very strong concerns that arrangements agreed at RVSM/TF/22 were expected to assist in reducing the numbers of LHD and therefore should be progressed with the minimum of delay.

5.21 RASMAG/4 was informed in respect of the outcomes of SCM for RVSM Task Force – Review of WPAC/SCS FLOS (SCM RVSM FLOS) that had been held at AEROTHAI headquarters, Bangkok, on 20 September 2005 in order to progress arrangements for the RVSM/TF/28 FLOS Review Meeting which would be held from 24 – 28 April 2006.

5.22 MAAR had provided SCM RVSM FLOS with three scenarios as a basis for conducting the international safety assessments for the FLOS review as follows:

a) Base Case: Current FLOS in WPAC/SCS;

b) Scenario 1: FLOS change proposed at RVSM/TF/22; and

c) Scenario 2: Scenario 1 with minor FLOS change on A1/P901.

5.23 Scenario 2 was essentially the same as Scenario 1, but with minor changes on A1/P901 to mitigate passing frequency. In order to eliminate existing transition issues while reducing the passing frequency on A1/P901, the following flight level allocation was proposed by MAAR for further consideration by RVSM/TF/28:

a) Class I: Northbound/Southbound: FL 310, 320, 350, 360, 390, 400

b) Class II: Eastbound: FL 290, 330, 370, 410
Westbound: FL 300, 340, 380

c) Class III: Eastbound: FL 310, 350, 390
Westbound: FL 320, 360, 400

d) Class IV: Eastbound: FL 290, 310, 330, 370, 410
Westbound: FL 300, 340, 380, 400

5.24 MAAR had advised the SCM RVSM FLOS that in Scenario 2, two flight levels were taken out for each direction of flight to reduce the passing frequency. The decision on which flight levels could be removed should be coordinated with affected States, including Cambodia, China, Hong Kong China, Lao PDR and Viet Nam.

5.25 The Regional Office issued a State letter Ref: AP-ATM0398 dated 14 October 2005 to Cambodia, China, Hong Kong China, Lao PDR and Viet Nam. The letter requested the States, as an important part of preparations for RVSM/TF/28, to study Scenario 2, with a view to adopting the flight level allocation for use in the WPAC/SCS area. As part of the consideration of Scenario 2, it would be necessary to for States to undertake safety assessment and simulation, and to consider which flight levels could be removed from the A1 and P901 flight level allocation.

5.26 SCM RVSM FLOS noted that not all the States concerned had been present at RVSM/TF/22 which had developed Scenario 1. Also, in order to facilitate the discussion at RVSM/TF/28, SCM RVSM FLOS suggested that it would be useful to include the scenarios in the invitation letter for States to be able to consider in advance. The Regional Office agreed to advise States by letter of the different scenarios and request that States complete required safety analysis and simulation of the scenarios in preparation for RVSM/TF/28.

Agenda Item 6: Review of Action Items

6.1 The meeting reviewed and updated Task List as shown in **Appendix J** to the Report.

Agenda Item 7: Future Work – Meeting Schedule

7.1 The meeting agreed tentatively on the future work programme of the Task Force as follows:

24-28 Apr 2006	RVSM/TF/28 (FLOS Review) Bangkok, Thailand
14-16 Nov 2006	RVSM/TF/29 (One-year Review Japan/Republic of Korea) TBD

Agenda Item 8: Any Other Business

<u>Operational Status of JCAB Air Traffic Management Centre (ATMC)</u>

8.1 Japan reported to the meeting that JCAB ATMC was formally established on 1 October 2005, replacing former Air Traffic Flow Management Center (ATFMC) in Fukuoka, Japan. ATMC is the core element of CNS/ATM systems in Japan.

Airspace management (ASM)

8.2 The meeting noted that ATMC started the coordination services with regard to altitude reservation (ALTRV) by the US Air Force on 3 October 2005. Also, ATMC conducted real-time coordination to utilize special use airspace (SUA), such as Japan Defense Force's high altitude training and testing airspace, by having Defense Agency liaison officers in ATMC.

Air traffic flow management (ATFM)

8.3 The meeting noted that ATFM was initiated when imbalance between traffic demand and system capacity was expected.

Consolidation of FIRs and oceanic ATS

8.4 The meeting recalled that ATS for the oceanic airspace had been provided by Tokyo and Naha ACCs. In order to integrate the oceanic control functions at ATMC, transfer of oceanic control functions had been programmed in a phased approach. The meeting was informed that ADS, CPDLC, AIDC functions had been integrated into the Third-generation Oceanic Display Processing System (ODP3) system for the oceanic control. The second Multifunctional Transport Satellite (MTSAT) was successfully launched on 18 February 2006, and full operations by two MTSAT will be realized later this year after completing assessment and confirmation of its performance.

Aeronautical information management (AIM)

8.5 The meeting also noted that AIM officers were responsible for processing nation-wide, real-time information about the availability of gates at airports, and promotes effective gate management.

CNS management service

8.6 It was noted that ATM engineering officers maintained a close watch on the relevant CNS systems, including navaids. One of the main functions of CNS management was to minimize the adverse impact on the quality and continuity of ATS and aircraft operations in case a failure of CNS systems occurs.

New data processing systems

8.7 It was further noted that JCAB FDP and Input Data Processing (IDP) systems had been located at Tokyo ACC. On 16 February 2006, when all functions were integrated to ATMC, as well as FDP and IDP, the Aeronautical Fixed Telecommunication Network (AFTN) system was integrated into the new Flight Data Management System (FDMS) in ATMC. Also, the meeting noted that this system switchover required careful planning and JCAB conducted a number of rehearsals in order to ensure a smooth change. The switchover commenced at 0100JST (1600UTC) on 16 February and its completion was confirmed after a 3-day monitoring period.

Future plan

8.8 The meeting noted that one of future services under consideration was to strengthen cooperation with neighbor countries and to introduce international ATM (IATM) with a view to achieving smooth international traffic operations.

8.9 IATA commended and thanked Japan for their continuous endeavor to keep CNS/ATM systems update to cope with the increasing air traffic. IATA requested that the RVSM/TF/29 one-year review meeting to be convened in Fukuoka, Japan to take the opportunity to observe ATMC.

<u>Airbus A380 Wake Turbulence</u>

8.10 As the new Airbus A380 large aircraft would commence regional demonstration flights from approximately 10 November 2005, ICAO had received a number of requests from States in respect of the wake turbulence separation minima to be applied. ICAO State letter AP108/05 (ATM) dated 3 November 2005 had been transmitted in this respect, advising caution in respect of wake turbulence spacing with A380.

8.11 On 10 November 2005, additional ICAO State letter AP111/05 (ATM) was transmitted by the Regional Office in respect of this issue. In view of the size and weight of the aircraft, an ad hoc work group of experts under the auspices of the United States Federal Aviation Administration (FAA), EUROCONTROL, the Joint Aviation Authorities (JAA) and the manufacturer was examining the wake turbulence aspects of the aircraft in comparison with other large aircraft. The final report of the work group was expected to be available in early 2006.

8.12 In the meantime, analyses and flight test data available to the group had raised concerns about horizontal and vertical wake turbulence spacing criteria for approach, landing, departure, and enroute operations of A380 relative to other aircraft. Current data analyses indicated that A380 wake vortices would descend further and be significantly stronger at 300 m (1 000 ft) below the altitude than for other aircraft in the heavy wake turbulence category. On rare occasions, A380 wake vortices may descend 600 m (2 000 ft) and possibly pose a passenger comfort issue, but not a hazard. It is not clear at present what level of hazard A380 wake vortices pose at 300 m (1 000 ft) to other aircraft. ICAO guidance is presented as follows:

1. Departure spacing:

a) one additional minute to be added to all separations listed in PANS-ATM, Paragraph 5.8, when an A380 is the leading aircraft;

b) one additional minute to be added to the separation in PANS-ATM, Paragraph 5.8.5.

2. Horizontal spacing:

a) where both aircraft are established on final approach, 10 NM between an A380 and any other following aircraft;

b) 15 NM minimum radar spacing for all other phases of flight, including enroute, between an A380 and all other aircraft operating directly behind at the same altitude or less than 300 m (1 000 ft) below. (See also paragraph 3 below.)

3. Vertical spacing:

Vertical spacing guidance will not be completed for several months. There are indications, however, from the initial analysis of data that wake vortex from an A380 may be encountered by aircraft flying 300 m (1 000 ft) below at greater strengths than from current aircraft of the heavy wake turbulence category. Because it has not yet been possible to establish the level of hazard associated with these wake vortices, offset tracks or additional vertical spacing is advised until the final vertical spacing guidance has been established.

8.13 States concerned may wish to further enquire with the State of manufacture and/or the aircraft manufacturer for information on latest wake turbulence data in order to facilitate consideration of these issues.

8.14 IATA informed the meeting that as advised by Airbus, the research of the wake turbulence of A380 in a clean configuration at cruise had been completed. Further research on the wake turbulence during take-off and approach phases of operation is expected to be completed by May 2006. The final recommendation from Airbus to ICAO is expected to be available in June 2006.

8.15 IFALPA was of view that States should also take into consideration the recommended increase in vertical separation for aircraft operating below A380 as there would be an impact on the availability of flight levels when reviewing the FLOS on the unidirectional routes in the WPAC/SCS area.

Wake Vortex Report – European Air Navigation Planning Group

8.16 On the 13th August 2005 an incident involving wake vortex was reported to Shannon Operations Management through the Irish Aviation Authority's Mandatory Occurrence Reporting (MOR) scheme. The report indicated that a B757-200 series aircraft had experienced a violent and uncontrollable roll of 45°accompanied by a 400 feet loss of altitude caused, in the pilot's opinion, by the wake of a preceding aircraft, an Airbus A345. A summary of this incident was reported (**Appendix K** refers) to the Forty Seventh meeting of the European Air Navigation Planning Group (EANPG/47) in December 2005.

8.17 In its review, EANPG/47 noted that in-trail climbs are a normal action used by air traffic controllers in the management and organization of air traffic and that, at the time of the incident, the separation between the aircraft was in excess of the separation standard used by air traffic control. The Group also noted the violent nature of the wake turbulence encounter at cruise altitude and recalled the anecdotal information related to wake turbulence that had been presented in the context of the implementation of RVSM.

8.18 In recognition of potential global concerns in this regard, EANPG formulated Conclusion 47/5 inviting EANPG States to note the information concerning the above mentioned wake turbulence incident and requesting the wide dissemination of information on the potential severity of such incidents. In order to determine the appropriate course of action to be taken in relation to wake vortex encounters, the EUR/NAT (Paris) Regional Office of ICAO requested that all wake turbulence related incidents in EANPG States be reported to the EUR/NAT Regional Office.

Review of Tenth IFATCA North-East Traffic Meeting

8.19 IFATCA reported to the meeting that IFATCA Tenth North East Asia Traffic Management meeting (NEAT10) was held in Fukuoka on 15-16 November 2005 to discuss issues between the Hong Kong, Manila, Naha and Taipei FIRs. Representatives of IFATCA member associations from each FIR, IFALPA, IATA and some airline companies attended the meeting. The meeting noted that NEAT10 had discussed matters in relation to:

a) A trial of five minute longitudinal separation (previously 10 minutes) for eastbound traffic overflying Tokyo FIR at the same altitude for North Pacific routes was initiated on 16 May 2005. The trial was ongoing until such separation standard is formalized in LOA between Naha and Taipei ACC.

b) Since the implementation of RVSM in the Naha and Tokyo FIR, IFATCA reported that Taipei ACC provided transition activities for all the flights from single alternate FLOS in the Naha FIR to modified single alternate FLOS in Hong Kong FIR.

c) Hong Kong, China reported that in light of the results of a safety assessment performed by MAAR in the Special ATS Coordination Meeting for Transition (September 2003, Bangkok), the SCM had agreed that single alternate FLOS would not be implemented on A1/P901 in non-radar procedural ATC airspace between the positions BUNTA and DAGON on A1, and ITBAM and IKELA on P901. The SCM in 2003 had agreed that the modified single alternate FLOS should continue to be used on A1/P901 on that portion of the route. Hong Kong, China is working with the adjacent FIRs to propose alternative routes that would meet the criteria.

d) Japan provided details of sudden increase in implementation of flow control measures since July 2004 and showed that of 90 occasions in 2005, 57 were due to extreme weather conditions in Hong Kong FIR. Events of 29 June 2005 were illustrated showing the high workload imposed on Naha ACC by the flow control measures.

e) A number of Contingency Plans for implementation during periods of Large Scale Weather Deviation are either in place or being discussed between the relevant parties. These plans also include separate arrangements for periods of turbulence. Contingency FLs arrangements had been agreed between Naha, Taipei and Manila for traffic on R596 and the LOA was effective on 29 September 2005.

f) Contingency FLs arrangements are proposed between Manila and Naha for traffic on B462, A582 and A590. These arrangements are under discussion and it is hoped they will be finalized in February 2006.

8.20 IATA complimented IFATCA on their initiative and good work in improving the efficiency of the air traffic services in the region. IATA also noted that there were serious issues in the region with high traffic growth and limited airspace capacity, and these should be raised at the relevant ICAO forums.

9. Closing of the Meeting

9.1 On behalf of the ICAO RVSM Implementation Task Force for the Asia Pacific Region, Mr. Kuah Kong Beng thanked all delegates, in particular Japan and the Republic of Korea for their commitment, dedication and efforts to enhance the operational efficiency of air traffic services through the implementation of RVSM.

9.2 The meeting was very grateful to the Chairman for his excellent job to keep the meeting focus on specific issues, and for the success of the meeting.

9.3 Japan and the Republic of Korea jointly expressed their appreciation to AEROTHAI for the safety assessment work provided to Japan and Republic of Korea to date.

9.4 On behalf of Mr. Nopadol, Managing Director of MAAR, Dr. Paisit thanked Japan and Republic of Korea for their cooperation and close coordination, their friendship and hospitality shown to MAAR.

