INTERNATIONAL CIVIL AVIATION ORGANIZATION

RVSM/RNAV/RNP TF/6 MEETING REPORT

(NAIROBI, 25 – 27 MAY 2005)

Prepared by the APIRG RVSM/RNAV/RNP TASK FORCE

The RVSM/RNAV/RNP Task Force is a Task Force of the AFI Planning and Implementation Regional Group (APIRG).

Its Reports are therefore submitted to APIRG through the ATS/AIS/SAR Sub-Group for review and action.

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PART I - HISTORY OF THE MEETING

1. Introduction

1.1 The Sixth meeting of the RVSM/RNAV/RNP Task Force (RVSM/RNAV/RNP TF/6) was convened pursuant to AFI/7 RAN Meeting Recommendations 5/7, 5/17 and APIRG/13 Decision 13/58 by the International Civil Aviation Organization in Nairobi from 25 to 27 May 2005.

1.2 The meeting was opened by Mr. Lot Mollel, ICAO ESAF Regional Director. He emphasized the preliminary studies which have to be done prior to the implementation of the required procedures aimed at increasing or improving the capacity of a given airspace in order to satisfy the demand of ever growing air traffic. In that regard, he emphasized the importance of the Sixth Meeting of the RVSM/RNAV/RNP Task Force being organized pursuant to APIRG/13 Decision 13/58. In order to enhance the implementation, Mr. Mollel remarked, the National Programme Managers whom we believe are the vital organs to the early implementation of RVSM were invited to work together with the Task Force to ensure ways of meeting the target date of implementation. He asked the meeting to discuss in details the contentious issues that need to be addressed and make appropriate recommendations for RVSM implementation in the AFI Region. He recalled APIRG 14 Conclusion 14/21 relating to the development of an AFI RVSM strategy/action plan within specific target dates. He recalled that as a pre-requisite to the implementation of RVSM, the ANC requested a safety Assessment should be conducted. The main elements of the safety assessment is the collision Risk Assessment (CRA) being done by the Netherlands Research Laboratories (NLR) the Functional Hazard Analysis (FHA) being conducted by ALTRAN Technologies of France and the National Safety Plan (NSP) to be developed by States. These three deliverables will be required to develop the AFI RVSM Pre-implementation Safety Case (PISC). He wished the members fruitful deliberations with a view to further enhance the safety of air navigation in the Region.

2. Officers and Secretariat

2.1 The meeting nominated Mr. Andrew F. K. Musoke, Director of Air Navigation Services and Manager RVSM Programme of Uganda as its moderator.

2.2 Mr. Apolo KHARUGA, Regional Officer, Air Traffic Management of the ICAO ESAF Office, acted as the Secretary of the meeting. He was assisted by Messrs. Ibrahim Usman AUYO, Regional Officer ATM, WACAF Office Dakar, BROU Konan, Regional Officer/ATM, ESAF, Amadou SENE, RO/CNS and Boitshoko SEKWATI, RO/MET.

3. Attendance

3.1 The meeting was attended by thirty seven (37) participants from twelve (12) States and five (5) International Organizations namely ALTRAN Technologies, ASECNA, IATA, NLR and Roberts FIR. It should be noted that ASECNA represents service provider of 16 Francophone States of WACAF region. The list of participants is given at **Appendix A** to this report.

4. Working Language

4.1 The meeting was conducted in the English language only.

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5. Agenda

5.1 The following Agenda was adopted:

Agenda Item 1

Review and follow-up of action of conclusions of fifth meeting of RVSM/RNAV/RNP Task Force and RVSM Stakeholders Meeting.

Agenda Item 2

Review of the activities relating to AFI RVSM Safety Assessment.

(i) Review the reports of Functional Hazard Analysis by ALTRAN Technologies Consultants.
(ii) Review of the progress on Collision Risk Assessment by NLR Consultants.
(iii) Review of the progress of Pre-Implementation Safety Case (PISC).
(iv) Status report of the AFI Regional Monitoring Agency (ARMA).
(v) Status of RVSM States readiness.

Agenda Item 3

Review of the final draft Proposal for Amendment to the Regional Supplementary Procedures - Doc.7030/4 African Indian Ocean (AFI) Region (Serial No. ESAF-S 04/1 – AFI RAC/1).

Agenda Item 4

Review and update the AFI RVSM Strategy/Action Plan.

Agenda Item 5

Any other business

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6. Conclusions

6.1 The Task Force recorded its actions in the form of Conclusions.

Summary of Conclusions

Number	Title
Conclusion 6/1:	**Safety assessment data** That States continue to provide the required safety assessment data to ARMA on monthly basis using Forms 1, 2, 3 and the revised Form 4 at **Appendix B**.
Conclusion 6/2:	**Passing Frequency for the Vertical Collision Risk Model** That ARMA/NLR examine the passing frequency inconsistencies and try to establish their cause in conjunction with operational experts from the pertinent States.
Conclusion 6/3:	**Civil/military coordination** That in order to ensure the safe and coordinated implementation of RVSM in the AFI Region, States ensure that the military aviation authorities are fully involved in the planning and the implementation process.
Conclusion 6/4:	**Nomination of a National RVSM programme manager** That States which have not done so, as a matter of urgency, nominate, a National RVSM Programme Manager who will be responsible for ensuring that the proper mechanisms are put in place for the safe implementation of the RVSM programme and will also act as the focal point or contact person.
Conclusion 6/5	**Reporting of data for monitoring and/or carrying out safety assessment** That: a) All States institute the procedures for reporting of data, incidents and conditions necessary for performing the collision risk calculations prerequisite for RVSM implementation to the AFI Regional monitoring agency (ARMA). The data will include, but not necessarily be limited to:

Number	Title
	i) Height deviations of 300 ft or more. ii) Total number of IFR movements for each month. iii) The average time per movement spent in the level band FL 290 to FL 410. iv) ATC coordination failures. v) Turbulence; and vi) Traffic data; and b) GMU Monitoring Unit GMU will be used for height monitoring in AFI Region which will be coordinated by the ARMA.
Conclusion 6/6:	**Implementation of RVSM in the AFI Region** **That:** a) All RVSM implementation preparation works (safety, assessment, training) be done taking into consideration the FL band 290 and 410 inclusive, being the AFI RVSM airspace. b) Implementation of RVSM in the AFI Region be harmonized and coordinated within the AFI Region as well as with the adjacent Regions.
Conclusion 6/7:	**Training of all personnel involved with the implementation of RVSM in the AFI Region** **That:** a) Seminars continue to be organized in the Region for training of air traffic services personnel in the RVSM field. b) States having difficulties in implementing RVSM implementation programme, may either individually or in group explore the possibility of seeking outside expertise; and **c)** On site training courses be conducted to expedite the training process.

Number	Title
Conclusion 6/8:	**Guidance material for Airworthiness and Operational Approval** That States in the AFI Region be urged to include in their national legislation and regulations the Airworthiness and Operational Approval process for aircraft and operators intending to operate within the RVSM airspace based on provisions of ICAO Annex 6 Part 1 Chapt 7 para. 7.2.3 and the guidance material contained in JAA Temporary Guidance Leaflet (TGL) N°6.
Conclusion 6/9:	**Enforcement in national legislation** **That:** States which have not done so, take the appropriate measures in order: a) to publish as a matter of urgency, an AIC informing the users of their intention to implement RVSM; and b) to include the necessary provisions in their national legislation.
Conclusion 6/10:	**Funding of the RVSM implementation programme** That National Governments, Regulatory bodies, operators, service providers and other stakeholders be granted budgetary allocations for acquisitions and other activities necessary for ensuring that all the requirements are met in a timely manner in order to safely implement RVSM in the AFI Region.
Conclusion 6/11:	**Aircraft/Operators readiness survey** That the results of ICAO/ARMA surveys be updated and presented at the RVSM TF/7 meeting for consideration.
Conclusion 6/12:	**Monitoring of Height Deviations** **That:** a) States which have radar establish at the ACC a unit to conduct monitoring of aircraft height deviations in the AFI RVSM airspace; and b) The data collected at a) above be forwarded to ARMA for action.

Number	Title
Conclusion 6/13:	**AFI RVSM Safety Policy** That States expedite the publication of an AIC on the AFI RVSM safety policy at **Appendix C** to this report.
Conclusion 6/14:	**National Safety Plan (NSP)** That States expedite the publication of their National Safety Plan using the sample at **Appendix D** to this report.
Conclusion 6/15:	**State Readiness Assessment** a) That ICAO urge the States which have not done so, to provide the State RVSM readiness assessment using the form at **Appendix E** to this report; and b) That ICAO urge the States to update "the State Readiness survey" at **Appendix F** to this report.
Conclusion 6/16:	**Exchange of RVSM data between ASECNA and ARMA** That ASECNA sub-regional monitoring unit continue to forward to ARMA the RVSM data collected from their member States.
Conclusion 6/17:	**Collision Risk Assessment (CRA)** That ARMA continue to provide the CRA data to NLR for inclusion in the AFI Pre-Implementation Safety Case (PISC).
Conclusion 6/18:	**Continuation of AFI RVSM Programme Office (ARPO)** That the AFI RVSM Programme Office (ARPO) located at the ICAO ESAF Office continue the coordination activities relating to RVSM implementation. website (www.icao.int /ESAF)
Conclusion 6/19:	**Target Date for AFI RVSM Implementation** That the target date for implementation of RVSM in the AFI Region will be 19 January 2006.

Number	Title
Conclusion 6/20:	**CVSM – RVSM Optimal Switch Over Time** That the TF Secretariat Support Team composed of Nigeria, South Africa, Tanzania, ASECNA and IATA coordinate and research all the associated elements, including weather and human factors, that will have an effect on the switch over, taking into account the FHA report at **Appendix G** and report back at Task Force 7 with their findings and a proposal for the optimal time for switch over.
Conclusion 6/21:	**AFI RVSM Core Airspace** a) That for Req_{core}_12 (refer AFI FHA report at **Appendix G**) “Air/Ground Communication system shall be designed to ensure a total coverage of the RVSM Airspace with a minimum MTBF (Mean Time Between Failure) of two months for a given FIR”; and b) That for Req_{core}_88 (refer to FHA report at **Appendix G**) “Aircraft shall be equipped with ACAS II version 7.00”.
Conclusion 6/22:	**AFI RVSM Switch-Over Period** a) That for $_{swit}$_24 (refer AFI FHA report at **Appendix G**) “Use of Eastbound RVSM FL (F1310, FL350 and FL390) shall be suspended for a period of **Two (2)** hours after the Time Zero (TO)”, b) That for $_{swit}$_40 (refer AFI FHA report at **Appendix G**) “Traffic density shall be limited during switch-over period as appropriate”, c) A Trigger NOTAM shall be published **Two (2) weeks** before Time Zero (TO) notifying the implementation of RVSM and relevant procedures to be applied, d) That for $_{swit}$_25 (refer AFI FHA report at **Appendix G**) “A NOTAM shall be published to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of **Two** hours”, e) That for $_{swit}$_35 (refer AFI FHA report at **Appendix G**) “Transit of non-RVSM civil aircraft shall be suspended for a period of **Two** hours after Time Zero (TO)”; and f) That for $_{swit}$_36 (refer AFI FHA report at **Appendix G**) “Operation above FL410 shall be suspended for non-RVSM aircraft for a period of **Two (2)** hours after Time Zero (TO)”.