9.5 Mr. Kyotaro Harano, on behalf of ICAO Asia and Pacific Office, expressed his appreciation to the meeting.

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LIST OF WORKING PAPERS (WPs) AND INFORMATION PAPERS (IPs)

WORKING PAPERS

NUMBER	AGENDA	WORKING PAPERS	PRESENTED BY
WP/1	1	Provisional Agenda RVSM/TF/27	Secretariat
WP/2	3, 4	Review of the Fourth Meeting of the Regional Airspace Safety Monitoring Advisory Group	Secretariat
WP/3	5	Review of the 16th Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group	Secretariat
WP/4	5	Review of Amendments to Annex 6 – *Operation Of Aircraft*, Annex 11 – *Air Traffic Services* and the *Procedures for Air Navigation Services – Air Traffic Management*	Secretariat
WP/5	6	Task List for the Implementation of the Reduced Vertical Separation Minimum	Secretariat
WP/6	4	90-Day Airspace Safety Oversight for the RVSM Implementation in Japan and Republic of Korea Domestic Airspace	MAAR
WP/7	4	Review of the Large Height Deviation Reporting Procedures	Secretariat
WP/8	4	Plan for the transfer of regional monitoring agency responsibilities from the MAAR to PARMO for sovereign Japanese and Republic of Korea airspace and associated international airspace	MAAR PARMO

INFORMATION PAPERS

NUMBER	AGENDA	INFORMATION PAPERS	PRESENTED BY
IP/1	-	List of Working Papers (WPs) and Information Papers (IPs)	Secretariat
IP/2	5	Terms of Reference of RVSM/TF	Secretariat
IP/3	8	Operational Status of JCAB Air Traffic Management Center (ATMC)	Japan
IP/4	5	Review of Flight Level Allocation of RVSM in the South China Sea Area	Secretariat
IP/5	5	Review of the Special ATS Coordination Meeting of ATS Route A593 and B576	Secretariat
IP/6	8	Guidance Material in Regard to Wake Vortex Aspects of A380 Aircraft	Secretariat
IP/7	8	Wake Turbulence Incident in NAT	Secretariat
IP/8	2,3,4	RVSM Operational Status after RVSM Implementation	Republic of Korea
IP/9	8	Review of the Tenth IFATCA North East Asia Traffic Meeting	IFATCA
IP/10	2,3,4	RVSM Pre-Implementation and Transition in Japan	Japan

NUMBER	AGENDA	INFORMATION PAPERS	PRESENTED BY
IP/11	4	Summary of a Post-Implementation RVSM Safety Assessment for the Japanese Domestic Airspace	Japan
IP/12	2	An Initial Study on RVSM Benefits in Japan	Japan
IP/13	4	RVSM Approval Data Verification	Japan

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Japan – RVSM Benefits Study

1. ANALYSIS METHODOLOGY

1.1 From the experiences in other regions where RVSM was implemented earlier, the following benefits are expected from the implementation of RVSM in the Japanese domestic airspace, which would increase availability and flexibility of flight level selection:

- fuel savings;
- cargo capacity increase;
- reduction of departure delay, including connecting flights at the first destination of certain passengers; and
- more flexibility of operations for ATC and pilots.

These expected benefits are considered to lead to overall effectiveness in aircraft operational costs, revenue, schedule regularity and passengers' convenience.

1.2 In order to examine the above-mentioned benefits, JCAB used our flight data processing (FDP) system and gathered information of planned FLs and actual assigned FLs of all flights conducted between FL250 and FL450 inclusive, from September to December 2005. The collected information was used to compare operational difference between the pre-implementation period in September and the post-implementation period through October to December, and determine to what degree actual flights were conducted at the planned FLs, and determine the average FL actually flown.

1.3 Then, using the calculated average FL, the expected fuel saving could be calculated based on the operators assumption that an increase of cruise altitude by 2,000ft in RVSM environment would generally save fuel burn by approximately 3%.

1.4 Data concerning departure delays at all domestic airports were collected by operators for the same period in order to examine the possible impact on schedule regularity.

1.5 Comments received from all airspace users, such as air traffic controllers, airlines pilots, general aviation, defense authority, were reviewed.

2. ANALYSIS RESULTS

2.1 Sampling data indicate that the correspondence rate between the planned FLs and actual assigned FLs was 64.0% before RVSM, but decreased to 59.3% after RVSM (Figure 1). However, in case of aircraft which were not assigned to the planned FL, the height value of difference between actually assigned FLs and the planned FLs became smaller after RVSM implementation (Figures 2 and 3). Based on this analysis, it is considered that RVSM operations permit aircraft to fly at FLs closer, if not at the planned FLs, to the planned FLs than before; in other words, aircraft have more opportunity to fly at more fuel efficient FLs than before.

2.2 An examination of FL distribution between FL250 and FL450 through September to December 2005 indicates that peak FLs have been reduced and FLs are now used more evenly. Figures 4 and 5 show how RVSM FLs are used and the peak has shifted to higher altitude.

Figure 1: Correspondence Rate Between Planned FLs and Assigned FLs (all domestic and international flights)

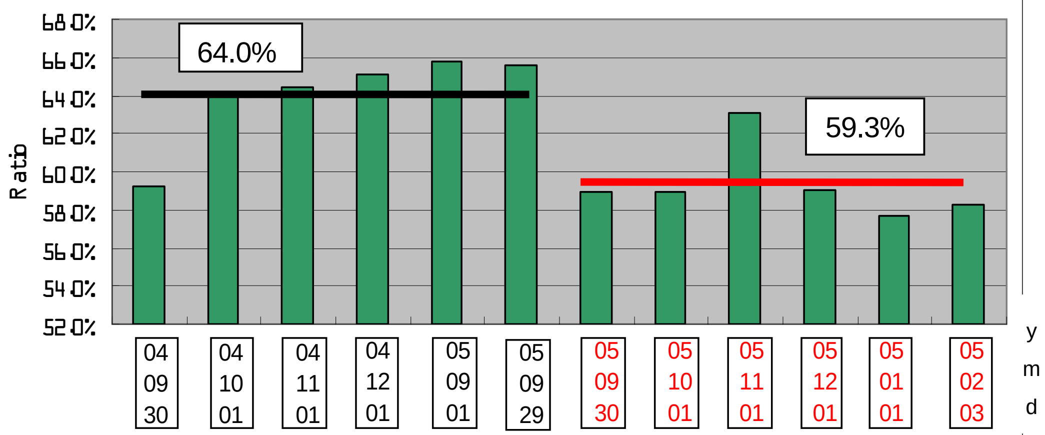


Figure 2: Height Value of Differendce Between Planned FLs and Assigned FLs (all domestic and international flights)

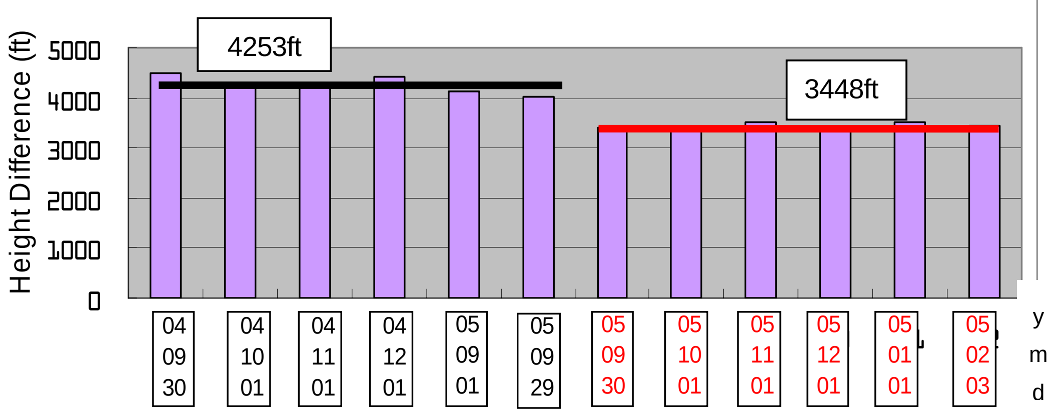


Figure 3: Height Value of Difference Between Planned FLs and Assigned FLs (domestic flights only)

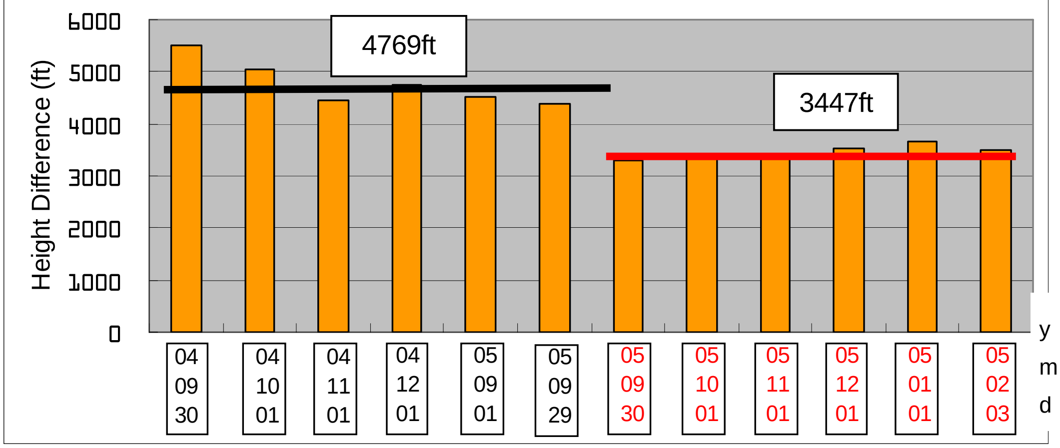
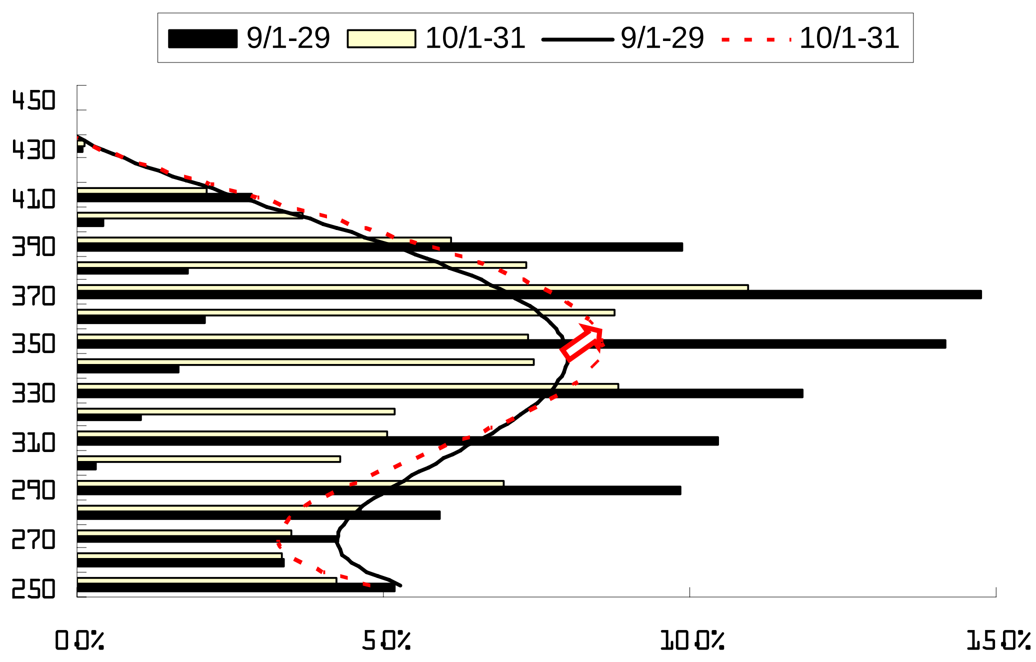
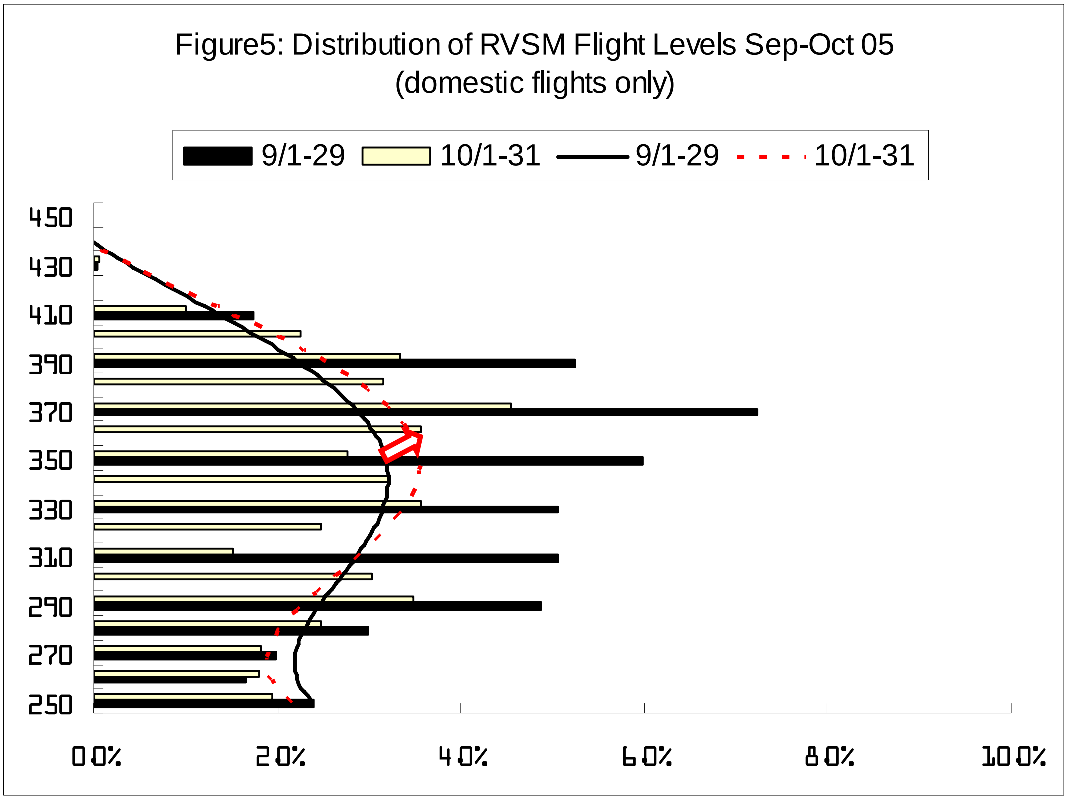


Figure4:Distribution of RVSM Flight Levels Sep-Oct 05 (all domestic and international flights)





2.3 Figure 6 illustrates the changes of average FLs actually flown by aircraft between pre-implementation and post-implementation. Tables 1 and 2 present such changes in details. From this analysis, it is concluded that the average FL has increased by approximately **400ft** as a result of RVSM implementation on 29 September 2005. This 400ft increase of average FLs is considered to lead to **0.6%** fuel saving when applying the assumption that an increase of cruise altitude by 2,000ft in RVSM environment would generally save fuel burn by approximately 3%.

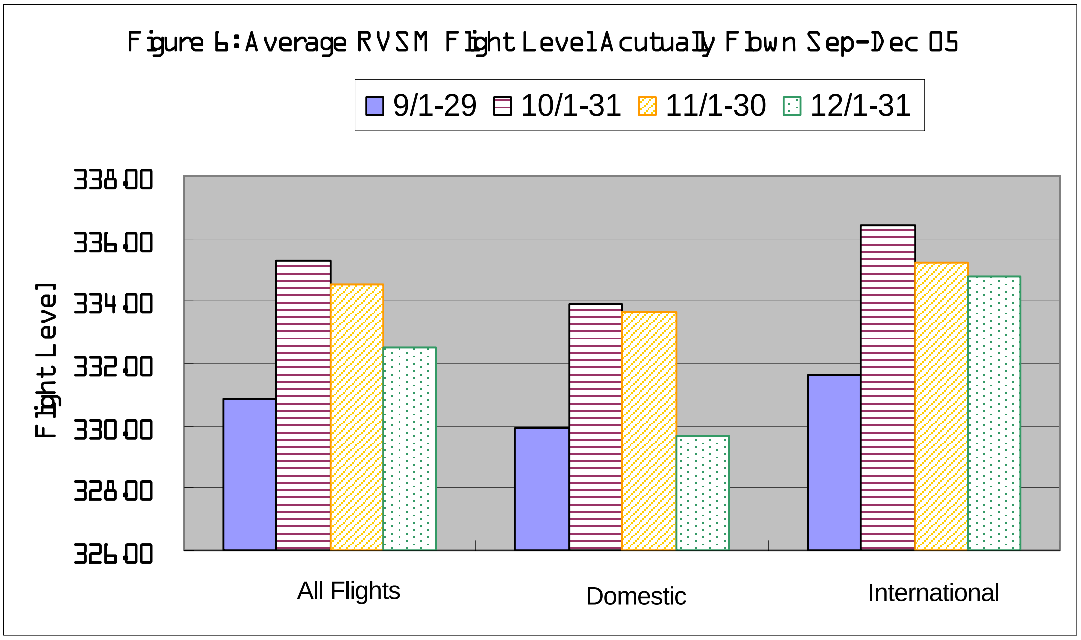


Table 1: Average RVSM Flight Levels actually flown pre- and post-implementation

(100 ft)

	1-29 Sep	1-31 Oct	1-30 Nov	1-31 Dec
All	330.85	335.26	334.52	332.50
Domestic	329.90	333.88	333.65	329.69
International	331.61	336.43	335.21	334.81

Table 2: Comparison of Average RVSM Flight Levels Against September Data

(100 ft)

		1-31 Oct	1-30 Nov	1-31 Dec
All	Difference	+ 4.41	+ 3.67	+ 1.65
	Ratio	+ 1.33%	+ 1.11%	+ 0.50%
Domestic	Difference	+ 3.98	+ 3.75	- 0.21
	Ratio	+ 1.21%	+ 1.14%	- 0.06%
International	Difference	+ 4.82	+ 3.60	+ 3.20
	Ratio	+ 1.45%	+ 1.09%	+ 0.96%

2.4 Notwithstanding above, actual data collected by participating airlines have not clearly indicated such fuel saving yet. Some operators' data suggest certain saving between 0.18 and 0.33% on limited routes though less than 0.6% while some others could not find any noticeable change in fuel burns. It is considered that flight distance and duration at RVSM cruise altitude are relatively short for domestic flights in Japan, and the expected benefit of fuel saving may not be achieved as estimated. The RVSM WG will continue the collection and analysis of data for better assessment and identification of any attributes.

2.5 As to the departure delay, airlines collected data on gate-off time based on their schedule and any delays caused by ATC. All participating airlines' data do not show any noticeable improvement in departure delays. The RVSM WG will continue the collection and analysis of data for better understanding of the situation.

2.6 Comments from controllers and operators, including pilots, indicate their great satisfaction with RVSM operations, and are summarized as below:

Air traffic controllers:

- reduction of time to issue clearance;
- smoother coordination to respond to pilot's request for in-flight altitude change;
- elimination of FL transition between domestic airspace and oceanic airspace; and
- congestion of arriving traffic at Tokyo, Haneda airport during peak hours;

Operators

- particular aircraft, such as MD11/90 and A300, which used to fly below FL310, now can have wider altitude selection up to FL340;
- improvement in adverse weather avoidance;
- more choices in FL considerations; and
- congestion on a particular route between Japan and China.

3. SUMMARY

3.1 This initial RVSM benefits study has identified the following:

a) RVSM operations provide aircraft with more fuel efficient FLs than before;
b) the average RVSM FL actually flown increased by approximately 400ft;
c) controllers and pilots have more operational flexibility;
d) actual fuel saving has not been clearly detected based on operators' data; and
e) reduction of departure delays has not been clearly detected based on operators' data.

Note: Figures shown in the analysis should not be considered as "final" or "agreed by all parties concerned", but merely as "initial study results"

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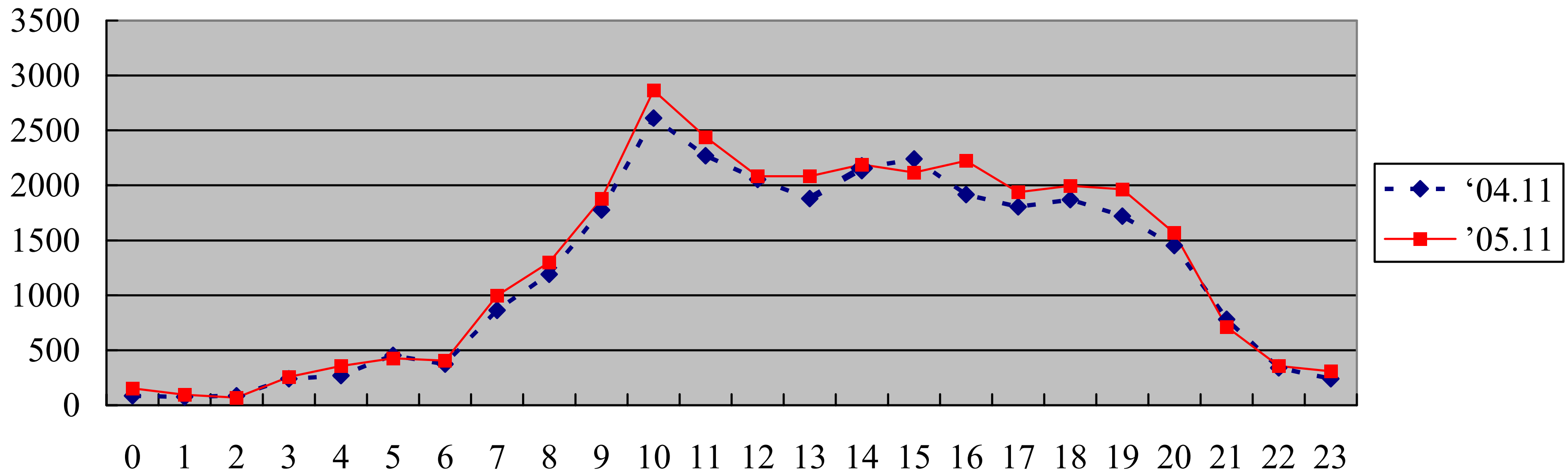
Statistics for Traffic Volume for the Month of November 2004 and 2005

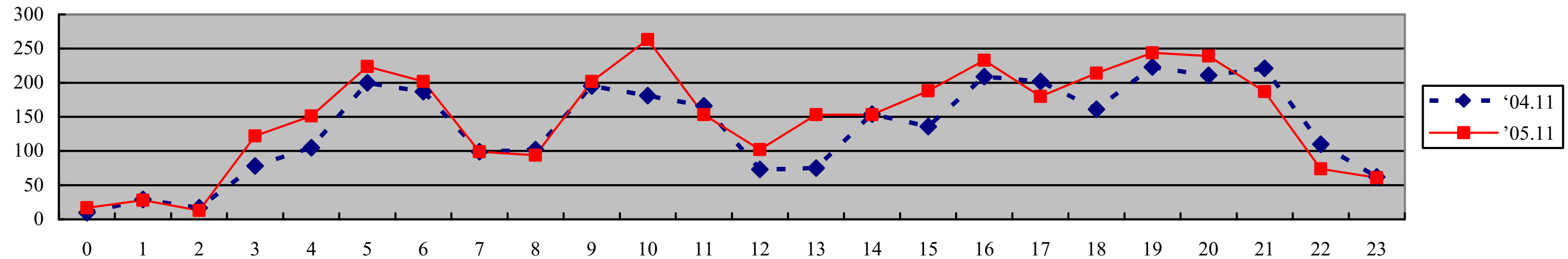
Monthly Traffic Volume

Time	00	01	02	03	04	05	06	07	08	09	**10**	**11**	12	13	14	15	**16**	17	18	**19**	20	21	22	23	Total
Monthly (‘04.11)	85	76	84	241	269	454	373	864	1191	1776	2613	2271	2055	1880	2156	2241	1915	1805	1869	1720	1452	780	339	240	28749
Daily	3	3	3	8	9	15	12	29	40	59	87	76	69	63	72	75	64	60	62	57	48	26	11	8	958
Monthly (’05.11)	153	95	68	258	357	426	405	996	1300	1877	2864	2441	2083	2083	2190	2117	2223	1938	1995	1964	1566	713	357	307	30776
Daily	5	3	2	9	12	14	14	33	43	63	95	81	69	69	73	71	74	65	67	65	52	24	12	10	1026



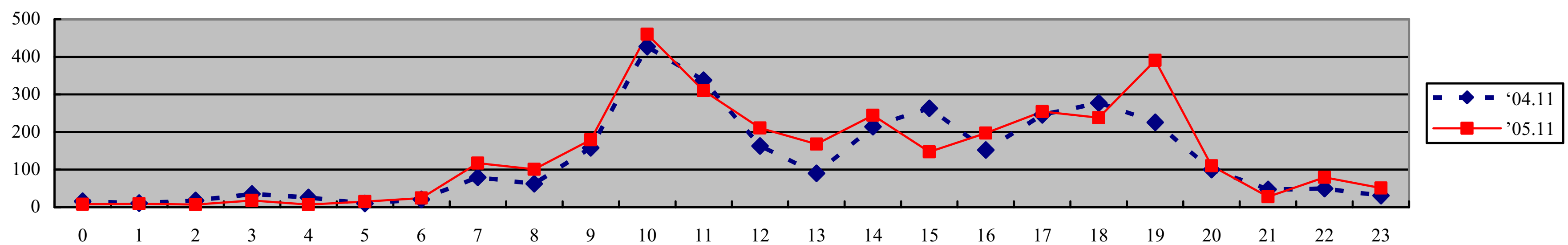
B576 (NIRAT↔ATOTI)

Time	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Monthly (‘04.11)	10	29	17	78	105	200	187	99	102	195	181	166	73	75	154	136	209	202	161	223	211	221	110	62	3206
Monthly (’05.11)	17	28	13	**122**	**151**	**224**	**202**	99	94	202	**263**	**153**	**102**	**153**	153	**188**	233	**180**	**214**	**244**	**239**	**187**	**74**	61	3596



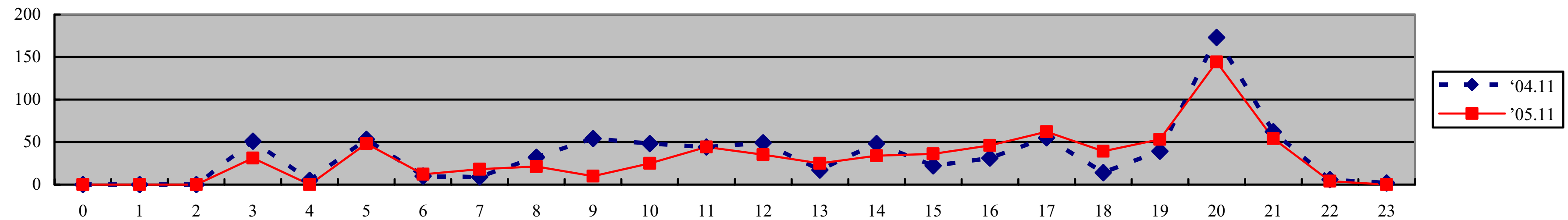
G597 (SORKA→LANAT)

Time	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Monthly (‘04.11)	16	11	18	35	26	10	21	79	62	158	427	338	163	90	214	263	152	246	277	226	100	47	49	31	3059
Monthly (’05.11)	8	9	**7**	**18**	**7**	15	24	**117**	**101**	**179**	**460**	**310**	**211**	**168**	**244**	**147**	**197**	254	**238**	**391**	**110**	**28**	**79**	**51**	3373



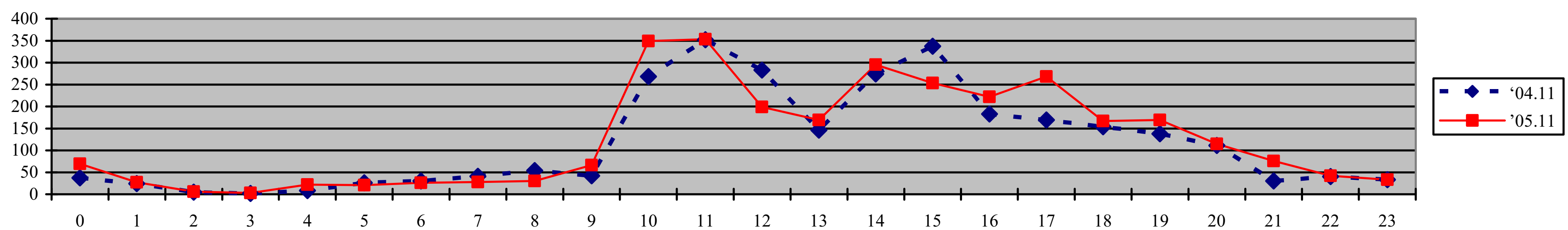
A582 (PSN↔APELA)

Time	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Monthly (‘04.11)	0	0	0	51	5	53	10	9	32	54	48	44	49	17	48	22	31	55	14	39	173	62	6	2	824
Monthly (’05.11)	0	0	0	**31**	0	48	12	18	**21**	**10**	**25**	44	**35**	25	**34**	**36**	**46**	62	**39**	**53**	**144**	54	4	0	741



G585 (KPO←SAPRA)

Time	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Monthly (‘04.11)	37	24	5	2	8	26	30	41	54	42	268	352	283	146	274	337	183	169	154	138	111	30	40	33	2787
Monthly (’05.11)	**69**	27	6	3	**22**	21	26	**28**	**30**	**66**	**349**	353	**199**	**169**	**295**	**253**	**222**	**268**	**167**	**169**	115	**76**	42	33	3008