Number	**Title**
Conclusion 6/23:	**FHA safety requirements needing appropriate actions by the RVSM Programme** That the following FHA safety requirements are allocated to the RVSM Programme: a) Req $_{Swit}$_37 "The switch-over period shall be performed during an appropriate low traffic density period" . b) Req $_{Swit}$_39 "The switch-over period shall be determined out of **Hajj** period", c) Req $_{Swit}$_40 "Traffic density shall be limited during switch-over period as appropriate", d) Req $_{Swit}$_41 "The FIR airspace shall be optimised to reduce controller workload", e) Req $_{Swit}$_52 "The date of switchover shall take into account the effect of adverse weather (thunderstorm, sandstorm, etc.) to minimize the effect on switch over operations"; and f) Req Swit_60 "Civil/Military coordination committee shall be in place". **Note: Req $_{Swit}$_ - refer to the FHA Report at Appendix G.**
Conclusion 6/24:	**Adoption of the FHA Final Report** That the results of the AFI RVSM Functional Hazard Assessment of the AFI RVSM Implementation in the AFI Region at **Appendix G** be used for the development of NSPs and PISC.
Conclusion 6/25:	**Amendment to ICAO Doc. 7030** That ICAO process, as soon as possible, the amendment proposal to the Regional Supplementary Procedures – Doc.7030/4 – African Indian Ocean Region (AFI) (Serial No. ESAF – S 04/1 – AFI RAC/1) which includes relevant provisions for RVSM implementation. (**Appendix H** refers).
Conclusion 6/26:	**AFI RVSM Strategy/Action Plan** That the updated RVSM Strategy/Action Plan at **Appendix I** be circulated to States for action.

Number	Title
Conclusion 6/27:	**Campaign to enhance RVSM Implementation** That sensitisation of Civil Aviation CEO/DGs by Regional Directors of ICAO and IATA on importance of RVSM and the need for its early implementation in the AFI Region be accorded priority during ICAO and IATA missions to States.
Conclusion 6/28:	**Regional Aircraft Certification Agency for RVSM Operation** **That:** a) States having difficulties with the implementation of operational airworthiness certification on the RVSM implementation should seek assistance from other States having this expertise. b) A cooperative approach for achieving AFI aircraft certified for RVSM should be given a high priority by States.
Decision 6/29:	**Venue of TF/7 and ATS/SG/8** That the TF/7 and ATS/SG/8 will be held in Dakar, Senegal from 8 to 9 August 2005 and 10 to 12 August 2005 respectively.

PART II: REPORT ON AGENDA ITEMS

Agenda Item 1

Review and follow-up of action of conclusions of fifth meeting of RVSM/RNAV/RNP Task Force and RVSM Stakeholders Meeting.

1.1 Under this Agenda Item the meeting reviewed and noted the action taken on the conclusions of the fifth meeting of the RVSM/RNAV/RNP Task Force and RVSM Stakeholders meeting. It reinstated conclusions which were still in force and proposed the action to be taken before the next Task Force meeting planned for 8 to 9 August 2005 in Dakar. These conclusions appear in Part 1 of this report.

Agenda Item 2

Review of the activities relating to AFI RVSM Safety Assessment.

2.1 The meeting was presented with several working papers relating to AFI RVSM Safety Assessment covering the following:

- The report of Functional Hazard Analysis by ALTRAN Technologies Consultants.

- The progress report on Collision Risk Assessment by the Netherlands Research Laboratory Consultants.

- The Status report on RVSM State Readiness.

2.2 WP/4 from NLR discussed the use of AFI traffic flow data for the estimation of the passing frequency parameter of the vertical collision risk model. The paper first discussed the need to take into account all passings between all possible pairs of aircraft operating on adjacent flight levels. Based on this discussion, the paper provided a recommendation to improve the current data collection form (form 4). The second part of the paper provided some examples of passing frequency calculations for a few, arbitrarily chosen, States. Some issues were identified concerning the occurrence of passings as a function of the cruising levels in use.

2.3 The meeting considered the following points from the FHA Consultants report:

a) AFI RVSM Core Airspace:

The ARTF/6 discussed in details the following FHA safety requirements and adopted them as part of the mitigation strategy for mature RVSM operations within the AFI RVSM core airspace.

✈ Req_{Core}_12 : “Air/Ground Communication system shall be designed to ensure a total coverage of the RVSM Airspace with a minimum MTBF (Mean Time Between Failure) of **Two** months for a given FIR”.

✈ Req_{Core}_88 : “Aircraft shall be equipped with ACAS II (TCAS version 7.00)”

b) AFI RVSM Switch-over Period:

The ARTF/6 discussed in details the following FHA safety requirements and adopted them as part of the specific mitigation strategy for RVSM operations during the Switch-Over Period. The period of time after Time Zero (TO) addressed by these requirements has been fixed at the value of **Two** hours.

✈Req $_{\text{Swit}}$_24: “Use of Eastbound RVSM FL (FL310, FL350 and FL390) shall be suspended for a period of **Two** hours after Time Zero (T0).
✈Req $_{\text{Swit}}$_40: “Traffic density shall be limited during switch-over period as appropriate”
✈Req $_{\text{Swit}}$_25 : “A NOTAM shall be published to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of **Two** hours”
✈Req $_{\text{Swit}}$_35 : “Transit of non-RVSM civil aircraft shall be suspended for a period of **Two** hours after Time Zero (T0)”
✈Req $_{\text{Swit}}$_36 : “Operation above FL410 shall be suspended for non-RVSM aircraft for a period of **Two** hours after Time Zero (T0)”

c) FHA safety requirements needing appropriate actions by the RVSM Programme:

The ARTF/6 took note of the following FHA safety requirements allocated to the RVSM program:

✈ Req $_{\text{Swit}}$_37 “The switch-over period shall be performed during an appropriate low traffic density period”
✈ Req $_{\text{Swit}}$_39 “The switch-over period shall be determined out of **Hajj** period”
✈ Req $_{\text{Swit}}$_40 “Traffic density shall be limited during switch-over period as appropriate”
✈ Req $_{\text{Swit}}$_41 “The FIR airspace shall be optimised to reduce controller workload”
✈ Req $_{\text{Swit}}$_52 “The date of switchover shall take into account the effect of adverse weather (thunderstorm, sandstorm, etc.) to minimize the effect on switch over operations”
✈ Req Swit_60 ”Civil/Military coordination committee shall be in place”

The RVSM Programme will take appropriate actions to satisfy these requirements.

Adoption of the FHA final report by ARTF/6

The ARTF/6 discussed the results of the AFI RVSM Functional Hazard Assessment (AT/SDI/05-024.A/05-003) and adopted it for the AFI RVSM implementation in the AFI Region.

2.3 In considering the aircraft readiness for RVSM ARMA reported 55% of AFI aircraft are RVSM approved which is an improvement from the previous assessment of 24%. The traffic sample revealed that 87% of aircraft within the AFI RVSM airspace are RVSM approved along with 73% of airline operators. A third readiness survey will be compiled for Task Force 7 meeting in August 2005.

In light of the discussions the meeting formulated the following conclusions:

Conclusion 6/1 - Safety assessment data

That States continue to provide the required safety assessment data to ARMA on monthly basis using Forms 1, 2, 3 and the revised Form 4 at Appendix B.

Conclusion 6/2 - Passing Frequency for the Vertical Collision Risk Model

That ARMA/NLR examine the passing frequency inconsistencies and try to establish their cause in conjunction with operational experts from the pertinent States.

Conclusion 6/3 - Civil/military coordination

That in order to ensure the safe and coordinated implementation of RVSM in the AFI Region, States ensure that the military aviation authorities are fully involved in the planning and the implementation process.

Conclusion 6/4 - Nomination of a National RVSM programme manager

That States which have not done so, as a matter of urgency, nominate, a National RVSM Programme Manager who will be responsible for ensuring that the proper mechanisms are put in place for the safe implementation of the RVSM programme and will also act as the focal point or contact person.

Conclusion 6/5 - Reporting of data for monitoring and/or carrying out safety assessment

That:

a) All States institute the procedures for reporting of data, incidents and conditions necessary for performing the collision risk calculations prerequisite for RVSM implementation to the AFI Regional monitoring agency (ARMA). The data will include, but not necessarily be limited to:

(i) Height deviations of 300 ft or more.
(ii) Total number of IFR movements for each month.
(iii) The average time per movement spent in the level band FL 290 to FL 410.
(iv) ATC coordination failures.
(v) Turbulence; and
(vi) Traffic data. and

b) Ground Monitoring Unit (GMU) will be used for height monitoring in AFI Region which will be coordinated by the ARMA.

Conclusion 6/6 - Implementation of RVSM in the AFI Region

That:

a) All RVSM implementation preparation works (safety, assessment, training) be done taking into consideration the FL band 290 and 410 inclusive being the AFI RVSM airspace

b) Implementation of RVSM in the AFI Region be harmonized and coordinated within the AFI Region as well as with the adjacent Regions.

Conclusion 6/7 - Training of all personnel involved with the implementation of RVSM in the AFI Region

That:

a) Seminars continue to be organized in the Region for training of air traffic services personnel in the RVSM field;
b) States having difficulties in implementing RVSM implementation programme, may either individually or in group explore the possibility of seeking outside expertise.; and
c) On site training courses be conducted to expedite the training process.

Conclusion 6/8 - Guidance material for Airworthiness and Operational Approval

That States in the AFI Region be urged to include in their national legislation and regulations the Airworthiness and Operational Approval process for aircraft and operators intending to operate within the RVSM airspace based on provisions of ICAO Annex 6 Part 1 Chapt 7 para. 7.2.3 and the guidance material contained in JAA Temporary Guidance Leaflet (TGL) N°6.