Republic of Korea- RVSM Approval Status

1. Korean Airlines

A/C Type	A/C Series	No.	RVSM Approval (Registration No.)
B744	400	41	HL7400, HL7402, HL7403, HL7404, HL7412 HL7434, HL7437, HL7438, HL7439, HL7448 HL7449, HL7460, HL7461, HL7462, HL7465 HL7466, HL7467, HL7472, HL7473, HL7480 HL7482, HL7483, HL7484, HL7485, HL7486 HL7487, HL7488, HL7489, HL7490, HL7491 HL7492, HL7493, HL7494, HL7495, HL7497 HL7498, HL7499, HL7600, HL7601, HL7602 HL7603
B747	300	1	HL7470
B747	200	2	HL7405, HL7408
B777	300	4	HL7532, HL7533, HL7534, HL7573
B777	200	11	HL7526, HL7530, HL7531, HL7574, HL7575 HL7598, HL7714, HL7715, HL7721, HL7733 HL7734
A330	300	16	HL7524, HL7525, HL7540, HL7550, HL7551 HL7553, HL7554, HL7584, HL7585, HL7586 HL7587, HL7701, HL7702, HL7709, HL7710 HL7720
A330	200	3	HL7538, HL7539, HL7552
A300	600	10	HL7239, HL7240, HL7295, HL7297, HL7299 HL7241, HL7242, HL7243, HL7244, HL7245
B737	800	14	HL7555, HL7556, HL7557, HL7558, HL7559 HL7560, HL7561, HL7562, HL7563,

A/C Type	A/C Series	No.	RVSM Approval (Registration No.)
			HL7564 HL7565, HL7566, HL7567, HL7568
B737	900	15	HL7599, HL7704, HL7705, HL7706, HL7707 HL7708, HL7716, HL7717, HL7718, HL7719 HL7724, HL7725, HL7726, HL7727, HL7728
G4	4	1	HL7222
Total		**118**	

2. Asiana Airlines

A/C Type	A/C Series	No.	RVSM Approval (Registration No.)
A320	200	2	HL7737, HL7738
A321	100	4	HL7588, HL7589, HL7594, HL7703
A321	200	11	HL7590, HL7549, HL7711, HL7712, HL7713, HL7722, HL7723, HL7729, HL7730, HL7731, HL7735
A330	300	3	HL7736, HL7740, HL7741
B737	500	3	HL7232, HL7233, HL7250
B737	400	10	HL7508, HL7509, HL7510, HL7511, HL7512, HL7513, HL7517, HL7518, HL7591, HL7592
B747	400	14	HL7413, HL7414, HL7415, HL7417, HL7418, HL7419, HL7420, HL7421, HL7422, HL7423, HL7426, HL7428, HL7436, HL7604
B767	300	9	HL7507, HL7515, HL7516, HL7200, HL7247, HL7248, HL7506, HL7514, HL7528
B777	200	6	HL7596, HL7597, HL7500, HL7700, HL7732, HL7739
Total		**62**	

3. Others (General Aviation)

A/C Type	A/C Series	No.	RVSM Approval (Registration No.)
B737	700	1	HL7770
BD700	1A10	1	HL7576
CL601	3R	1	HL 7577
Total		**3**	

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90-DAY AIRSPACE SAFETY OVERSIGHT FOR REDUCED VERTICAL SEPARATION MINIMUM (RVSM) IMPLEMENTATION IN JAPAN/REPUBLIC OF KOREA DOMESTIC AIRSPACE

February 2006

Submitted to:

ICAO Asia/Pacific RVSM Implementation Task Force
Japan Civil Aviation Bureau
Republic of Korea Civil Aviation Safety Authority

Monitoring Agency for Asia Region

Aeronautical Radio of Thailand, Inc
(AEROTHAI)

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This document constitutes the report of 90-day airspace safety oversight, supporting the RVSM implementation in Japan/Republic of Korea (ROK) domestic airspace. For the completion of the RVSM safety oversight, this report provides a comprehensive traffic analysis of the collected traffic sample data (TSD). In this regard, flight operation statistics, traffic flow characteristics, operator and aircraft profiles, and flight level utilization are given.

In regards to the risk estimation for Japan/ROK RVSM implementation, the large height deviation (LHD) occurrences in Japan/ROK domestic airspace since January 2005 were examined. There have been seven LHD occurrences, accounted for the duration of 8.7 minutes.

Based on the collected TSD and LHD reports, both technical and total risks were found to satisfy the agreed TLS value of no more than 2.5×10^{-9} and 5.0×10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 1,000 ft and to all causes, respectively.

1. INTRODUCTION

This report provides the results of 90-day airspace safety oversight for the RVSM implementation in the Japan and Republic of Korea (ROK) domestic airspace. Following the introduction, the content of the report includes:

- Background,
- Summary of Know Your Airspace (KYA) analyses,
- Summary of Large Height Deviation (LHD) occurrences, and
- Results of RVSM risk assessment

2. BACKGROUND

Monitoring Agency for Asia Region (MAAR) was established by Aeronautical Radio of Thailand, Ltd. (AEROTHAI) under the approval of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) to officially assume the duties and responsibilities of the Regional Monitoring Agency (RMA) for the Asia Region from 2 September 2003. The principal role of MAAR is to assist the International Civil Aviation Organization (ICAO) in the continuation of the safety assessment program for the RVSM implementation.

At the Special ATS Coordination Meeting on the RVSM Implementation in the Incheon, Naha and Tokyo FIRs (SCM/RVSM-Japan/Republic of Korea) held in Bangkok from 5 to 7 July 2004, the meeting reviewed the monitoring and safety assessment required as part of the RVSM implementation process. As the Pacific Approval Registry and Monitoring Organization (PARMO) was heavily committed to the scheduled implementation of RVSM in the USA, Canada and Mexico scheduled for 20 January 2005, MAAR agreed to provide necessary services for the pre-RVSM implementation in Incheon, Naha, and Tokyo FIRs scheduled for 29 September 2005.

In addition, MAAR agreed to conduct the safety oversight required for the 90-day review of the RVSM implementation in the Incheon, Naha and Tokyo FIRs. Subsequent to the 90-day review meeting of the RVSM/TF, PARMO would resume the responsibility for the Incheon, Naha and Tokyo FIRs.

2.1 FIRs Implemented RVSM

The geographical area included in this airspace safety review is the Japan and ROK domestic airspace. The Flight Information Regions (FIRs) included in this airspace are summarized in **Table 1**.

States	FIRs
Japan	Naha (Domestic)
	Tokyo (Domestic)
ROK	Incheon

Table 1: Japan/ROK FIRs Implementing RVSM

2.2 Data Inquiry for Japan/ROK RVSM Safety Oversight

The 90-day review of airspace safety monitoring for the RVSM implementation in Japan/ROK domestic airspace are conducted based on:

- One-month traffic sample data (TSD) collected from 1 to 30 November 2005,
- Monthly Large Height Deviation (LHD) reports since January 2005

It is important to note that both TSD and LHD reports are significant pieces of information for estimating risks from technical and operational errors, which would facilitate the completion of the safety oversight for the Japan/ROK domestic airspace where RVSM was implemented.

Table 2 and **3** provide summaries of the TSD and LHD reports received by MAAR from the States implementing RVSM, respectively.

States	FIR Name	TSD Status	Remarks
Japan	Naha (Domestic)	Received	Data completed
	Tokyo (Domestic)	Received	Data completed
ROK	Incheon	Received	Data completed

Table 2: Summary of Two-Month TSD Provided by Japan and ROK

States	FIR Name	LHD Received		Remarks
		From	To	
Japan	Naha (Domestic)	January 05	January 06	-
	Tokyo (Domestic)	January 05	January 06	-
ROK	Incheon	January 05	January 06	-

Table 3: Summary of LHD Reports Provided by Japan and ROK since January 05

3. KNOW YOUR AIRSPACE ANALYSES

This section presents the summary of the comprehensive traffic analysis of the collected TSD, also called "Know Your Airspace (KYA)" analysis. **Table 4** presents the information requested for an individual traffic movement, or flight, in the sample.

Item No.	Item	Example	Mandatory/ Required if Available
1	Date (DD/MM/YY format)	23/08/04	Mandatory
2	Aircraft Call Sign	AAR301	Mandatory
3	Aircraft Type	B744	Mandatory
4	Origin Aerodrome	RKSI	Mandatory
5	Destination Aerodrome	VHHH	Mandatory
6	Entry Fix into RVSM Airspace	DADGA	Mandatory
7	Time at Entry Fix (UTC)	00:44	Mandatory
8	Flight Level at Entry Fix	310	Mandatory
9	Airway at Entry Fix	B576	Mandatory
10	Exit Fix from RVSM Airspace	LAMEN	Mandatory
11	Time at Exit Fix (UTC)	01:29	Mandatory
12	Flight Level at Exit Fix	310	Mandatory
13	Airway at Entry Fix	A593	Mandatory
A1	Fix 1 Within RVSM Airspace after Entry Fix	NIRAT	Required if Available
A2	Time at Fix 1	01:14	Required if Available
A3	Flight Level at Fix 1	310	Required if Available
A4	Airway at Fix 1	A593	Required if Available
B1	Fix 2 Within RVSM Airspace after Fix 1	-	Required if Available
B2	Time at Fix 2	-	Required if Available
B3	Flight Level at Fix 2	-	Required if Available
B4	Airway at Fix 2	-	Required if Available
(Continue with as many Fix/Time/Flight-Level entries as are required to describe the flight's movement within RVSM airspace)			
N1	Fix …N Within RVSM Airspace after Fix N-1	-	Required if Available
N2	Time at Fix N	-	Required if Available
N3	Flight Level at Fix N	-	Required if Available
N4	Airway at Fix N	-	Required if Available
Note: Fix N = Fix before the Exit Fix			

Table 4: Information Required for a Flight in Traffic Sample

The results of the KYA analysis of the Japan/ROK collected TSD received by MAAR are presented in the following contents:

- Flight operation statistics
- Traffic flow characteristics
- Operator and aircraft profiles, and
- Flight level utilization.

3.1 Flight Operation Statistics

The provisional flight operational statistics in the RVSM domestic airspace of the Japan and ROK include:

- Number of flights by State (**Table 5**)
- Average number of flights by States per day (**Figure 1A** and **1B** for Japan and ROK, respectively)

State	Number of Flights for November 2005	Percentage of Flight by Each States
Japan	63,425	81.4%
ROK	14,493	18.6%
Total	77,918	-

Table 5: Number of Flights in Japan/ROK Domestic Airspace from the Collected TSD

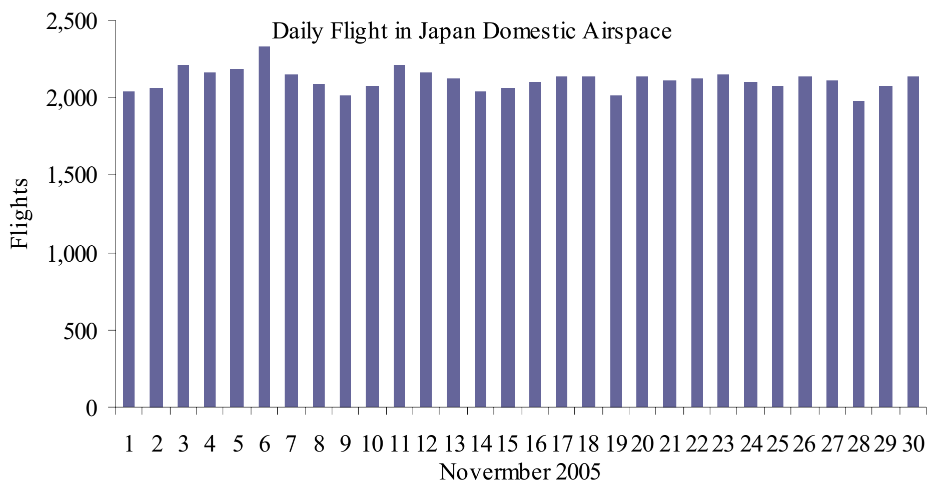

Figure 1A: Number of Flights per Day in Japan Domestic Airspace

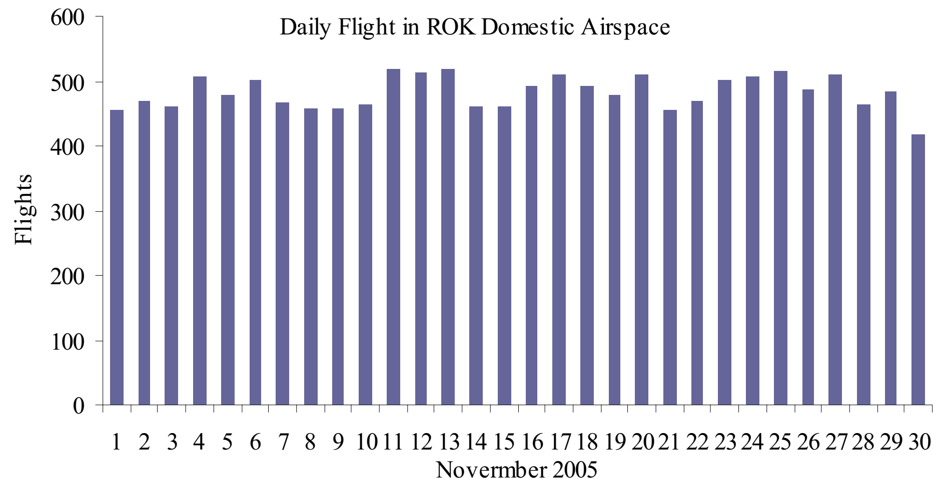

Figure 1B: Number of Flights per Day in ROK Domestic Airspace

3.2 Traffic Flow Characteristics

The analyzed characteristics of traffic flow in the planned RVSM domestic airspace in Japan/ROK region include:

- Top-15 state pairs (**Figure 2**)
- Top-15 city pairs (**Figure 3**)

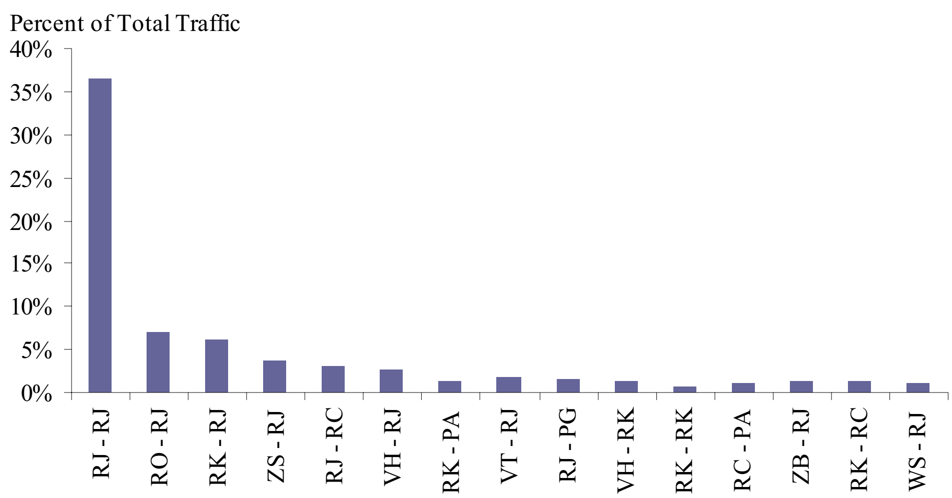

Figure 2: Top-15 State Pairs

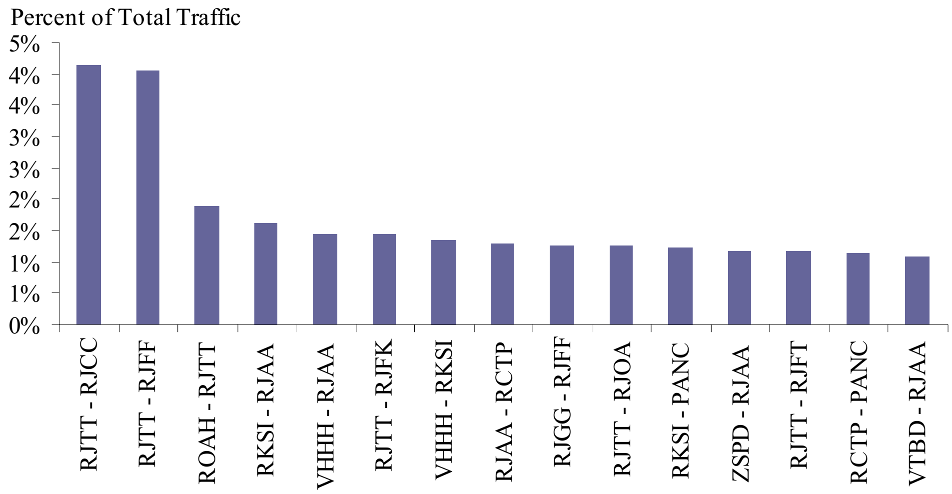

Figure 3: Top-15 City Pairs

3.3 Operator and Aircraft Profiles

The information regarding the airspace users for the planned RVSM domestic airspace in Japan/ROK region includes:

- Top-15 operators (**Figure 4**)
- Top-15 aircraft types (**Figure 5**)

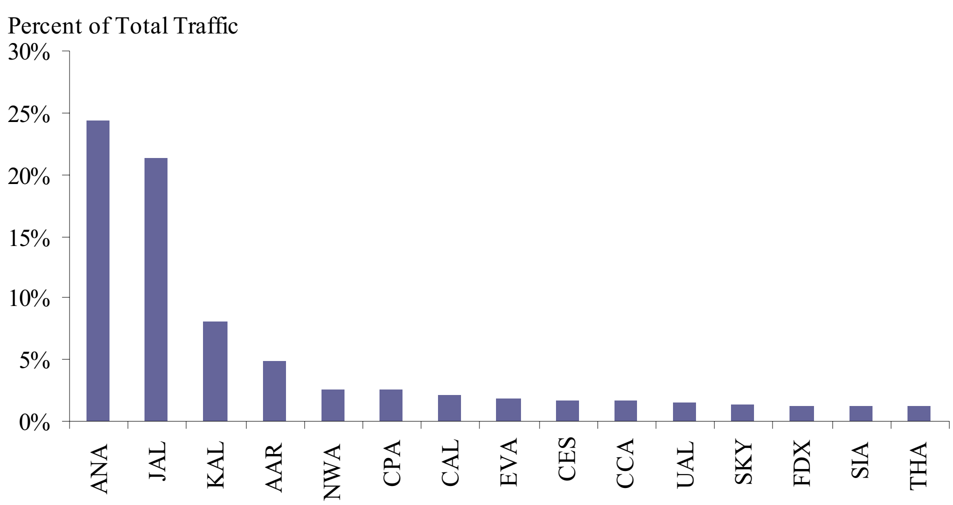

Figure 4: Top-15 Active Operators in the Planned RVSM Domestic Airspace of Japan/ROK Region

Appendix A provides the full names of ICAO 2-letter State, 4-letter City codes, and 3-letter Operator codes shown in **Figure 2**, **3**, and **4**, respectively.

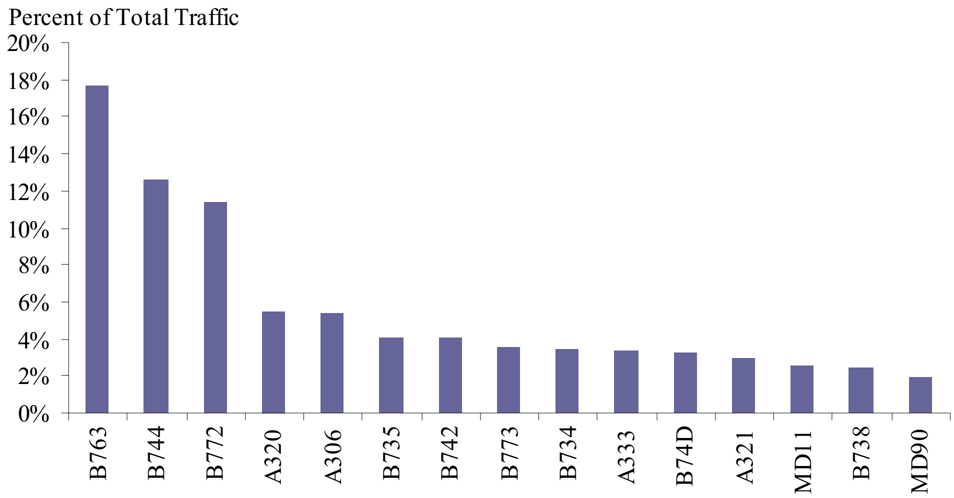

Figure 5: Top-15 Aircraft Types Operated in the Planned RVSM Domestic Airspace of Japan/ROK Region

It is important to note that the top-15 operators and aircraft types represent more than 84 percent of the operations observed in the TSD.

3.4 Flight Level Utilization

Figure 6 represents the utilization of flight levels (FL) in the RVSM airspace of the Japan/ROK region, given that the Single Alternate Flight Level Orientation Scheme (FLOS) was applied full band between FL290 and 410.

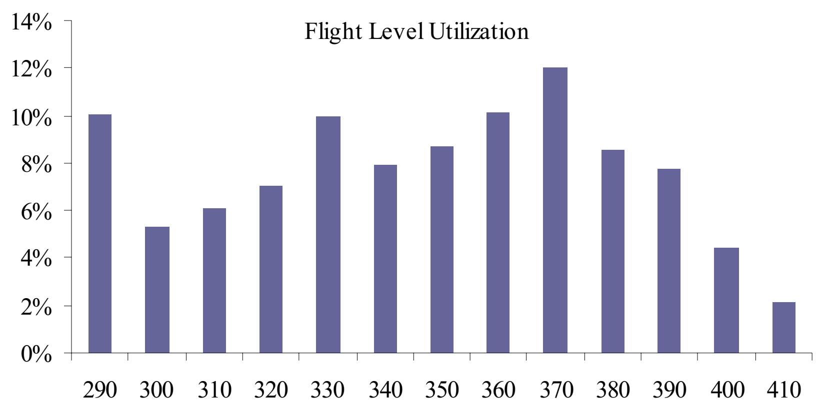

Figure 6: FL Utilization in the Planned RVSM Domestic Airspace of the Japan/ROK Region

4. LARGE HEIGHT DEVIATION OCCURRENCES

This section provides the summary of the LHD occurrences associated with the RVSM implementation in Japan/ROK domestic airspace. The data gathered from the LHD reports are used to estimate risk from operational errors. Such risk estimate would assist MAAR in performing the safety oversight, which would demonstrate whether the overall target level of safety (TLS) for the RVSM implementation in Japan/ROK domestic airspace is continued to be met.

Based on the received LHD reports shown in **Table 3**, the LHD occurrences in the Japan/ROK RVSM airspace since January 2005 are summarized as follow:

- Number of LHD occurrences and associated LHD duration (in minutes) by month
- Number of LHD occurrences and associated LHD duration (in minutes) by State/FIR
- Number of LHD occurrences by cause

Table 6 and **Figure 7** summarize the number of LHD occurrences and associated LHD duration (in minutes) by month in the Japan/ROK domestic airspace since January 2005.

Month-Year	No. of LHD Occurrences	LHD Duration (Min)	Cumulative No. of LHD Occurrences	Cumulative LHD Duration (Min)
2005				
Jan	0	0.0	6	4.0
Feb	0	0.0	6	4.0
Mar	0	0.0	6	4.0
Apr	0	0.0	5	3.8
May	0	0.0	5	3.8
Jun	0	0.0	5	3.8
Jul	2	0.1	7	3.9
Aug	0	0.0	4	2.4
Sep	3	5.3	6	5.8
Oct	1	3.0	7	8.8
Nov	0	0.0	6	8.4
Dec	1	0.3	7	8.8
2006				
Jan	0	0.0	7	8.8

Table 6: Summary of LHD Occurrences and Duration in Japan/ROK Domestic Airspace

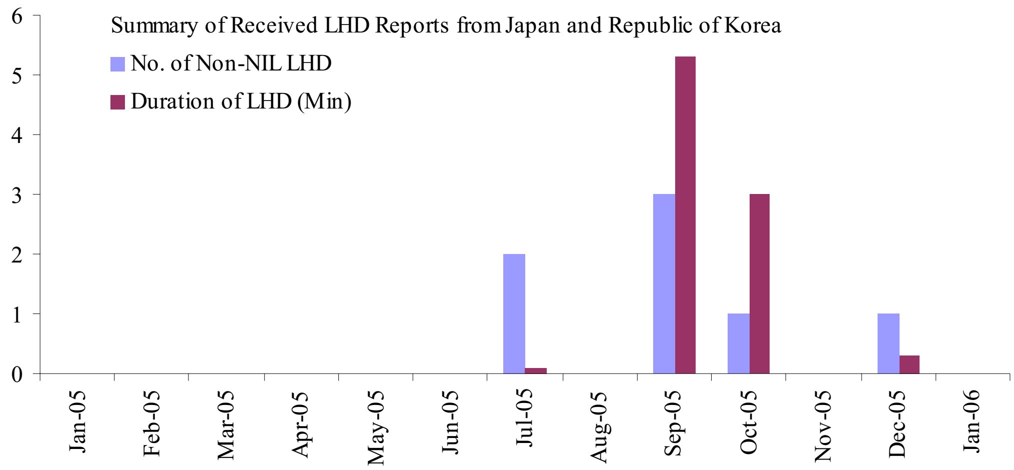

Figure 7: Summary of LHD Occurrences (by Month) in the Japan/ROK RVSM Airspace

Figure 8 summarizes the number of LHD occurrences and associated LHD duration (in minutes) by State in the Japan/ROK domestic airspace Since January 2005.

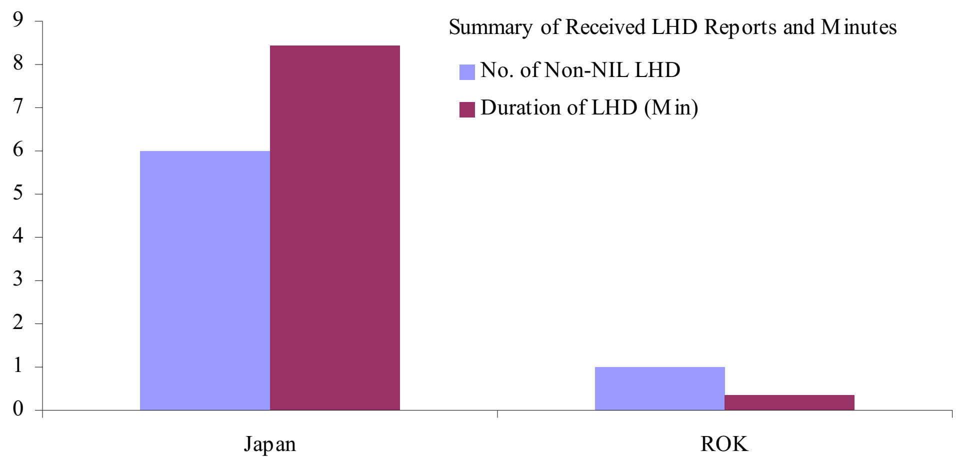

Figure 8: Summary of LHD Occurrences (by State) in the Japan/ROK RVSM Airspace

Table 7A presents the summary of the total number of LHD occurrences by the cause of deviation, using the LHD letter-coding scheme in **Table 7B**.

Code	No. of LHD Occurrences		
	Japan	ROK	Total
A	-	-	-
B	-	-	-
C	-	-	-
D	1	-	1
E	-	-	-
F	-	-	-
G	-	-	-
H	-	-	-
I	-	-	-
J	-	-	-
K	-	-	-
L	-	-	-
M	4	-	4
N	-	1	1
O	1	-	1
Sum	**6**	**1**	**7**

Table 7A: Cause of LHD Occurrences in Japan/ROK Domestic Airspace

Code	Cause of Large Height Deviation
A	Failure to climb/descend as cleared
B	Climb/descend without ATC Clearance
C	Entry into airspace at an incorrect flight level
D	Deviation due to turbulence or other weather related cause
E	Deviation due to equipment failure
F	Deviation due to collision avoidance system (TCAS) advisory
G	Deviation due to contingency event
H	Aircraft not approved for operation in RVSM restricted airspace
I	ATC system loop error; (e.g. pilot misunderstands clearance message or ATC issues incorrect clearance)
J	Equipment control error encompassing incorrect operation of fully functional FMS or navigation system (e.g. by mistake the pilot incorrectly operates INS equipment)
K	Incorrect transcription of ATC clearance or re-clearance into the FMS
L	Wrong information faithfully transcribed into the FMS (e.g. flight plan followed rather than ATC clearance or original clearance followed instead of re-clearances)
M	Error in ATC-unit-to ATC-unit transferred/transition message
N	Negative transfer received from transferring/transition ATC-unit
O	Other

Table 7B: Codes Defining Causes of LHD Occurrences

In light of the above, the LHD occurrences in the Japan/ROK RVSM airspace are summarized as follow:

- Total of 7 LHD occurred in the Japan/ROK RVSM airspace, account for 8.8 minutes since January 2005
- 4 of 7 LHD occurrences are subject to Error in ATC-unit-to ATC-unit transferred/transition message (Category M)
- The rest of the LHD occurrences are subject to the Negative transfer received from transferring/transition ATC-unit (Category N), turbulence (Category D), and other cause (Category O)

The detailed information of the reported LHD occurrences by JCAB and ROK CASA is provided in the **Appendix B**.