Conclusion 6/9 - Enforcement in national legislation

That:

States which have not done so, take the appropriate measures in order:

a) **to publish as a matter of urgency, an AIC informing the users of their intention to implement RVSM; and**

b) **to include the necessary provisions in their national legislation.**

Conclusion 6/10 - Funding of the RVSM implementation programme

That National Governments, Regulatory bodies, operators, service providers and other stakeholders be granted budgetary allocations for acquisitions and other activities necessary for ensuring that all the requirements are met in a timely manner in order to safely implement RVSM in the AFI Region.

Conclusion 6/11 - Aircraft/Operators readiness survey

That the results of ICAO/ARMA surveys be updated and presented at the RVSM TF/7 meeting for consideration.

Conclusion 6/12 - Monitoring of Height Deviations

That:

a) **ICAO request the States of Algeria, Botswana, Cape Verde, Egypt, Ghana, Kenya, Nigeria, South Africa and Tanzania to establish at the ACC where radar is implemented, a unit to conduct monitoring of aircraft height deviations in the AFI RVSM airspace; and**

b) **The data collected at a) above be forwarded to AFI RMA for action.**

Conclusion 6/13 - AFI RVSM Safety Policy

That States expedite the publication of an AIC on the AFI RVSM safety policy at Appendix C to this report.

Conclusion 6/14 - National Safety Plan (NSP)

That States expedite the publication of their National Safety Plan using the sample at Appendix D to this report.

Conclusion 6/15 - State Readiness Assessment

a) That ICAO urge the States which have not done so, to provide the State RVSM readiness assessment using the form at Appendix E to this report; and

b) That ICAO urge the States to update "the State Readiness survey" at Appendix F to this report.

Conclusion 6/16 - Exchange of RVSM data between ASECNA and ARMA

That ASECNA sub-regional monitoring unit continue to forward to ARMA the RVSM data collected from their member States.

Conclusion 6/17 - Collision Risk Assessment (CRA)

That ARMA continue to provide the CRA data to NLR for inclusion in the AFI Pre-Implementation Safety Case (PISC).

Conclusion 6/18 - Continuation of AFI RVSM Programme Office (ARPO)

That the AFI RVSM Programme Office (ARPO) located at the ICAO ESAF Office continue the coordination activities relating to RVSM implementation. website (www.icao.int /ESAF).

Conclusion 6/19 - Target Date for AFI RVSM Implementation

That the target date for implementation of RVSM in the AFI Region will be 19 January 2006.

Conclusion 6/20 - CVSM – RVSM Optimal Switch Over Time

That the TF Secretariat support Team composed of Nigeria, South Africa, Tanzania, ASECNA and IATA coordinate and research all the associated elements, including weather and human factors, that will have an effect on the switch over taking into account the FHA report at Appendix I and report back at Task Force 7 with their findings and a proposal for the optimal time for switch over.

Conclusion 6/21 - AFI RVSM Core Airspace

a) **That for Req_{core}_12 (refer AFI FHA report at Appendix G) "Air/Ground Communication system shall be designed to ensure a total coverage of the RVSM Airspace with a minimum MTBF (Mean Time Between Failure) of two months for a given FIR"; and**

b) That for Req_{core}_88 (refer to FHA report at Appendix G) "Aircraft shall be equipped with ACAS II version 7.00".

Conclusion 6/22 - AFI RVSM Switch-Over Period

a) That for $_{swit}$_24 (refer AFI FHA report at Appendix G) "Use of Eastbound RVSM FL (F1310, FL350 and FL390) shall be suspended for a period of Two (2) hours after the Time Zero (TO)",

b) That for $_{swit}$_40 (refer AFI FHA report at Appendix G) "Traffic density shall be limited during switch-over period as appropriate",

c) A Trigger NOTAM shall be published Two (2) weeks before Time Zero (TO) notifying the implementation of RVSM and relevant procedures to be applied,

d) That for $_{swit}$_25 (refer AFI FHA report at Appendix G) "A NOTAM shall be published to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of two hours",

e) That for $_{swit}$_35 (refer AFI FHA report at Appendix G) "Transit of non-RVSM civil aircraft shall be suspended for a period of two hours after Time Zero (TO)"; and

f) That for $_{swit}$_36 (refer AFI FHA report at Appendix G) "Operation above FL410 shall be suspended for non-RVSM aircraft for a period of Two (2) hours after Time Zero (TO)".

Note: Req $_{Swit}$_ - refer to the FHA Report at Appendix G.

Conclusion 6/23 - FHA safety requirements needing appropriate actions by the RVSM Programme

FHA safety requirements needing appropriate actions by the RVSM Programme

That the following FHA safety requirements are allocated to the RVSM Programme:

a) Req $_{\text{Swit}}$_37 "The switch-over period shall be performed during an appropriate low traffic density period",

b) Req $_{\text{Swit}}$_39 "The switch-over period shall be determine out of Hajj period ",

c) Req $_{\text{Swit}}$_40 "Traffic density shall be limited during switch-over period as appropriate",

d) Req $_{\text{Swit}}$_41 "The FIR airspace shall be optimised to reduce controller workload",

e) Req $_{\text{Swit}}$_52 "The date of switchover shall take into account the effect of adverse weather (thunderstorm, sandstorm, etc.) to minimize the effect on switch over operations"; and

f) Req Swit_60 "Civil/Military coordination committee shall be in place".

Conclusion 6/24 - Adoption of the FHA Final Report

That the results of the AFI RVSM Functional Hazard Assessment of the AFI RVSM Implementation in the AFI Region at Appendix G be used for the development of NSPs and PISC.

Agenda Item 3

Review of the final draft Proposal for Amendment to the Regional Supplementary Procedures - Doc.7030/4 Africa Indian Ocean (AFI) Region (Serial No. ESAF-S 04/1 – AFI RAC/1)

3.1 The meeting reviewed the final draft proposal for amendment to the Regional Supplementary Procedures - Doc.7030/4 Africa Indian Ocean (AFI) Region (Serial No. ESAF-S 04/1 – AFI RAC/1). The meeting agreed that the final draft be presented to the ATS/SG/8 for their consideration. The final version which includes provisions for RVSM implementation appears at **Appendix H** to this report.

The following conclusion was formulated:

Conclusion 6/25 - Amendment to ICAO Doc. 7030

That ICAO process, as soon as possible, the amendment proposal to the Regional Supplementary Procedures – Doc.7030/4 – African Indian Ocean Region (AFI) (Serial No. ESAF – S 04/1 – AFI RAC/1) which includes relevant provisions for RVSM implementation. (Appendix H refers).

Agenda Item 4

Review and update the AFI RVSM Strategy/Action Plan.

4.1 The meeting recalled that in noting the APIRG/14 Conclusion 14/21 (implementation of RVSM in the AFI Region) the ANC had expressed its concern that RVSM required a sophisticated implementation process and requested the States to monitor preparations and assist, to the extent possible, as an acceptable level of safety should be achieved and maintained.

4.2 The meeting noted that the ANC emphasized the provision of ATC and the required CNS facilities and services as a pre-requisite to the RVSM implementation. The ANC further requires the Pre-Implementation Safety Case to be presented for approval.

4.3 The meeting re-affirmed its earlier conclusion that the AFI RVSM airspace remains FL290 – FL410 inclusive and that there will not be any transition airspace.

4.4 Furthermore, the meeting agreed that the revised AFI strategy/action plan at **Appendix I** be circulated to States for action.

4.5 The meeting agreed that the implementation of RVSM in AFI should be pursued in a pragmatic manner and in detail following the steps in the revised strategy/action plan. The meeting agreed that the strategy/action plan will be reviewed at each of the TF meetings before any decision is made to implement the RVSM.

4.6 The meeting noted the slow progress in responding to the AFI action plan required for RVSM implementation in the Region and considered that there was a need for the issue to be addressed at the highest level of the Civil Aviation Chief Executive Officers and Director Generals.

4.7 The meeting considered issues relating to the need of establishing a Regional aircraft certification Agency on RVSM operation. The meeting considered such an Agency was not necessary and recommended that States having difficulties with implementation of operational airworthiness should seek assistance from other States having experience. A cooperative approach for achieving AFI aircraft certified for RVSM should be given high priority.

In view of the foregoing, the meeting formulated the following conclusions:

Conclusion 6/26 - AFI RVSM Strategy/Action Plan

That the updated RVSM Strategy/Action Plan at Appendix I be circulated to States for action.

Conclusion 6/27 - Campaign to enhance RVSM Implementation

That sensitisation of Civil Aviation CEO/DGs by Regional Directors of ICAO and IATA on importance of RVSM and the need for its early implementation in the AFI Region be accorded priority during ICAO and IATA missions to States.

Conclusion 6/28 - Regional Aircraft Certification Agency for RVSM Operation

That:

a) States having difficulties with the implementation of operational airworthiness certification on the RVSM implementation should seek assistance from other States having this expertise.

b) A cooperative approach for achieving AFI aircraft certified for RVSM should be given a high priority by States.

Agenda Item 5

Any other business

Venue and date of the Seventh RVSM/RNAV/TF meeting and Stake Holders Coordination Meeting

5.1. The Task Force noted that the Seventh RVSM Task Force Meeting will be held from 8 to 9 August followed by ATS/SG/8 meeting from 10 to 12 August 2005 in Dakar, Senegal. The meeting also noted that the Eighth Task Force meeting and second Stakeholders meeting (GO/DELAY) will be held in Lagos, Nigeria from 10 to 11 October 2005 and 12 to 14 October 2005 respectively.

Decision 6/29 - Venue of TF/7 and ATS/SG/8

That the TF/7 and ATS/SG/8 will be held in Dakar, Senegal from 8 to 9 August 2005 and 10 to 12 August 2005 respectively

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INTERNATIONAL CIVIL AVIATION ORGANIZATION
EASTERN AND SOUTHERN AFRICAN OFFICE

RVSM/RNAV/RNP/TF/6 MEETING
(NAIROBI, 25 – 27 MAY 2005)

LIST OF PARTICIPANTS

	NAME	TITLE DESIGNATION	ADDRESS
	BOTSWANA		
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AFI REGIONAL MONITORING AGENCY (ARMA)

ARMA forms for use in obtaining information from a State authorities and/or Service Providers

NOTES TO AID COMPLETION OF ARMA FORMS

1. Please read these notes before attempting to complete forms for the ARMA.

2. It is important for the ARMA to have an accurate record of a point of contact for any queries that might arise. States are therefore requested to identify their National Program Manager with their first reply to the ARMA. Thereafter, there is no further requirement unless there has been a change to the information requested on the form.

3. If recipients are unable to pass the information requested to the ARMA through the Internet, by direct electronic transfer, or by data placed on a floppy disk/CD, a hard copy must be completed.