5. RVSM RISK OVERSIGHT

This section updates the results of airspace safety oversight for the RVSM implementation over Japan/ROK domestic airspace. In this regard, the internationally accepted collision risk methodology is applied in assessing the safety of implementing RVSM in the /ROK domestic airspace [Reference 1, 2, and 3].

As envisioned by the Review of the ICAO General Concept of Separation Panel (RGCSP), introduction of RVSM would be safe if:

- Collision risk due to aircraft height-keeping systems does not exceed 2.5 fatal accidents per 10^9 flying hours, and
- Collision risk due to all causes does not exceed 5 fatal accidents per 10^9 flying hours.

The TSD of November 2005 and the continuous LHD reports associated with the Japan/ROK domestic airspace since January 2005 are used to estimate the risks presented in this report.

For the safety oversight of the RVSM implementation in the Japan/ROK domestic airspace, the risk estimation is conducted based on the Single Alternate FLOS applied on the ATS routes structure in this region.

5.1 Estimate of the CRM Parameters

Table 8 summarizes the value and source material for estimating values for each of the inherent parameters of the internationally accepted Collision Risk Model (CRM) to conduct the safety oversight for the RVSM implementation in the Japan/ROK domestic airspace.

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
Significant Parameters			
T	Annual flight hours	910,044 flight-hours per year	Estimated based on the submitted TSD
E_z(same)	Same-direction vertical occupancies	0.0016	Estimated based on the submitted TSD, Sx = 10nm
E_z(opposite)	Opposite-direction vertical occupancies	0.0049	Estimated based on the submitted TSD, Sx = 10nm
Pz(1000)	Probability of vertical overlap (with planned vertical separation equal to 1,000 ft)	1.70×10^{-8}	Used conservative value from ICAO Doc 9574
$P_y(0)$	Probability of lateral overlap	0.1098	Conservative value based on the percentage of GPS-equipped aircraft in the submitted TSD
Pz(0)	Probability of vertical overlap (with planned vertical separation equal to zero)	0.5380	Conservative value used in NAT, Pacific, Western Pacific/South China Sea RVSM safety assessments
$P_h(\theta)$	Probability of horizontal overlap	1.73×10^{-4}	Conservative estimation based on the submitted TSD

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
Relatively Insensitive Parameters			
λ_x	Average aircraft length	0.0308 nm	Estimated based on the submitted TSD
λ_y	Average aircraft wingspan	0.0274 nm	
λ_z	Average aircraft height	0.0085 nm	
λ_h	Diameter of the disk representing the shape of an aircraft in the horizontal plane	0.0308 nm	
$\overline{\lvert\Delta V\rvert}$	Average relative along-track speed between aircraft on same direction routes	38.3 knots	Estimated based on the submitted TSD
$\overline{\lvert V\rvert}$	Average absolute aircraft ground speed	480 knots	Conservative value used in NAT, Pacific, Western Pacific/South China Sea RVSM safety assessments
$\overline{\lvert\dot{y}\rvert}$	Average absolute relative cross track speed for an aircraft pair nominally on the same track	3.5 knots	
$\overline{\lvert\dot{h}(\theta)\rvert}$	Average relative horizontal speed during overlap for aircraft pairs on routes with crossing angle θ (let θ=45°)	367.4 knots	
$\overline{\lvert\dot{z}\rvert}$	Average absolute relative vertical speed of an aircraft pair that has lost all vertical separation	1.5 knots (all traffic flows)	Corresponds to average aircraft speed of 480 knots

Table 8: Estimates of the Parameters in the CRM

5.2 Risk Assessment Results for the Japan/ROK RVSM implementation

Table 9 summarizes the results of the risk assessment in terms of technical, operational, and total risks for the RVSM implementation in the Japan/ROK domestic airspace.

Source of Risk	Lower Bound Risk Estimation	TLS	Remarks
Technical Risk	8.08×10^{-10}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.80×10^{-09}	-	-
Total Risk	3.60×10^{-09}	5.0×10^{-9}	Below Overall TLS

Table 9: Risk Estimates for the RVSM Implementation in Japan/ROK Domestic Airspace

Figure 9 presents the trends of collision risk estimates for each month using the appropriate 12-month interval of LHD reports since January 2005.

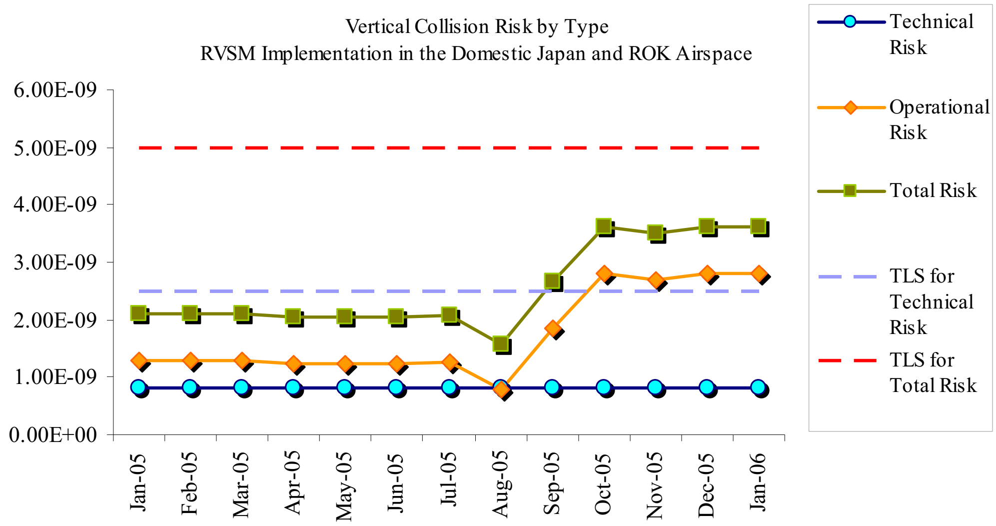

Figure 9: Trends of Risk Estimates for the RVSM Implementation in Japan/ROK Domestic Airspace

Based on the provided CRM input and estimated collision risks, **both technical and total risks satisfy the agreed TLS value of no more than 2.5 x 10^{-9} and 5.0 x 10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 1,000 ft and to all causes, respectively.**

…………………………………

REFERENCES

1. *Manual on Implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive*, International Civil Aviation Organization, Doc 9574, Montreal, March 1992.

2. Review of the General Concept of Separation Panel, Sixth Meeting, Montreal, 28 November – 15 December 1988, ICAO Doc 9536, RGCSP/6, Volumes 1 and 2.

3. Review of the General Concept of Separation Panel, Seventh Meeting, Montreal, 30 October – 20 November 1990, ICAO Doc 9572, RGCSP/7.

APPENDIX A

1. ICAO 2-Letter State Code

State Code	State
PA	United States of America (Alaska)
PG	Northern Marianas, Guam
PH	United States of America (Hawaii)
RC	Taiwan
RJ	Japan
RK	Republic of Korea
RO	Japan
VH	Hong Kong
VT	Thailand
WS	Singapore
ZB	People's Republic of China
ZS	People's Republic of China

2. ICAO 4-Letter City (Airport) Code

State Code	State
PANC	Anchorage International, AK
RCTP	Taibei City/Taibei International, AP
RJAA	New Tokyo International (Narita – NRT)
RJCC	Sapporo/New Chitose
RJFF	Fukuoka
RJFK	Kagoshima
RJFM	Miyazaki
RJFT	Kumamoto
RJNN	Nagoya, Honshu(Komaki), Japan(NGO)
RJOA	Hiroshima
RJTT	Tokyo International (Haneda – HND)
RKSI	Incheon International
ROAH	Naha/Okinawa (OKA)
VHHH	Hong Kong International
ZSPD	Pudong

3. ICAO 3-Letter Operator Code

Operator Code	Operator Name	State of Registry
ANA	All Nippon Airways Co. Ltd.	Japan
JAL	Japan Airlines International Co. Ltd.	Japan
JLJ	Japan Airlines Domestic Co. Ltd.	Japan
KAL	Korean Air Lines Co. Ltd.	Republic of Korea
AAR	Asiana Airlines, Inc.	Republic of Korea
NWA	Northwest Airlines, Inc.	United States of America
CPA	Cathay Pacific Airways Ltd.	Hong Kong
CES	China Eastern Airlines	China
CAL	China Airlines	Taiwan
CCA	Air China International Corporation	China
UAL	United Airlines, Inc.	United States of America
EVA	EVA Airways Corporation	Taiwan

Operator Code	Operator Name	State of Registry
SIA	Singapore Airlines Limited	Singapore
FDX	Federal Express Corporation (FedEx)	United States of America
CSN	China Southern Airlines	China

APPENDIX B
Detailed LHD Occurrences in Japan/ROK Domestic Airspace

1. Japan Domestic Airspace

FIR	Location	Date dd-mm-yy	FL Assigned	FL Observed	Duration (Min)	Cause/Situation
Naha	ATOTI	09 Jul 05	FL 390	FL 350	0 min	Transfer error
Fukuoka	MOMPA	30 Jul 05	FL 330	32,650 ft	5 sec	Turbulence
Naha	ATOTI	07 Sep 05	FL 390	FL 350	3 min	Transfer error
Naha	ATOTI	07 Sep 05	FL 310	FL 390	2 min	Transfer error
Naha	ATOTI	09 Oct 05	FL 360	FL 320	3 min	Transfer error
Sapporo	ATE/270/4NM	23 Dec 05	FL 300	30,524 ft	20 sec	Human error

2. Republic of Korea Domestic Airspace

FIR	Location	Date dd-mm-yy	FL Assigned	FL Observed	Duration (Min)	Cause
Incheon	SADLI on A593	13 Sep 05	N/A	FL330	20 sec	Nil transfer

Post-Implementation Assessment for Japan's Domestic Airspace by JCAB

1. Introduction

1.1 JCAB conducted a post-implementation RVSM safety assessment for the domestic airspace in coordination with MAAR and with the assistance of Electronic Navigation Research Institute (ENRI).

2. Large Height Deviation (LHD) reports

2.1 From July 2004 to January 2006 JCAB received 13 LHD reports. Table 1 presents the summary of these LHD reports.

Table 1: Summary of LHD reports received from 8 July 2004 to 30 June 2005

Month-Year	No. of LHD Occurrences	LHD Duration (Min)	Cumulative No. of LHD Occurrences	Cumulative LHD Duration (Min)
2004				
July	0	0	0	0
Aug	3 (2 by TCAS/ 1 by TRF error)	1.5	3	1.5
Sep	2 (1 by Technical error/ 1 by TRF error)	2.7 (0.7 is attribute to technical error)	5	4.2
Oct	0	0	5	4.2
Nov	1(overshoot)	0.3	6	4.5
Dec	0	0	6	4.5
2005				
Jan	0	0	6	4.5
Feb	0	0	6	4.5
Mar	0	0	6	4.5
Apr	0	0	6	4.5
May	0	0	6	4.5
June	1 (human error)	(40)	7	4.5
July	2 (1 by TRF error/1 by turbulence)	0.1(technical error)	9	4.6
Aug	0	0	9	4.6
Sep	2 (TRF errors)	5	11	9.6
Oct	1 (TRF error)	3	12	12.6
Nov	0	0	12	12.6
Dec	1 (over shoot)	0.3 (524ft)	13	12.9
2006				
Jan	0	0	13	12.9

2.2 Solely based on the received LHD reports, we scrutinized each case of LHD and concluded that 13 LHD occurrences would be attributable to technical error and operational error. Table 2 summarizes the specific time and location of the reported 13 LHD occurrences that are attributable to technical and operational errors. Items 4 and 9 are attributable to technical error. Table 3 presents RMA LHD letter-coding scheme. Calculation of technical risk and operational risk is explained in Section 3 later.

Table 2: Detailed information on LHD occurrences in Japanese domestic airspace

Item	Reported Area	LHD Causes	Date (dd/mm/yy)	Time (UTC)	Duration of LHD	Position
1	Tokyo ACC	F	1 Aug 04	2337	0.5 min	KMC 35NM/SW
2	Naha ACC	F	6 Aug 04	0123	0.8 min	MYC 20NM/NE
3	Naha ACC	M	18 Aug 04	1000	0.2 min	ATOTI
4	Naha ACC	J	2 Sep 04	0200	0.7 min	POMAS
5	Naha ACC	M	6 Sep 04	0500	2.0 min	ATOTI
6	Fukuoka ACC	O	15 Nov 04	0045	0.3 min	TSC 040/20NM
7	Fukuoka ACC	O	5 June 05	0228	(40 min)	RJFU-RJTT
8	Naha ACC	M	9 July 05	1025	0.0 min	ATOTI
9	Fukuoka ACC	D	30 July 05	2340	0.1 min	MOMPA
10	Naha ACC	M	7 Sep 05	0310	3.0 min	ATOTI
11	Naha ACC	M	7 Sep 05	0715	2.0min	ATOTI
12	Naha ACC	M	9 Oct 05	0048	3.0 min	ATOTI
13	Sapporo ACC	O	23 Dec 05	0954	0.3 min	ATE 270/4NM

2.3 With regard to LHD caused by ATC operational errors relating to transfer (TRF) between ATC units, cooperative actions were undertaken by the ATC units concerned with the aim of preventing further recurrence of similar error after the October 2005 case. Since then, no LHD report caused by ATC transfer error has been observed to date; thus we are assuming that the actions taken were effective. However, we will continue monitoring the situation and coordinate any improvements with adjacent ATC units.