(1) Enter the single letter ICAO identifier as contained in ICAO Doc 7910. In the case of their being more than one identifier designated for the State, use the letter identifier that appears first.
(2) Enter the operator's 3 letter ICAO identifier as contained in ICAO Doc 8585. For International General Aviation, enter "IGA". For military aircraft, enter "MIL". If none, place an X in this field and write the name of the operator/owner in the Remarks row.
(3) Enter the ICAO designator as contained in ICAO Doc 8643, e.g., for Airbus A320-211, enter A320; for Boeing B747-438 enter B744.
(4) Enter series of aircraft type or manufacturer's customer designation, e.g., for Airbus A320-211, enter 211; for Boeing B747-438, enter 400 or 438.
(5) Enter ICAO allocated Aircraft Mode S address code.
(6) Date example: For October 26, 1998 write 10/26/98.
(7) Use a separate sheet of paper if insufficient space available.

AFI REGIONAL MONITORING AGENCY (ARMA)

POINT OF CONTACT DETAILS/CHANGE OF POINT OF CONTACT DETAILS FOR MATTERS RELATING TO RVSM APPROVALS

This form should be completed and returned to the address below on the first reply to the ARMA or when there is a change to any of the details requested on the form (PLEASE USE BLOCK CAPITALS).

STATE OF REGISTRY: enter State here

STATE OF REGISTRY (ICAO 2 LETTER IDENTIFIER): enter 2 letter State here
Enter the 2-letter ICAO identifier as contained in ICAO Doc 7910. In the event that there is more than one identifier for the same State, the one that appears first in the list should be used.

ADDRESS:

CONTACT PERSON:

Full Name: enter full name here

Title: Surname: Initials:

Post/Position:

Telephone #: Fax #:

E-mail:

Initial Reply/Change of Details (*Delete as appropriate)*

When complete, please return to the following address:

RMA Address: Mr Kevin Ewels, Manager: ARMA Private Bag X1, Bonaero Park South Africa 1622

Telephone: 27-11- 928-6433

Fax: 27-11- 928-6420

E-Mail: afirma@atns.co.za

AFI REGIONAL MONITORING AGENCY (ARMA)

HEIGHT DEVIATIONS (Form 1)

STATE:	ACC:	MONTH:
State of Registry		
Flight Identification		
Operator		
State of Operator		
Aircraft Type and Series		
Registration		
Serial Number		
Mode S Address		
Total height deviation		
Total time of deviation		
Cause of Deviation[1]		

Date and Time of Measurement	Assigned Flight Level	Observed Flight Level	Air route	Geographical Location

Provide description of incident including total height profile if available

[1] Include Number from List Below

1. Error in altimetry or altitude-keeping system of an aircraft
2. Turbulence or weather related phenomena
3. Emergency descent by aircraft without crew following established contingency procedures
4. Response to Airborne Collision Avoidance System (ACAS) advisories
5. Error in following a correctly issued ATC clearance, resulting in flight at an incorrect flight level
6. Error in issuing an ATC clearance, resulting in flight at an incorrect flight level
7. Errors in coordination or transfer of control responsibility for an aircraft between adjacent ATC units, resulting in flight at an incorrect flight level
8. Other reason, include reason in Description of incident.

NOTE: Complete with available information

AFI REGIONAL MONITORING AGENCY (ARMA)		
MONTHLY MOVEMENTS		**(FORM 2)**
STATE:	**ACC:**	**MONTH:**
TOTAL IFR MOVEMENTS FOR THE MONTH:		
TOTAL MONTHLY IFR MOVEMENTS IN THE BAND F290 – F410		
AVERAGE TIME PER MOVEMENT IN LEVEL BAND F290 – F410		
	LEVEL FLIGHT	
	CLIMBING AND DESCENDING	

AFI REGIONAL MONITORING AGENCY (ARMA)

OTHER OPERATIONAL CONSIDERATIONS		(Form 3)
STATE:	ACC:	MONTH:

COORDINATION FAILURES

NUMBER OF EVENTS IN MONTH	

COMMUNICATION FAILURE

DATE	TIME	DURATION	CAUSE OF COMMUNICATION FAILURE

TOTAL TIME FOR MONTH	

TURBULENCE

DATE	TIME	DURATION	MAGNITUDE[1]	LOCATION

[1] Magnitude as measured from Meteorology Turbulence Scale

ACAS INDICENTS

Date	Time	Description of ACAS Incident

AFI REGIONAL MONITORING AGENCY (ARMA)

AIRCRAFT TRAFFIC FLOW DATA									(Form 4) *Revised by RVSM/TF/6 May 2005	
STATE:				ACC:				MONTH:		
Please include information on all flights within the flight level band F290 – F410 (inbound, outbound and over flights)										
DATE	ROUTE	CALLSIGN	AIRCRAFT TYPE	OPERATOR	DEPARTURE AERODROME	DESTINATION AERODROME	NAV EQUIPMENT	WAYPOINT/ REPORTING POINT	TIME AT WAYPOINT/ REPORTING POINT	FLIGHT LEVEL
01-01-2005	UR978	AFR827	A319	AFR	FCPP	LFPG		ERKEL	00:24	350
								KAMER	03:02	350
								ATAFA	01:04	350
								BOD	01:21	350
								ELO	02:11	350
								NADJI	02:21	350
01-01-2005	UR978	KQA310	B744	KQA	HKJK	VABB		ERKEL	00:59	370

EXAMPLE

Note: Please include all waypoints/reporting points, times and FL for the entire route per FIR

AFI REGIONAL MONITORING AGENCY (ARMA)

AIRCRAFT TRAFFIC FLOW DATA **(Form 4)**
*Revised by RVSM/TF/6
May 2005

STATE: **ACC:** **MONTH:**

Please include information on all flights within the flight level band F290 – F410 (inbound, outbound and over flights)

DATE	ROUTE	CALLSIGN	AIRCRAFT TYPE	OPERATOR	DEPARTURE AERODROME	DESTINATION AERODROME	NAV EQUIPMENT	WAYPOINT/ REPORTING POINT	TIME AT WAYPOINT/ REPORTING POINT	FLIGHT LEVEL

Note: Please include all waypoints/reporting points, times and FL for the entire route per FIR

AFI REDUCED VERTICAL SEPARATION MINIMUM (RVSM) RVSM SAFETY POLICY

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AFI REDUCED VERTICAL SEPARATION MINIMUM (RVSM) SAFETY POLICY

1. INTRODUCTION

This document, the RVSM Safety Policy Document, sets out the Safety Policy, the Safety Objectives and describes the RVSM Safety Sub-Program tasks and actions necessary to ensure the safe implementation of RVSM in the AFI region.

The RVSM Safety Policy Document is intended to provide a framework to facilitate the safety regulation process of the AFI RVSM Program. As such, it is considered to be a formal deliverable of the RVSM Program.

The RVSM Safety Policy Document describes the deliverables of the RVSM Safety Sub-Program together with their role in the overall AFI RVSM Program and in the national safety assurance programs.

2. RVSM OPERATIONAL CONCEPT

The principal concept behind RVSM is the reduction of the vertical separation minimum between adjacent aircraft from 2000 feet to 1000 feet between the Flight Levels FL290 and FL410 inclusive. This will provide six additional cruising levels to air traffic, increase the capacity of the Air Traffic Management system and facilitate the task of Air Traffic Services in maintaining a safe, orderly and expeditious flow of traffic. It can be expected that the capacity and system benefits of RVSM will, by facilitating the Air Traffic Control function, also have the potential for possible safety benefits.

This vertical separation minimum shall be applied between RVSM approved aircraft within the airspace of the designated RVSM airspace. Therefore, all operators proposing to operate across the lateral limits of the RVSM airspace shall be required to indicate on Filed Flight Plans their RVSM status. Except within the AFI RVSM Transitional Airspace Non-RVSM approved aircraft, other than state aircraft, shall not be permitted to operate within RVSM airspace.

For the transition between RVSM and non-RVSM airspace specific procedures shall be established to facilitate the safe transition between RVSM and Non-RVSM airspace. The transition tasks shall be accomplished so as to make RVSM operations transparent to adjacent non-RVSM regions.

The RVSM Program requires that specific training for aircrew and ATC staff shall be performed prior to the start of RVSM operations. The Program also requires ATC equipment and procedures to be modified according to specific Program requirements prior to the start of RVSM operations.

3. AFI RVSM PROGRAM SAFETY POLICY

The Safety Policy for RVSM implementation has been established to meet the requirements of ICAO Standards and Recommended Practices and guidance material on managing collision risk consequent on the implementation of RVSM.

The following statements define the Safety Policy of the RVSM Program:

(i) The AFI RVSM Program uses an explicit, pro-active approach to safety management in the development, implementation and continued operation of RVSM.

(ii) The responsibility of management for the safety performance of the RVSM Program is recognised. The RVSM Program Manager is responsible for the overall management of the Program. The RVSM Safety Program Manager is responsible to the RVSM Program Manager for ensuring the compliance of the Program with AFI Safety Policy and appropriate international standards and requirements. The RVSM Safety Program Manager is also responsible for liaison with the Regulation Authorities.

(iii) The implementation of RVSM shall be conducted in accordance with ICAO requirements and requires ninety percent RVSM approved aircraft within the Region;

(iv) The safety of air navigation has been given the highest priority in the development of the RVSM operational concept and the Implementation Program;

(v) The RVSM Program shall minimise the program's contribution to the serious or risk bearing incidents or aircraft accidents as far as is reasonably practicable.

4. RVSM IMPLEMENTATION SAFETY OBJECTIVES

(i) The RVSM Program shall conduct a full Functional Hazard Analysis looking at the whole system including air and ground segments and the proposed operational concept. This analysis shall adopt a total aviation system perspective and a risk based approach to the classification of hazards. The analysis shall include, but not be restricted to, those risks already identified by ICAO for RVSM implementation;

(ii) The RVSM Program shall, as its principal safety objective, minimise the program's contribution to the risk of an aircraft accident. The RVSM Program recognises the AFI Safety Objectives and Strategy, in particular the general objective to improve safety levels by ensuring that the number of ATM induced accidents and serious or risk bearing incidents do not increase and, where possible, decrease. Therefore, the implementation of RVSM shall not adversely affect the risk of en-route mid-air collision;

(iii) The RVSM Program shall establish an explicit Safety Sub-Program to ensure that Program's contribution to the risk of an aircraft accident is minimised in accordance with the principal safety objective;

(iv) In accordance with ICAO Guidance Material the management of vertical collision risk within RVSM airspace shall meet the Target Level of Safety of 5×10^{-9} fatal accidents per flight hour;

(v) In accordance with ICAO Guidance Material, the risk of mid-air collision in the vertical dimension within RVSM airspace, due to technical height keeping performance, shall meet a Target Level of Safety of 2.5×10^{-9} fatal accidents per flight hour.

(vi) Guidance shall be given to the States to explain the necessary activities to provide evidence about the safe implementation of RVSM on the national level and subsequently assure the preparedness of the States.

These Safety Objectives will be complemented by Safety Requirements which may arise as results from the detailed Functional Hazard Analysis which yet has to be carried out.

5. RVSM IMPLEMENTATION SAFETY OBJECTIVES

As part of the RVSM Program, an RVSM Safety Sub-Program has been developed to provide evidence on the compliance of the Implementation Program with the RVSM Safety Policy and the RVSM Safety Objectives.

The work program of the RVSM Safety Program comprises the following elements:

(i) Detailed Hazard Analysis, Preliminary System Safety Assessment and System Safety Assessment of the proposed RVSM operational concept;

(ii) Assessment of operational error reports, both prior to and after implementation, to identify any additional risks and hazards associated with the proposed operational concept and to provide data for the assessment of the target levels of safety;

(iii) Establishment of formal requirements for participating states to demonstrate that all necessary national activities and actions have been undertaken prior to implementation.

(iv) Assessment of the risk of mid-air collision, using methods specified in ICAO guidance material;

(v) A major assessment of aircraft height keeping performance to monitor compliance with height keeping requirements.

Each of these elements will produce deliverables, in the form of reports, which will be formally presented to the ARTF as the Program proceeds.

6. RVSM SAFETY DELIVERABLES

In this section, the major deliverables of the RVSM Safety Sub-Program are described. Although the deliverables are in the form of formal documents, interim reports will be provided for review prior to completion of the final version of a deliverable document.

6.1 RVSM Functional Hazard Analysis

A detailed Functional Hazard Analysis (FHA) shall be carried out to provide assurance that all hazards and risks associated with RVSM have been identified and classified. The FHA shall cover (i) the situation that RVSM is operational one year after its introduction, (ii) the particular situation in States which have to ensure the transition between RVSM and non-RVSM airspace and (iii) the change-over on the day of RVSM introduction. The results of the FHA shall be documented in a detailed report and a hazard/risk matrix. It will be used as input to the Collision Risk Assessment and the National Safety Cases where appropriate. A summary of the results will constitute one chapter of the AFI RVSM Pre-Implementation Safety Case and the detailed report will appear as an Annex.

6.2 Collision Risk Assessment

A Collision Risk Assessment (CRA) shall be carried out in order to provide the evidence that the collision risk in RVSM airspace meets the Target Level of Safety required by ICAO. A summary of the results will form one chapter of the AFI RVSM Pre-Implementation Safety Case and the detailed report will appear as an Annex.

6.3 National Safety Plans

Guidance shall be given to the States to explain the necessary activities to provide evidence about the safe implementation of RVSM on the national level. Using the guidance material National Safety Plans should be produced by the States, submitted to the National Regulator as appropriate and shall be summarised by the RVSM Safety Sub-Program in to order to form one section of the AFI RVSM Pre-Implementation Safety Case.

6.4 AFI RVSM Pre-Implementation Safety Case

The AFI RVSM Pre-Implementation Safety Case shall provide the assurance that the objectives stated in the AFI RVSM Safety Policy Document are met. Evidence will be provided that (i) all identified hazards and risks are managed and mitigated, (ii) the collision risk meets the ICAO Target Level of Safety and (iii) States show they will safely implement RVSM through the development of national safety documentation.

6.5 AFI RVSM Post-Implementation Safety Case

The required contents of the Post-Implementation Safety Case will be developed as a result of the pre-implementation safety activities. However, the main objective will be to confirm assumptions and estimations being made in order to determine if in an operational RVSM environment the safety objectives can be met. It is expected that the document demonstrates *inter alia* that safety is continuously ensured, the aircraft approval process is effective, the target levels of safety are being met, operational errors do not increase and ATC procedures introduced for RVSM remain effective.

7. AFI RVSM SAFETY PROGRAM SCHEDULE

The following graphic depicts the timescales for the principal elements of the RVSM Safety Sub-Program and the major deliverables foreseen.

<table>
<tr><th>2005 1st Qtr.</th><th>2005 2nd Qtr.</th><th>2005 3nd Qtr.</th><th>2005 4th Qtr.</th><th>2006 1st Qtr.</th><th>2006 2nd Qtr.</th><th>2006 3rd Qtr.</th></tr>
<tr><td colspan="2">Functional Hazard Analysis (FHA) -April 2005</td><td></td><td></td><td>RVSM Implementation 19 January 2006</td><td></td><td></td></tr>
<tr><td></td><td>Safety Policy – May 2005</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">National Safety Plans - May 2005</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Collision Risk Assessment (CRA) -July 2005</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Pre-Implementation Safety Case (PISC) – July 2005</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Pre-Implementation Safety Case by TF/7 and ATS/SG/8 – August 2005</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">PISC approval by APIRG and ANC September 2005</td><td></td><td></td><td></td></tr>
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[*Insert Name of State*] Safety Plan For the Implementation of RVSM

DOCUMENT APPROVAL

The following table identifies all Authorities that have successively approved the present issue of this document.

AUTHORITY	NAME AND SIGNATURE	DATE
National RVSM Safety Manager		
National RVSM Program Manager		
Head of Operations in National ATS Provider		
Approval Authority		

NOTES

- This draft plan is written to provide a template for use by individual States
- Where possible the text is written to be suitable for direct inclusion in State's Safety Plans.
- Where additional text is required to be inserted by the State, this is indicated in the text in Italics within brackets, for example [*insert Name of responsible authority here*].
- Some of the text is illustrative. In such circumstances a State may need to develop text appropriate to its circumstances, which reflects its local environment and activities etc. The illustrative text does, however, broadly represent best practice and may be used by States for their planning. States should note that there may be more than one way to achieve best practice and the text in this draft plan only reflects one of these possibilities.
- This draft plan does not try to take into account all the specifics of safety planning in use in the States. Each State needs to identify those aspects of their safety planning that are not included in this draft plan. States should include, as appropriate, such aspects within their State Safety Plan

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1 INTRODUCTION

1.1 Safety Plan Objective

The objective of this Safety Plan for [*Name of State*] is to set out those National activities that are required to support the RVSM Safety Case. The plan also addresses safety requirements identified by the State's Regulator [*Insert Name of regulatory authority*]. Each of the National activities required for the implementation of RVSM by [*Name of State*] is described in some detail. The descriptions address:

- The role of the activity in support of the safe implementation and operation of RVSM in [*Name of State*],
- The standards to be applied to the conduct of the activity,
- The additional supporting activities that will provide confidence that the identified National activities will lead to the successful implementation of RVSM within [*Name of State*]. These supporting activities include:
  - Those that help achieve quality,
  - Those that help manage identified risks.

The purpose in showing this level of information is to provide early assurance that *[Name of State]* takes its safety responsibilities seriously and has developed a plan to achieve the safe implementation of RVSM.

This safety plan has also been produced to help those within *[Name of State]* who have responsibility for the provision and regulation of the State's Air Traffic Service [*insert Name of ATS Provider*]. It helps them understand the safety aspects of the State's RVSM activities and shows how the National Program Manager is managing these aspects.

1.2 Approach

This National safety plan is divided into sections that consider the National activities for RVSM as follows:

- Section 2: Aircraft and Operator Approvals for RVSM
- Section 3: ATS Training,
- Section 4: Changes to ATS Equipment,
- Section 5: Changes to ATS Procedures,
- Section 6: Airspace Design Changes,
- Section 7: RVSM Switchover,
- Section 8: Operational Monitoring of RVSM.

Within each section the plan:

(a) Describes those activities that are necessary to provide an appropriate ATS following the implementation of RVSM in the AFI region;

(b) Identifies the appropriate responsible Authorities, together with a description as to how these Authorities discharge their responsibility;

(c) Describes the detailed activities and checks that underpin the achievement of quality of the activities described in item (a) above;

(d) Shows how the hazard and risk information that will be produced by AFI's RVSM Program will be addressed as appropriate by the State.

1.3 Organisation

The Organisation for the RVSM safety plan and associated activities is as follows**.**

(a) [*Insert Name*] has been appointed as the Safety Manager for RVSM and is responsible for the production of this plan;

(b) The National Program Manager [*insert Name*] has responsibility for the National RVSM program. He approves the safety plan and is responsible for obtaining the further approvals that are described below. In approving the plan the National Program Manager is confirming that in his view the plan is acceptable, and accurately describes the activities that are required to show that the stated safety requirements will be achieved;

(c) The Head of ATS Operations [*insert Name*] has overall responsibility for the ATS operations. In approving the plan the Head of Operations is confirming that from a safety perspective all necessary actions have been or will be undertaken by the ATS provider to ensure that RVSM can be safely implemented and operated within *[Name of State]*;

(d) The CAA/ATS provider company [*insert Name*] is the designated Authority and is responsible for the provision of an appropriate Air Traffic Service within the State. In approving the plan the DG is confirming that he is satisfied that responsibility for the safe implementation of RVSM has been properly delegated; that the staff delegated have been duly authorised to act on his behalf; and that they are competent to act on his behalf.

In addition to the above, specific approvals for individual activities are also required (see sections 2.4, 3.4 through to 8.4).

The above organisation applies during the pre-implementation phase of RVSM. There are activities (in particular safety monitoring activities) that take place post-implementation. The responsibility for post-implementation safety activities rests with responsible staff in the State and the ATS provider [*insert Names, otherwise state that the post-implementation safety organisation and responsibilities are not yet determined*].

2 AIRCRAFT AND OPERATOR APPROVALS

2.1 Introduction

This section deals with Aircraft/operator approval requirements for aircraft to operate within the AFI RVSM region and describes the approval program within the State.

2.2 Safety Requirement

The safety requirement is to show that all Operators based in *[Name of State]* are aware of the RVSM implementation and have obtained RVSM approval for themselves and their aircraft as appropriate. Both the aircraft and the Operator require approval if they are to operate in RVSM airspace. It is the responsibility of the State's CAA to describe their regulatory activities that will lead to documentary proof of the State's CAA diligence with respect to these approvals.

2.3 Standards Applied

[Name of State] will use TGL6 revision 1 to conduct the approval for civil aircraft and operators for RVSM operations.

2.4 Planned Aircraft/Operator Activities

An approval program has been developed to support the implementation of RVSM. The details of the program are found in [*Name of State*] National RVSM Plan. The program subdivides into two main activities:

(a) Awareness Activities
Operators and State aircraft authorities have already been informed about RVSM approval and monitoring requirements through:

- AICs [*supply details of AICs issued and planned for issue*].
- RVSM Seminars/workshops [*Supply details of seminars/workshops already run and planned to be run*]
- A working group has been set up with the Operators and State aircraft Authorities to discuss RVSM implementation. [*supply details of working group*]

(b) Approval Activities
These are described in 2.5 below.