Table 3: Codes Defining Causes of LHD Occurrences

Code	No. of LHD Occurrences
A	Failure to climb/descend as cleared
B	Climb/descend without ATC Clearance
C	Entry into airspace at an incorrect flight level
D	Deviation due to turbulence or other weather related cause
E	Deviation due to equipment failure
F	Deviation due to collision avoidance system (TCAS) advisory
G	Deviation due to contingency event
H	Aircraft not approved for operation in RVSM restricted airspace
I	ATC system loop error; (e.g. pilot misunderstands clearance message or ATC issues incorrect clearance)
J	Equipment control error encompassing incorrect operation of fully functional FMS or navigation system (e.g. by mistake the pilot incorrectly operates INS equipment)
K	Incorrect transcription of ATC clearance or re-clearance into the FMS
L	Wrong information faithfully transcribed into the FMS (e.g. flight plan followed rather than ATC clearance or original clearance followed instead of re-clearance)
M	Error in ATC-unit-to ATC-unit transferred/transition message
N	Negative transfer received from transferring/transition ATC-unit
O	Other

3. Calculation

3.1 Collision Risk Model

3.1.1 Using the parameters such as average size of aircraft and average relative speed of the aircraft pair in Table 4 below, coefficients of passing frequencies for the same and opposite direction traffic can be calculated by

$$K(same) = 1 + \frac{\lambda x}{Vrx(same)}\left(\frac{Vry}{\lambda y} + \frac{Vrz}{\lambda z}\right) \quad (1)$$

$$K(opp) = 1 + \frac{\lambda x}{Vrx(opp)}\left(\frac{Vry}{\lambda y} + \frac{Vrz}{\lambda z}\right) \quad (2)$$

3.1.2 The Technical Risk can be calculated by

$$N_{az}^{technical} = N_{az}^{technical}(o+s) + N_{az}^{technical}(cross) \quad (3)$$

where,

$$N_{az}(o+s) = P_z(1000)P_y(0)N_x^{\ z}(e)K(o) \quad (4)$$

$$N_{az}^{technical}(cross) = P_z(1000)\sum_{\theta} P_h(\theta)E_z^{\ cross}(\theta)\left[\frac{2\left|\dot{h}(\theta)\right|}{\pi\lambda_{xy}} + \frac{\left|\dot{z}\right|}{2\lambda_z}\right] \quad (5)$$

$P_h(\theta)$ was calculated assuming that a standard deviation of the distribution of cross-track deviations is 0.132 NM, which is the value estimated by radar data analysis, and that of along-track deviations is 5 NM, which is radar separation standard, over the square root of six. $P_h(\theta)$, $E_z^{cross}(\theta)$ and $V_{rh}(\theta)$ were calculated every ten degrees.

3.1.3 The Operational Risk can be calculated by

$$N_{az}^{operational} = N_{az}^{operational}(o+s) + N_{az}^{operational}(cross) \quad (6)$$

where,

$$N_{az}^{operational}(o+s) = \frac{\sum P_z(z)T(z)}{H} P_y(0)N_x^{\ z}(e)K(o) \quad (7)$$

$$N_{az}^{operational}(cross) = \frac{\Sigma P_z(z)T(z)}{H}\sum_{\theta} P_h(\theta)E_z^{\ cross}(\theta)\left[\frac{2\left|\dot{h}(\theta)\right|}{\pi\lambda_{xy}} + \frac{\left|\dot{z}\right|}{2\lambda_z}\right] \quad (8)$$

3.2 Based on the Traffic Sample Data (TSD) extracted from the flight data processing system (FDPS) November 2005 as same as MAAR. The number of passing events, np(same) and np(opp), were calculated for each route segment consisting of two fixes. JCAB estimated RVSM risk level using by passing frequency calculation system. This system contained the calculation program based on the ENRI program.

3.3 Table 4 shows the values of Nx(opposite), Nx(same) and H(total flight hours). From September 2004 to February 2005 values are by the ENRI report. Right side of Table 4 shows brand new calculating system results. These values shows passing frequencies are decreased after implemented RVSM. Table 5 shows CRM parameters.

Table 4: Nx(opposite), Nx(same), H(total flight hours)

	Nx(opp)	Nx(same)	H		Nx(opp)	Nx(same)	H
Sep 2004	0.702	0.119	44184.3	Sep 2005	□	□	□
Oct 2004	0.643	0.131	50760.4	Oct 2005	0.184	0.048	79319.6
Nov 2004	0.684	0.103	59060.9	Nov 2005	0.229	0.030	59260.7
Dec 2004	0.615	0.085	57564.2	Dec 2005	0.186	0.027	30717.5
Jan 2005	0.643	0.085	61476.2	Jan 2006	0.255	0.032	59660.1
Feb 2005	0.579	0.139	61189.8	Feb 2006	□	□	□

Table 5: CRM parameters

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
Vry	Average cross track speed of aircraft pairs	11.6 kt	Kushiro Air Route Surveillance Radar data (R220 route, NOPAC)
Vrz	Average vertical speed of aircraft pairs	1.5 kt	Value often used
λx	Average aircraft length	0.0364 nm	FDP data (NOPAC)
λy	Average aircraft width	0.0321 nm	FDP data (NOPAC)
λz	Average aircraft height	0.0101 nm	FDP data (NOPAC)
Vrx(same)	Average same direction along track speed	28.9 kt	Kushiro Air Route Surveillance Radar data (R220 route, NOPAC)
Vrx(opp)	Average opposite direction along track speed	960 kt	Value often used
$Nx^z(e)$	Equivalent opposite-direction passing frequency	0.278	FDP data (November 2005)
K(same)	Coefficient of passing frequency for same direction traffic	1.64	Calculated by above-mentioned parameter values
K(opp)	Coefficient of passing frequency for opposite direction traffic	1.02	Calculated by above-mentioned parameter values
Pz(1000)	Probability that two aircraft nominally separated by the vertical separation minimum 1000 feet are in vertical overlap	1.7×10^{-8}	Value specified in ICAO Doc. 9574

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
Pz(0)	Probability of vertical overlap in operational risk estimation for the assigned vertical separation z=1000 ft	0.54	Value often used (shown in RVSM/TF-9-IP/2)
Pz(500)	Probability of vertical overlap in operational risk estimation for the assigned vertical separation z=500 ft	7.8×10^{-4}	Using the data of Navigation Accuracy Measurement System (NAMS) in RGCSP/6 report
Pz(600)	Probability of vertical overlap in operational risk estimation for the assigned vertical separation z=600 ft	2.7×10^{-4}	Using the data of Navigation Accuracy Measurement System (NAMS) in RGCSP/6 report
Py(0)	Probability that two aircraft on the same track are in lateral overlap	0.091	Using the data of secondary surveillance radar obtained by the Hachinohe Air Route Surveillance radar (domestic RNAV route)
Naz(cross, technical)	The collision risk for crossing routes (technical dimension)	4.0×10^{-11} [accidents/flight hour]	FDP data (November 2005)
Naz(cross, operational)	The collision risk for crossing routes (operational dimension)	2.3×10^{-10} (2.1×10^{-10} for 19-month period) [accidents/flight hour]	FDP data (November 2005)
H	Total flight hours of aircraft flying on the route segments within airspace under consideration	59260.7 flight hours (November 2005)	12 times for 90 day review (711128.4 hrs), 19 times for the 19 month period review (1125953.3 hrs)
T(0)	LHD duration in hours (deviated by 1,000 ft)	0.135 (0.182 for 19-month period) flight hours	Received LHD reports
T(500)	LHD duration in hours (deviated by 500 ft)	0.0056 (0.014 for 19-month period) flight hours	Received LHD reports
T(600)	LHD duration in hours (deviated by 400 ft)	0 (0.019 for 19-month period) flight hours	Received LHD reports

4. Result of calculation of the collision risk in the Japanese domestic airspace

4.1 This section summarizes the results of the post implementation safety assessment for the 19-month period as well as the 12-month period of the Japanese domestic RVSM airspace.

4.2 Tables 6 and 7 provide estimates of the Technical Risk calculated by collision risk model eq.(3), the Operational Risk calculated by collision risk model eq.(6) and the Overall Risk for the Japanese domestic RVSM airspace.

Table 6: Risk Estimates for the last 19-month period of the Japanese domestic RVSM airspace

Source of Risk	Lower Bound Risk Estimation [accidents / flight hour]	TLS [accidents / flight hour]	Remarks
Technical Risk	4.8×10^{-10}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.5×10^{-9}		
Overall Risk	3.0×10^{-9}	5.0×10^{-9}	Below Overall Risk

Table 7: Risk Estimates for the last one year (12-month) of the Japanese domestic RVSM airspace

Source of Risk	Lower Bound Risk Estimation [accidents / flight hour]	TLS [accidents / flight hour]	Remarks
Technical Risk	4.8×10^{-10}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.9×10^{-9}		
Overall Risk	3.4×10^{-9}	5.0×10^{-9}	Below Overall Risk

4.3 These values are smaller than the TLS value for Technical Risk, Operational Risk and Overall Risk suggested by a handbook for a regional monitoring agency supporting the implementation and continued safe use of the RVSM in the Japanese domestic airspace.

5. Conclusions

5.1 This result of the Japanese domestic RVSM airspace safety assessment indicates that the regionally agreed TLS is met for RVSM operation. We will continue collecting TSD and LHD reports and conduct safety assessment to ensure that TLS will be met.

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Reproduction of Appendix K to the RVSM/TF/6 Report

Message format for a report to the Asia/Pacific Approvals Registry and Monitoring Organization of an altitude deviation of 300ft or more, including those due to TCAS, turbulence and contingency events

REPORT OF AN ALTITUDE DEVIATION OF 300FT OR MORE BETWEEN FL290 & FL410

(1) Reporting agency

(2) Location of deviation

(3) NOPAC/CENPAC/CEP/SOPAC/Japan-Hawaii/South China Sea/Other

(4) Flight identification and type

(5) Flight level assigned

(6) Observed/reported final level Mode C/Pilot report

(7) Duration at flight level

(8) Cause of deviation

(9) Other traffic

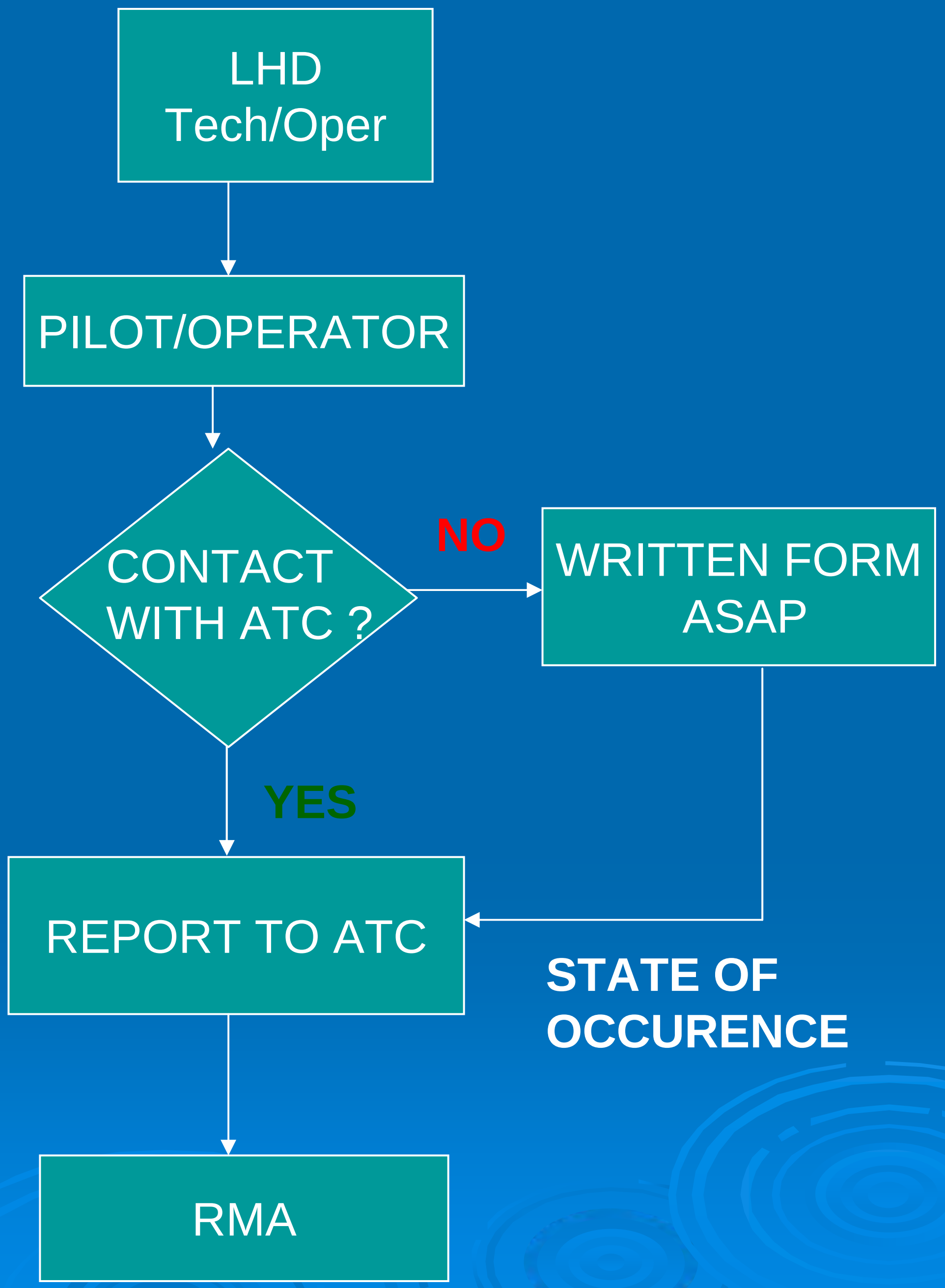
(10) Crew comments, if any, when noted

(11) Remarks

When complete please return to the following address:

William J Hughes Technical Center (WJHTC)
NAS & International Airspace Analysis Branch (ACT-520)
Atlantic City International Airport
Atlantic City, NJ 08405
Telephone: +1 609-485-5475
Fax: +1 609-485-5117
E-Mail: APARMO@.tc.faa.gov

PROCEDURE FOR REPORTING LARGE HEIGHT DEVIATIONS (LHD)