2.5 Approval Activities

There are two areas for which *[Name of State]* has an established approval/regulatory process:

(a) Operator Approval

Those Operators that are based in *[Name of State]*, and wish to operate within the AFI RVSM Airspace, will apply to the State CAA to obtain operational approval (in line with TGL 6). The responsible officer for giving such approvals is [*insert title and name of current jobholder*]. His approval is based on [*insert approval criteria – this should be based on establishing compliance with the relevant aspects of TGL 6*].

(b) Aircraft Certification and Approval

Operators (or owners) of aircraft registered within *[Name of State]* will apply to the State CAA for certification and approval (in line with TGL 6). The responsible officer for giving such approvals is [*insert title and name of current jobholder*]. His approval is based on [*insert approval criteria – this should be based on establishing compliance with the relevant aspects of TGL 6*].

In addition military Authorities have elected to submit identified military transport aircraft for RVSM certification and approval. The responsibility for this rests with *[Name of State]* Ministry of Defence. It has elected to implement the principles embodied in TGL 6 Issue 1. The responsible officer for giving such approvals is [*insert title and name of current jobholder*]. His approval is based on [*insert approval criteria*].

2.6 Quality Assurance of Activities

It is important to ensure that the approval activities are effective and lead to RVSM approved aircraft that are capable of meeting the more stringent height keeping requirements within the AFI RVSM airspace and air crew that are familiar with RVSM rules and procedures. There are several elements that provide confidence in this capability.

2.6.1 Aircraft Technical Height Keeping Performance Monitoring

The ARMA has established a Height Monitoring Infrastructure that will provide ongoing monitoring of a substantial proportion of the aircraft fleet operating within the AFI RVSM region.

Aircraft that are not within the specified standards will be reported to the appropriate State Authorities that approved the aircraft for RVSM operations. The Operator of the non-compliant aircraft will also be contacted. [*Insert Name of State Authority*] will follow up all such reports with the Operators concerned. This review will take place within the normal framework of aircraft certification and operator licensing.

2.6.2 Operational Error Monitoring

The AFI Regional Monitoring Agency (ARMA) has an established and ongoing program of operational error data collection and assessment. Information is obtained from ACCs and States on operational altitude deviations of 300 ft or greater. ARMA will use the data as part of the RVSM Safety Case. At present mechanisms have not been developed to inform the appropriate States of clusters of events associated with a specific operator or region of airspace. These will be established prior to the implementation of RVSM.

In addition to the above, [*insert Name of State Authority*] monitors and reviews aircraft airworthiness and Operator Licenses both on a regular basis and in response to identified concerns or trends.

2.7 Aircraft and Operator Risk Management

Hazards associated with regulatory or approval processes are not normally covered within FHAs. It is however appropriate to review those hazards in the AFI FHA that are associated with aircraft, aircrew and Operator hazards. The results of the FHA have been distributed to States. *[Name of State]* will review the hazards and risks that will have been identified by the FHA. The purpose of the review is to identify those aspects where the local circumstances are different from those assumed within the AFI FHA. Any additional activities, required as a result of this review, will be listed as actions in future updates to this safety plan.

3 ATS TRAINING

3.1 Introduction

This section focuses on [*Name of State*] ATS training activities that are needed to ensure that operational staff is familiar with RVSM procedures. Additionally further details are provided to show how this training program supports and underpins the safe implementation of RVSM.

3.2 Safety Requirement

The safety requirement associated with the ATS training is to show that all relevant staff have been appropriately trained in RVSM procedures and are competent to operate within an RVSM environment.

3.3 Standards Applied

There are no standards. The AFI training material supplied by AFI has been used as reference guidance for the development of *[Name of State]*'s training material.

3.4 Planned ATS Training Activities

An ATS training program has been developed to support the implementation of RVSM. The details of the program are found in [*insert reference to appropriate documents*]. The detailed program subdivides into four main activities and shows that it is the intent to train all controllers licensed in RVSM airspace sectors prior to RVSM Implementation on 19 January 2006.

3.4.1 Training Roles and Responsibilities

Staff has been identified to lead, prepare and deliver RVSM training to ACC Staff. [Include *Names, staff positions and RVSM training roles*].

3.4.2 Training Material

The training material supplied by ARPO will be used as the basis for the State training material. This will be supplemented by locally developed material. All the designated instructors will become familiar with the material.

3.4.3 Training Program

A program of courses will be established at each ACC [*Names of the ACCs and summary of each training program to be included*]. The program will be developed in close co-operation with managers at each ACC. All controllers who will have operational responsibility in the AFI RVSM region (ie above FL 290) will receive this training. Other controllers and staff within the Air Traffic Provider will as a minimum be familiarise with RVSM operations and how it affects them in their duties. As far as is practical all controllers at an ACC will receive the full RVSM training. This is subject to operational and staffing constraints.

3.4.4 ACC Training Program

Courses will be run at each ACC as required. Follow-up and refresher training will be provided as needed.

3.5 RVSM Training Program Approval

There are two aspects of these training activities for which *[Name of State]* has established an approval process. These two aspects are:

3.5.1 Training Material Approval

All ATS training material is subject to strict control and changes must be approved prior to first use. The RVSM training material is subject to this process. The responsible officer for the approval of the training material is [*insert title and name of current jobholder*]. His approval is based on [*insert approval criteria*].

3.5.2 Controller Competence in RVSM Operations

The change to RVSM does not require changes to the controller's ATC license (or certificate of competence). However the ATS provider does accept the responsibility to ensure that controllers are capable of RVSM operations. To discharge this responsibility the manager of that ACC approves the RVSM training program for each ACC. Approval of the program represents a commitment from each ACC to ensure that all appropriate staff receives RVSM training and that this training makes full use of the approved training material.

3.6 RVSM Training Quality Assurance

It is important to ensure that the ATS training in RVSM operations is effective and understood by controllers. There are several elements that provide confidence in this effectiveness.

3.6.1 Use of the AFI Material as Guidance

The AFI material has been developed by Air Traffic Navigation Services (ATNS) in South Africa and has been subject to extensive review within the RVSM Program. This material forms the core of the training material developed for the State RVSM training program.

3.6.2 ATC Instructors

The responsibility for the development and delivery of the training rests with [*insert Name(s) and roles*]. They are experienced training instructors and are licensed as On-the-Job Training (OJT) Instructors. [*Further evidence of their experience may be usefully provided here*]. They are familiar with RVSM procedures. [*Insert Name(s)*] has attended the AFI Training Course on the RVSM Training material [*insert dates*]. They in turn will ensure that all the other designated instructors become familiar with, and understand, the material.

3.6.3 Training Material Review

Operational and management staff at each ACC will review the material prior to first use. The review comments will be documented and the material will be amended as appropriate.

3.6.4 Timely Training Program

The ATS provider recognizes its responsibility for the competence of controllers in operating within the AFI RVSM region. It will therefore ensure that:

- The training program allows controllers sufficient time from their operational duties to attend one of the courses,
- That accurate course attendance records are kept (including time spent on training simulators), and
- Controllers are encouraged to seek clarification, and further training if necessary, on those aspects they did not fully understand.

3.6.5 Interactive Training Program

Specific interaction will be encouraged through a course feedback questionnaire. The questionnaire will seek attendee views on the quality and ease of understanding of the course. This will be fed back to the instructors and course developers and used to further refine the course. Secondly the material will be presented in an interactive manner and interaction with attendees will be encouraged. Areas of difficulty in assimilating/understanding the material will be sought from attendees and will be addressed on an individual or group basis through further explanation and training if necessary.

3.6.6 Refresher Training

RVSM training may, through operational and staffing constraints, be provided to a controller more than 6 months in advance of RVSM. In such circumstances in the weeks prior to implementation, refresher training will be provided, so that what was learnt on the course is refreshed in the mind. [Provide d*etails of the provisions at each ACC for such refresher and follow-up training*].

3.7 ATS Training Risk Management

A key part of the management of safety is that the safety risks associated with poor or inadequate training are identified and, as appropriate, shown to be acceptably low. Within the AFI RVSM program there is commitment to perform a Functional Hazard Assessment (FHA) (which identifies hazards and assesses the risk associated with such hazards). The results of the FHA have been distributed to States. When made available, *[Name of State]* will review the hazards and risks that will have been identified by the FHA. The purpose of the review is to identify those aspects where the local circumstances are different from those assumed within the AFI FHA. Any additional activities, required as a result of this review, will be listed as actions in future updates to this safety plan.

4 ATS EQUIPMENT

4.1 Introduction

This section addresses those changes to ATS equipment required for RVSM Operations and describes the program of activities that has been established to make the required changes to ATS equipment. Additionally further details are provided to show that these changes will be completed successfully and will underpin the safe implementation of RVSM.

4.2 Safety Requirement

The safety requirement is to show that the changes to the ATS equipment have been made successfully and approved for operational use.

4.3 Standards Applied

ICAO Technical Document 7030/4 (*Include as Appendix..*) provides the standards for procedures. ARPO has developed an AFI ATC manual that is consistent with ICAO Document 7030/4 and provides further information. This latter document provides the basis for the changes to ATS equipment that are required for the AFI RVSM Region.

4.4 Planned ATS Equipment Changes

[*Name of State*] has developed a program for changes to ATS equipment to support the implementation of RVSM. The details of the program are found in [*insert reference to the National RVSM Plan*]. This detailed program shows that it is the intent to complete the ATS equipment changes well before the implementation of RVSM on 19 January 2006. [*Dates to be inserted and tight timescales requires each the State to summarize the contingency plans that have been developed to mitigate the risk of slippage in the dates*].

In [*Name of State*] changes are required to the Flight Date Processing (FDP), Radar Data Processing (RDP), Display, flightstrip and On-Line Data Interchange (OLDI) systems. Software Modifications are required to all these systems to ensure that they are compatible with the ATC Manual for RVSM.

The State ATS Provider [*insert Name of ATS Provider*] is in contract with an external supplier who will make the necessary changes to the above systems. The contractor will make the changes to the systems, and test them. Following on from the successful conclusion of these tests, the ATS provider will accept the changed software and apply to the [*State CAA*] for approval to operate with the changed software.

4.5 Approval of Activities

There are two aspects of these ATS equipment changes for which *[Name of State]* has established an approval process.

4.5.1 Modified ATS Equipment

With the exception of minor updates to software, all changes require approval from the [*State CAA*] prior to their installation at ACCs. The responsible officer is [*insert title and name*]. He will approve the changes to ATS equipment prior to installation. His approval is based on [*insert approval criteria*].

4.5.2 Modified ATS Equipment for Operational Use at ACCs.

The changes to ATS equipment need to be installed satisfactorily at each ACC. The acceptance of the installed changes is required at each ACC by the [*State CAA*]. The responsible officer is [*insert title and name*] He will approve the equipment at each ACC prior to operational use. His approval is based on [*insert approval criteria or responsible officer's terms of reference, where available and appropriate*].

4.6 Quality assurance of ATS Equipment Changes

It is important to ensure that the changes are successful, in that they fully implement the agreed requirements; and are fully compatible with the systems and practises at each ACC. There are several elements that provide confidence in the successful change to the ATS equipment:

4.6.1 Functional Requirements

Functional Requirements for the change have been established [*reference to be supplied by State*] and the delivered changes will be judged against these requirements. These functional requirements were an integral part of the specification agreed with the contractor.

4.6.2 Software Development

Contractors have development processes for software modifications needed for RVSM operations. These are internal contractor procedures and have been established for some time [*supply ref to these procedures*].

4.6.3 Developed Software

Developed software will go through a series of tests and user trials prior to acceptance. Each of the identified functional requirements will be formally tested against agreed acceptance criteria [*ref on acceptance criteria to be supplied here*].

4.6.4 The Human Machine Interface

Controllers, as part of the RVSM training, will evaluate the Human-Machine Interface (HMI). Feedback will be sought from those attending courses on the usability and clarity of the HMI.

4.7 Risk Management of ATS Equipment Changes

A key part of the management of safety is that the safety risks associated with poor or inadequate ATS equipment are identified and, as appropriate, shown to be acceptably low. Within the AFI RVSM program there is commitment to perform a Functional Hazard Assessment (FHA) (which identifies hazards and assesses the risk associated with such hazards). The results of the FHA have been distributed to States. When made available, *[Name of State]* will review the hazards and risks that will have been identified by the FHA. The purpose of the review is to identify those aspects where the local circumstances are different from those assumed within the AFI FHA. Any additional activities, required as a result of this review, will be listed as actions in future updates to this safety plan.

5 ATS PROCEDURES

5.1 Introduction

This section identifies changes required to ATS Procedures for implementation of RVSM in the AFI region and to implement new ATS procedures within each ACC. Additionally further details are provided to show how these activities underpin the safe implementation of RVSM.

5.2 Safety Requirement

The safety requirement is to show that the changes to the ATS procedures have been approved for use. Assurance is required to show that the new procedures are appropriate; do not cause excessive controller and aircrew workloads; and have been co-ordinated with other organisations.

5.3 Standards Applied

ICAO Document 7030/4 provides the standards. AFI has developed an ATC manual that is consistent with ICAO Document 7030/4 and provides further amplification of its implementation in the AFI region.

5.4 ATS RVSM Procedures

A program of activities has been established to develop and co-ordinate the changes to the ATS procedures. The details of the program are found in [*Name of State*] National RVSM Plan. The program subdivides into the following main activities:

5.4.1 State Aircraft Authorities Co-ordination

State aircraft in [*Name of State*] have no restriction on operating between flight levels FL290 and FL410 and do not require special procedures or co-ordination. State aircraft will operate within a policy of the flexible use of airspace and in co-operation with the Civil Authorities. The implementation of RVSM potentially imposes additional requirements on both State and Civil Authorities. A co-ordinating committee [*insert Name*] has been formed with these State-aircraft Authorities to ensure that satisfactory procedures are developed and that the high standards of co-operation and co-ordination continue following the Implementation of RVSM.

5.4.2 Adjacent ACC Co-ordination

The changes to procedures required for RVSM at an ACC will need to be co-ordinated with adjacent ACCs. New (or amended) letters of agreement (LoAs) are required. The Head of the ATS Provider is responsible for making the necessary agreements.

5.4.3 ATSU Operations Manual Changes

Each ACC will need to change its ATSU Operations Manual to include the changes as a result of RVSM. This is the responsibility of ACC management. The changes will include these appropriate changes due to the new LoAs, and any new agreements with the State Authorities concerning the use of RVSM airspace by State aircraft.

National Program activities recognise the links between the changes to airspace, which must precede the changes to procedures, and the development of RVSM ATC training which can only be fully completed when the new procedures are available.

5.5 Approval of ATS Procedures Changes

There are two aspects of these changes to procedure activities for which *[Name of State]* has established an approval process.

5.5.1 ATSU Operations Manual Approval

Any change to an ACC Operations Manual is subject to strict control. All changes must be approved prior to use. The responsible officer is [*insert title and name of current jobholder*]. He will approve the changes to the manual for use. His approval is based on [*insert approval criteria*].

5.5.2 ACC Amended Agreements (LoAs)

Changes to LoAs are approved (signed) by ACC managers of both centers. For ACCs within [*Name of State*] approval is based on [*insert approval criteria*].

In addition within [*Name of State*] it is policy for to require additional, more senior signatures where the Adjacent or subjacent ACC is in another State. In [*Name of State*] the Director General/CEO of the CAA signs. His approval is based on [*insert approval criteria or responsible officer's terms of reference, where appropriate*].

5.6 ATS Procedures Changes Quality assurance

It is important to ensure that the changes to ATS procedures are appropriate and have been conducted in a professional manner. There are several elements that provide confidence in this.

5.6.1 ICAO and AFI Material

ICAO Documents 7030/4, 9574 and the AFI ATC Manual for RVSM have been subject to extensive review and development and provide a definitive basis for these changes.

5.6.2 Operational Staff Review

Operational staff at each ATSU will review the ATSU Operations Manuals. The review comments will be documented and where appropriate the manual will be modified.

5.6.3 LoA Control Process

All LoAs within *[Name of State]* are subject to extensive review. Within [*Name of State*] this includes the Airspace policy staff, and ACC operational staff.

5.6.4 Procedure and Airspace Design Change Simulation

[Name of State] has a computer based simulation capability. The changes to airspace design and use of RVSM procedures will be subject to simulation. The simulation validates the use of the new RVSM procedures and changes to airspace policy. [Insert s*imulation dates, constraints and objectives*].

5.7 ATS Procedure Risk Management

A key part of the management of safety is that the safety risks associated with poor or inadequate ATC procedures are identified and as appropriate shown to be acceptably low. Within the AFI RVSM Program there is commitment to perform a Functional Hazard Assessment (FHA) (which identifies hazards and assesses the risk associated with such hazards. The results of the FHA have been distributed to States.

When made available, *[Name of State]* will review the hazards and risks that will have been identified by the FHA. The purpose of the review is to identify those aspects where the local circumstances are different from those assumed within the AFI FHA. Any additional activities, required as a result of this review, will be listed as actions in future updates to this safety plan.

6 AIRSPACE DESIGN

6.1 Introduction

This section addresses airspace design activities needed to ensure safe and effective RVSM operations. Additionally further details are provided to show how these airspace changes underpin the safe implementation of RVSM.

6.2 Safety Requirement

The safety requirement associated with the changes to airspace design is to show that the changes are appropriate and are consistent with the safe operation of RVSM in the AFI region.

6.3 Standards Applied

Whilst it is best practice to simulate such changes to show both the impact on traffic flows and controller workload, there are no applicable standards for evaluating proposed changes.

6.4 Planned Airspace Design Changes

A program for airspace design changes has been developed to support the implementation of RVSM. The details of the program are found in [*Name of State*] National RVSM Plan. There are several changes to the design of airspace that have been proposed to support the effective implementation of RVSM. These include:

(a) Changes to entry, reporting and exit points to minimise possible congestion at these points;
(b) Changes to **DFL**, if it is currently an RVSM level;
(c) A new flight level allocation scheme;
(d) Re-sectorisation of the upper airspace to allow the capacity in the upper airspace to increase to take advantage of the new RVSM levels;
(e) Some modifications to allow more direct routings.

Some of these changes need to be agreed with ACCs in adjoining states and are reflected in the LoA change process described in section 5.3 above.

6.5 Approval of Airspace Design Changes

There are two aspects of these airspace design activities for which *[Name of State]* accepts responsibility and has established an approval process.

6.5.1 Approval of the Changes

All airspace design issues are subject to strict change control and must be approved prior to first use. The responsible officer [*insert title and name of current jobholder*] will approve the changes. His approval is based on [*insert approval criteria*].

6.5.2 Changes Included in the LoAs as Necessary

This approval process is described above in section 5.5.

6.6 Airspace Design Quality Assurance

It is important to ensure that the changes to airspace design are effective. There are several elements that provide confidence in this effectiveness.

6.6.1 Use of Simulations

Simulations have been performed [*insert ref here*]. The studies show that the airspace design changes are effective within simulations of RVSM Operations. The simulation shows that controllers can safely handle RVSM operations.

6.6.2 Review Airspace Changes

The proposed airspace design changes receive extensive review by management staff within each of the ACCs. The review comments will be documented and where appropriate the manual will be modified.

6.7 Airspace Design Change Risk Management

A key part of the management of safety is that the safety risks associated with poor or inadequate changes to airspace design are identified and as appropriate shown to be acceptably low. Within the AFI RVSM program there is commitment to perform a Functional Hazard Assessment (FHA) (which identifies hazards and assesses the risk associated with such hazards). The results of the FHA are currently not available to the States. When made available, *[Name of State]* will review the hazards and risks that will have been identified by the FHA. The purpose of the review is to identify those aspects where the local circumstances are different from those assumed within the AFI FHA. Any additional activities, required as a result of this review, will be listed as actions in future updates to this safety plan.

7 RVSM SWITCHOVER

7.1 Introduction

Switchover is the operational process of managing the actual conversion of ATS from a 2000-ft separation (CVSM) environment to a 1000-ft (RVSM) environment. It covers the changes in the few hours before switchover on 19 January 2006 and the first few hours after the switchover. This switchover is the key operational aspect of the countdown to the implementation of RVSM. This section confirms that the operational impact of switchover to RVSM has been addressed and contingency plans exist. Details are provided to show how this changeover activity supports and underpins the safe implementation of RVSM.

7.2 Safety Requirement

The safety requirement is to show that the special procedures for the switchover to RVSM have been approved for use. Assurance should be provided to show that procedures and reversionary modes of operation are in place.

7.3 Applied Standards

[Name of State] will use the AFI RVSM countdown plan as the basis for its own countdown plan. (*Include as Appendix ..*).

7.4 Planned Switchover

Activities need to be planned to enable the safe and effective switchover to RVSM. The details of these planning actives are found in [*insert ref*]. The plan assumes that the AFI countdown activities will identify the optimum way to handle the switch from CVSM to RVSM. *[Name of State]* planning activity focuses on the establishing information and special procedures for its ACCs and establishing suitable arrangements and staffing levels for the switchover period.