SN	Activity	Start	Complete	Present Status	Group Responsible	
1	**Identify Operational Need**					
2	Agree operational concept for Naha and Tokyo FIRs and Incheon FIR	5-Jul-04	7-Jul-04	**Completed**	ATC/WG, RVSM Task Force	
3	**Safety Assessment**					
4	Review available summary data (non-compliant aircraft, aberrant aircraft etc)	5-Jul-04	8-Jul-05	**Completed**	SAM/WG, MAAR, RVSM Task Force	
5	Examine history of height keeping errors related to ATC clearances and assess possible RVSM impact	5-Jul-04	8-Jul-05	**Completed**	SAM/WG, MAAR, RVSM Task Force	
6	Confirm RVSM risk model assumptions/parameters are consistent with airspace where RVSM is to be applied	5-Jul-04	8-Jul-05	**Completed**	SAM/WG, MAAR, RVSM Task Force	
7	Conduct simulations to predict occupancy after RVSM implementation	5-Jul-04	8-Jul-05	**Completed**	SAM/WG, MAAR, RVSM Task Force	
8	Collect weather and turbulence data for analysis	5-Jul-04	On-going	**Completed**	SAM/WG, OPSAIR, RVSM Task Force	
9	Report monthly large height deviations (including operational errors) to MAAR and PARMO	1-Mar-04	On-going	**On-going**	ATS Providers, Users	
10	Collect traffic sample data for safety assessment for RVSM implementation	1-Aug-04	30-Sep-04	**Completed**	ATS Providers	
11	**Feasibility Analysis**					
12	Examine the operational factors and workload associated with RVSM implementation	5-Jul-04	8-Jul-05	**Completed**	ATC/WG, RVSM Task Force	
13	**Determination of Requirements (airborne & ground systems)**					
14	States assess the impact of RVSM implementation on controller automation systems and plan for upgrades/modifications	5-Jul-04	8-Jul-05	**Completed**	States	
15	**Aircraft & Operator Approval Requirements**					
16	Promulgate the operational approval process	5-Jul-04	On-going	**Completed**	OPS/AIR/WG, RVSM Task Force	
17	Notify States when significant changes occur to RVSM documentation	5-Jul-04	On-going	**On-going**	OPS/AIR/WG, RVSM Task Force	
18	**Perform Rulemaking (if required)**					
19	Recommend State airspace regulatory documentation	5-Jul-04	7-Jul-05	**Completed**	States	
20	**Perform Necessary Industry & International Co-ordination**					
21	Establish target implementation date	5-Jul-04	7-Jul-04	**Completed**	RVSM Task Force, States	
22	Report to ATM/AIS/SAR/SG/15	25-Jul-05	29-Jul-05	**Completed**	RVSM Task Force Chairman	
23	Process Doc 7030 amendment	5-Jul-04	7-Jul-05	**On-going**	ICAO Regional Office (to include BOB FIRs)	
24	Publish advance AIC	5-Jul-04	31-Jul-04	**Completed**	States	
25	Publish AIP Supplement containing RVSM policy/procedures	5-Jul-04	7-Jul-05	**Completed**	States	
26	Review inter-facility coordination procedures	5-Jul-04	8-Jul-05	**Completed**	States	
27	Finalize changes to Letters of Agreement	5-Jul-04	8-Jul-05	**Completed**	States	
28	Disseminate information on RVSM policy and procedures through RVSM Website	5-Jul-04	On-going	**Completed**	OPS/AIR WG, RVSM Task Force	
29	**Approval of Aircraft & Operators**					
30	Establish approved operations readiness targets	5-Jul-04	8-Jul-05	**Completed**	IATA, ATC/WG, RVSM Task Force	
31	Assess operator readiness	5-Jul-04	8-Jul-05	**Completed**	IATA, OPS/AIR/WG	

SN	Activity	Start	Complete	Present Status	Group Responsible	
32	**Develop Pilot & ATC Procedures**					
~~33~~	~~Review application of tactical offset procedure to mitigate the effects of wake turbulence and TCAS alerts~~	~~5-Jul-04~~	~~24-Nov-05~~		~~RVSM Task Force~~	
34	Review weather and contingency procedures for applicability under RVSM	5-Jul-04	7-Jul-05	**Completed**	RVSM Task Force	
35	Publish appropriate Pilot/ATC policy & procedures on RVSM website	5-Jul-04	On-going	**Completed**	RVSM Task Force	
36	Identify transition areas and procedures	5-Jul-04	7-Jul-05	**Completed**	States, ATC/WG	
37	Conduct simulation modelling to assess impact of RVSM operations	5-Jul-04	7-Jul-05	**Completed**	States, ATC/WG	
38	Report on simulation activity	5-Jul-04	8-Jul-05	**Completed**	ATC/WG, RVSM Task Force	
39	Coordinate use of ACAS II (TCAS V.7) for RVSM operations	5-Jul-04	On-going	**Completed**	OPS/AIR/WG, RVSM Task Force	
40	Develop procedures for handling non-compliant aircraft (inc ferry & mntce) in ATS documentation	5-Jul-04	7-Jul-05	**Completed**	OPS/AIR/WG, ATC/WG, RVSM Task Force	
41	Develop mutually acceptable ATC procedures for non-approved State acft to transit RVSM airspace	5-Jul-04	7-Jul-05	**Completed**	ATC/WG, RVSM Task Force	
42	Implement procedures for suspension of RVSM	5-Jul-04	5-Sep-05	**Completed**	ATC/WG, RVSM Task Force	
43	Liaise with State defense authorities regarding military operations	5-Jul-04	8-Jul-05	**Completed**	States	
44	**Pilot & ATC Training**					
45	Provide Pilot/ATC training documentation based on past experience	31-Oct-04	On-going	**Completed**	IATA, RVSM Task Force	
46	Conduct local RVSM training for air traffic controllers	5-Jul-04	31-Aug-05	**Completed**	States, ATC/WG	
47	**Perform System Verificiation**					
48	Height keeping performance monitoring needed to undertake initial safety analysis	5-Jul-04	On-going	**Completed**	MAAR and SAM/WG, RVSM Task Force	
49	Provide representative traffic movement data to MAAR	1-Aug-04	30-Sep-04	**Completed**	States	
50	Undertake initial safety analysis	1-Oct-04	8-Jul-05	**Completed**	SAM/WG, RVSM Task Force	
51	Prepare/maintain regional status report detailing RVSM implementation plans	5-Jul-04	8-Jul-05	**Completed**	RVSM Task Force	
52	**Final Implementation Decision**				RVSM Task Force	
53	Review aircraft altitude-keeping performance and operational errors	5-Jul-04	8-Jul-05	**Completed**	SAM/WG, OPS/AIR/WG	
54	Complete ATS State documentation	5-Jul-04	7-Jul-05	**Completed**	States	
55	Publish Trigger NOTAM	19-Sep-05	19-Sep-05	**Completed**	States	
56	Complete readiness assessment	31-May-05	8-Jul-05	**Completed**	MAAR and SAM/WG, RVSM Task Force	
57	Complete safety analysis	31-May-05	8-Jul-05	**Completed**	MAAR and SAM/WG, RVSM Task Force	
58	**Declare Initial Operational Capability**				MAAR and SAM/WG, RVSM Task Force	
59	**Monitor System Performance**					
60	Perform Follow-On Monitoring	29-Sep-05	On-going	**On-going**	PARMO, MAAR, OPS/AIR/WG, SAM/WG	
61	Adopt the global use of Minimum Monitoring Requirements (MMR)	5-Jul-04	On-going	**Completed**	RVSM Task Force	
62	**Declare Full Operational Capability**				RVSM Task Force	
63	Special ATS Coordination Meeting (Bangkok) - Japan & Korea Implementation - 3 days	5-Jul-04	7-Jul-04	**Completed**	RVSM Task Force	

SN	Activity	Start	Complete	Present Status	Group Responsible	
64	Task Force/22 (Bangkok) - Review of FLOS for Western Pacific/South China Sea - 5 days	20-Sep-04	24-Sep-04	**Completed**	RVSM Task Force	
66	Task Force/23 (Bangkok) - Japan & Korea Implementation - 5 days	18-Oct-04	22-Oct-04	**Completed**	RVSM Task Force	
67	Task Force/24 (Bangkok) - 1 year follow up Bay of Bengal and Beyond implementation - 5 days	8-Nov-04	12-Nov-04	**Completed**	RVSM Task Force	
68	RVSM Seminar/6	21-Mar-05	22-Mar-05	**Completed**	RVSM Task Force	
69	Task Force/25 (Incheon) - Japan & Korea Implementation - 3 days	23-Mar-05	25-Mar-05	**Completed**	RVSM Task Force	
70	Task Force/26 (Tokyo) - Japan & Korea Implementation (Go/ No-Go Meeting) - 5 days	4-Jul-05	8-Jul-05	**Completed**	RVSM Task Force	
70	Task Force/27 (Bangkok) - 90 days follow up Japan & Korea implementation - 3 days	27-Feb-06	1-Mar-06	**Completed**	RVSM Task Force	
71	Task Force/28 (Bangkok) - Review of FLOS for Western Pacific/South China Sea - 5 days	24-Mar-06	28-Mar-06		RVSM Task Force	
71	Task Force/29 (Bangkok) - 1 year follow up Japan & Korea implementation - 3 days	14-Nov-06	16-Nov-06		RVSM Task Force	

European and North Atlantic Office

EUROPEAN AIR NAVIGATION PLANNING GROUP

FORTY-SEVENTH MEETING

(Paris, 29 November to 1 December 2005)

Agenda Item 3: Aviation safety issues

WAKE TURBULENCE

(Presented by the Ireland)

1. Background

1.1 On the 13th August 2005 an incident involving wake Vortex was reported to Shannon Operations Management through the Irish Aviation Authority's Mandatory Occurrence Reporting scheme. The report indicated that a B757 – 200 series Aircraft had experienced a violent and uncontrollable roll of 45°accompanied by a 400' loss of altitude, caused, in the pilot's opinion by a preceding Aircraft, an Airbus A345 that had climbed through his level.

2. The incident

2.1 Both Aircraft were flying Eastbound coming off the NAT Eastbound track structure the B757-200 had departed Toronto bound for Manchester and had been cleared from 54N/15W (RESNO) direct to position LIFFY (East of Dublin on the Shannon/NATS boundary). The Airbus 345 had departed Newark bound for Singapore and was also cleared direct from 54N015W to position LIFFY.

2.2 On entering Irish Airspace the A345 was maintaining FL340 and was 2000 below the B752 but was flying at between 30/35knots faster.

2.3 The A345 at FL340 gradually overtook the B752 (FL360) and at a position approximately 60 NM west of Dublin, the A345 had overtaken the B752.

2.4 When the overtaking Aircraft was 7NM ahead the PIC requested climb to F370. Having assessed the request, the controller climbed the A340 to Flight Level 370. The following is the time sequence derived from the Radar Playback Facility:

09:00:00 - 7nm between the aircraft, The A345 in the 11 o clock position at F340 (G Speed 525kts) and the Boeing 752 at F360 (G Speed 524kts).

09:00:30 - The A345 commences a slow climb – 7nm ahead.

09:02:00 - 8nm between the aircraft, the A345 passing F350 (G Speed 552kts) and the Boeing 752 (G Speed 525).

(3 pages)

09:03:10 - The A345in the 12 o clock position

09:04:10 - The A345 passing F360 (G Speed 548kts), Boeing 752 (G Speed 526kts) – 8nm apart, A345 in the 12 O'clock position.

09:05:00 - The A345 (G Speed 539kts) passing F364 – 9nm ahead of the Boeing 752

09:06:00 - The A345 reaches F370 and Boeing 752 descends to F357

09:06:35 - The Boeing 752 at F360 and appears to break left – 9nm apart

3. Reports

3.1 The Incident was reported by the Controller through the Mandatory Reporting Scheme and the PIC indicated that he would be filing an Air Safety Report.

4. Aftermath

4.1 The Pilot submitted the Air Safety Report thorough his company Flight Safety Department and thereafter provided an enhanced report. The additional report is repeated as follows:

4.2 "I put in an MOR on Saturday morning following an in-flight incident with the Boeing 752 from YYZ, where wake turbulence resulted in a departure from flight level. The purpose of this e-mail is to give further details should anything extra be require or useful.

4.3 Coming off the Ocean we were overtaken 2000' below by an A345, and XXX and myself had commented whether the Aircraft was one of the new A340-500's and was flying New York JFK direct to Singapore. Shortly afterwards he was given clearance to climb 3000' to FL370, through our level approximately 6NM in front of us. At this point I was busy as PNF getting weather reports from Dublin Volmet, but this was interrupted by violent shaking followed almost immediately by a "flipping motion" to the left through a bank angle of at least 45 degrees, accompanied by autopilot disengagement. I though for a moment we were to be flipped on our back, and took control to stop the bank angle from increasing – the artificial Horizon was indicating a bank angle in excess of one of the white lines, but I'm not sure whether it was the 45 or 60 degree marker. Looking out of the window the nose began falling through the horizon, but fortunately at this point the bank began reversing towards wings level. I let the nose continue to fall until most of the bank was off, and then rotated gently to level flight and reengaged the autopilot of FL356. I didn't want to apply any pitching up moment until the wings were about level to minimize stuff flying about in the cabin – we had heard the carts shifting around in the front gallery due to the bank angle. No stall buffet was encountered in recovering to level flight, and a track away front eh turbulence was flown, recovering to FL360 whilst talking to Shannon ATC.

4.4 In the cabin the 3 crew members in the back gallery were thrown violently to the floor by door 4L and 2 pax standing by the aft toilets were also thrown to the floor. 1 of the cabin crew in the front gallery was thrown to the floor, another one standing by door 1L was thrown against the door injuring her back on the door handle/lever. The Cabin Manager was prevented from being thrown around by being pinned against the bulkhead by one of the carts, fortunately not suffering any significant injury, and also preventing that cart from crashing onto the crew member on the floor. The rest of the pax appeared to have been seated, although one pax subsequently claimed her back was twisted by the event (she walked off the Aircraft at MAN without requesting any assistance). After establishing there were no serious injuries or any damage to the Aircraft we elected to continue to MAN, but informed ATC a report would be filed. &n bsp; One cabin crew member required help off the Aircraft and to the crew room and was to be looked at by the Airports medical centre.

4.5 Obviously the cause of the upset was wake turbulence form the A340, and insufficient separation was provided by ATC. Originally, when the A340 overtook us he was about 1mile abeam us to the North, but with both of us being given direct routing s to different way paths our paths crossed, unfortunately at the same time our levels crossed. The wake turbulence was violent, and the 757 was flipped to an extreme bank in less than 1 second. Recovery was instinctive and smooth (perhaps all those recoveries from U/P's in the Jet Provost years back proved their worth) getting control of the bank before applying pitch, and the recent simulator detail of recovery at altitude from extreme positions was certainly prominent in my mind. I have given some thought since of what I would have done should the Aircraft have been flipped onto its back as I can see it is feasible for that to happen, and to happen very quickly encountering such violent wake turbulence."

4.6 The detailed contained in the supplementary report, quoted about, demonstrates how frightening an event this Wake Turbulence encounter was for both passengers and crew.

4.7 The controllers on duty were unaware of any injury to cabin crew or passengers.

5. Conclusion:

5.1 Contrary to the Pilots report, the separation between these Aircraft was at all times in excess of the standard used by Air Traffic Control, and in fact, at the time of the incident the Separation between the Aircraft was 1000' vertical and 9NM in-trail.

5.2 In-trail climbs are a normal action used by Controllers in the Management and organisation of Air Traffic.

5.3 In this incident the Controller's assessment of the request to climb was correct and, at the time of the incident the in-trail spacing was almost twice the permitted separation. That a Vortex of this strength could be generated at these altitudes is highly unusual and has resulted in advisory briefings being issued to Controllers in Irish and UK Control centres.

6. Action by the Meeting

6.1 The EANPG is asked to note:

1) the incident and the violent nature of the encounter;

2) that the Wake Vortex encounter occurred at altitudes not normally associated with vortices of this strength.

3) that the A345 was climbed through the B752 in accordance with separation standards and, in fact, at the time of the encounter almost twice the standard required separation existed

4) Take any necessary action to promulgate lesson dissemination to the Aviation Community.

– END –