7.5 Approval of Switchover Plans

There is one aspect of this switchover for which *[Name of State]* accepts responsibility and has established an approval process.

7.5.1 Approval of Special Procedures Developed for each ACC

These special ATS procedures (to cover switchover) will require approval prior to use just like any other ATS procedure. The responsible officer is [*insert title and name of current jobholder*]. He will approve the material for use and the approval is based on [*insert approval criteria*].

7.6 Switchover Quality Assurance

It is important to ensure that the planning for switchover is effective. There are several elements that provide confidence in this effectiveness.

7.6.1 AFI Countdown Material

The AFI material on the countdown process is being developed and the switchover aspects are an identified key part of the countdown process. This AFI material has been subject to extensive review.

7.6.2 Review of Switchover Procedures

Operational and management staff at each ACC will review the material. The review comments will be documented and the material will be amended as appropriate.

7.7 Switchover Risk Management

A key part of safety management is that the safety risks associated with the switchover are identified and shown to be acceptably low. Within the AFI RVSM program there is commitment to perform a Functional Hazard Assessment (FHA) (which identifies hazards and assesses the risk associated with such hazards). The results of the FHA have been distributed to States. *[Name of State]* will review the hazards and risks that will have been identified by the FHA. The purpose of the review is to identify those aspects where the local circumstances are different from those assumed within the AFI FHA. Any additional activities, required as a result of this review, will be listed as actions in future updates to this safety plan.

8 RVSM OPERATIONAL SAFETY MONITORING AND REVIEW

8.1 Introduction

This section identifies activities required for post-implementation monitoring of the safety performance of RVSM operations by *[Name of State]*.

8.2 Safety Requirement

The safety requirement is to provide appropriate monitoring of the operational safety performance of the ATS in the application of RVSM.

8.3 Applied Standards

There are no appropriate standards.

8.4 Monitoring Activities

The post-implementation monitoring arrangements are not yet determined. This determination is part of the establishment of post-implementation arrangements. In [*Name of State*] this will be considered as one aspect of the development of national countdown arrangements.

There are two key activities:

(a) ATS Performance Safety Monitoring

These arrangements will be a specific aspect of the normal monitoring of safety performance by the State.

(b) Operational Error Reporting

[Name of State] commits to providing operational error data reported by controllers in its ACCs. The State already supplies this information as part of its contribution to the AFI Pre-Implementation Safety Case. The data supplied is used, together with data from the other RVSM states, to assess the likely risk of collision in AFI RVSM region. In addition *[Name of State]* will assess this data provided by its own ACCs and act on the evidence as appropriate.

8.5 Approvals

The approval process for the establishment of such monitoring arrangements is not yet determined.

8.6 Quality Assurance

[Name of State] will develop monitoring arrangements that achieve the safety requirement to monitor operational performance. However, as the arrangements have not yet been determined, it is not possible to identify requirements at present as to the aspects of these arrangements that give confidence in the achievement of quality.

8.7 Risk Management

Monitoring arrangements will help manage operational risks and do not introduce additional risks.

RVSM IMPLEMENTATION READINESS ASSESSMENT SURVEY: AFI REGION

State	

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
	RVSM Implementation Program					
1. RVSM Implementation Program – Target Date 19 January 2006	Is the National RVSM Implementation plan/Program harmonized with the AFI RVSM Regional Implementation Plan?					Conclusion: ARTF 4/5
	Has your administration developed an RVSM aircraft and operators approval program?					Conclusion: ARTF 4/7
	Has your Administration submitted a National RVSM Implementation plan/Program to ICAO Regional Program Office?					Conclusion: ARTF 4/11 National RVSM Plan
	Has the National RVSM Implementation plan/Program taken into account the users requirements?					Doc. 9574 Chapter 3 National RVSM Plan
	Has the administration determined the RVSM status of the national fleet?					Doc. 9574 Chap 3 Conclusion: ARTF 4/11 & ARTF 4/12
	Has your administration disseminated the National RVSM Implementation Program to all stakeholders?					Conclusion: ARTF 4/11 National RVSM Plan
	Has the administration designated the National Program Manager for the RVSM implementation program?					Conclusion: 4/3 National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
	RVSM Implementation Program					
	Has your administration designated an ATS Manger responsible for the ATM RVSM Sub-program?					National RVSM Plan
	Has your administration designated a Manager responsible for aircraft OPS/Airworthiness sub-program?					National RVSM Plan
	Has the administration designated a Manager responsible RVSM Safety Sub-Program?					Conclusion: 4/18 National RVSM Plan
	Will RVSM be implemented in the airspace on the date agreed upon by AFI?					Conclusion : ARTF 4/5
	Has your administration published the procedures to accommodate aircraft in RVSM airspace?					Conclusion: ARTF 4/11 National RVSM Plan
	Has your administration made provision to accommodate non-RVSM State aircraft in RVSM airspace?					Conclusion: ARTF 4/9 ICAO Doc 7030/4 National RVSM Plan
	Have national rules/regulations been developed/published for RVSM implementation?					Conclusion: ARTF 4/8

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
	RVSM Implementation Program					
	Has your administration assess the impact of RVSM implementation on controller automation systems and plan for upgrades/ modifications?					Conclusion: ARTF 4/11 National RVSM Plan
	Have documents related with RVSM approval of aircraft and operators of the JAA Temporary Guidance Leaflet (TGL) 6 y/o FAA Document 91 RVSM been adopted?					Conclusion: ARTF 4/7
	Has the RVSM Advisory Circular been adopted for RVSM approval of aircraft and operators?					Conclusion: ARTF 4/7
	Has your Administration established National RVSM approved Aircraft Database?					Doc. 9574 Conclusion: ARTF 4/4
	Are RVSM approvals granted to aircraft and/or operators registered in your State?					Conclusion: ARTF 4/12
	Is a letter of Authorization issued when RVSM approval to individual aircraft granted?					
	Has AFI Regional monitoring Agency (ARMA) form been completed to communicate the status of RVSM approval or withdrawal to ARMA?					Conclusion: ARTF 4/4

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
	RVSM Implementation Program					
	Has the Guidance material on the implementation of a 300 M (1000 FT) vertical separation minimum between FL290 and FL410 inclusive for application in the airspace of the AFI Region been adopted?					Conclusion: ARTF 4/4
	Has National RVSM implementation legislation been published?					Doc. 9574 Conclusion: ARTF 4/8
	Has the AIC been published in advance informing stakeholders of the date for RVSM implementation?					Conclusion: ARTF 4/11
	Is the administration disseminating RVSM legislation and documentation through adequate means?					Conclusion: ARTF 4/11
	Has the Guidance material on the implementation of a 300 M (1000 FT) vertical separation minimum between FL290 and FL410 inclusive for application in the airspace of the AFI Region been adopted?					Conclusion: ARTF 4/4
	Has your administration analysed the impact that would have in RVSM implementation if the required documentation were not taken into account?					Conclusion: ARTF 4/18

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
	Operations & Airworthiness					
2. RVSM Operations &Airworthiness	Has your administration implemented the National RVSM Operator/ Aircraft approval Program?					Doc. 9574 Chapter 4.2 Conclusion: ARTF 2/8 & ARTF 4/11
	Does the program cover aircraft airworthiness certification (approval of modifications and major repairs) and operational separately?					Doc. 9574 Chapter 4 National RVSM Plan
	Will the program be completed before the RVSM implementation date 19 January 2006?					National RVSM Plan Conclusion: APIRG 14/21
	Has your Administration adopted TGL6 Revision 1 for approval of operators/aircraft for RVSM Operations?					Doc. 9574 Chapter 4 Conclusion: ARTF 4/7
	Has your administration published the National RVSM Operator/ Aircraft approval Legislation?					Doc. 9574 Chapter 4 Conclusion: ARTF4 2/8 & ARTF 4/8
	Has your administration published the required maintenance program to ensure RVSM airworthiness?					Doc. 9574 Chapter 5 National RVSM Plan
	Has your administration developed a Database for RVSM approved aircraft?					Doc. 9574 Chapter 5 Conclusion: ARTF4 4/11 National RVSM Plan
	Has your administration completed a RVSM approved aircraft readiness assessment?					Conclusion: ARTF4 4/12

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Operations & Airworthiness						
3. RVSM Operations & Airworthiness Training	Has an RVSM training program been prepared for OPS/Airworthiness personnel?					Doc. 9574 Chapter 4/5 Conclusion: ARTF 4/6 & ARTF 4/11
	Does the program cover aircraft airworthiness certification (approval of modifications and major repairs) and operational (procedures approval and operator training program) separately?					Doc. 9574 Chapter 4 Conclusion: ARTF 4/7
	Will the program be completed before the RVSM implementation date 19 January 2006? If such were the case, the finalization of the training program?					Conclusion: APIRG 14/21
	Does the program have the RVSM training material in OPS/ Airworthiness areas?					
	Which documentation did the administration use to prepare RVSM training material?					
	Has the training material been approved by the corresponding authority?					

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Operations & Airworthiness						
	How many phases are envisaged for the training?					
	Has OJT been foreseen and completed before RVSM implementation date?					
	Does the administration make sure that personnel training is appropriate and carried out in a professional manner?					
	Do OPS/Airworthiness instructors have sufficient experience?					
	Are the OPS/Airworthiness instructors used for training qualified to provide on the job training (OJT)?					
	Can the administration assure that the necessary time for an appropriate training was used or will be used?					
	Does training include the establishment of adequate refresher courses, if necessary?					
	Has the administration analysed the impact that would have in RVSM implementation if the requirements for personnel training were not taken into account?					

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Air Traffic Management						
4. Modification in the Airspace Structure	Has your Administration implemented your RVSM National Plan?					Conclusion: ARTF 4/3 National RVSM Plan
	Will your Administration implement RVSM in the Airspace as identified by AFI?					
	Has your administration identified new entry/exit points to RVSM airspace?					Doc. 9574 National RVSM Plan
	Has your administration identified modifications to the existing route network?					Doc. 9574 National RVSM Plan
	Has your administration designated transition airspaces between RVSM and non-RVSM airspaces?					Doc. 9574 National RVSM Plan
	Has your administration identified Modifications in airspace sectorization for RVSM purposes?					Doc. 9574 Chapter 5 Conclusion: 2/13
	If such were the case, was the airspace structure subject to simulations?					Doc. 9574 National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Air Traffic Management						
5. ATC Procedures	Has your administration identified changes in civil/military coordination?					Doc. 9574 Chapter 5 Conclusion: ARTF 4/2
	Does you administration consider air traffic flow management for your State?					
	Has the administration adopted the Cruise Levels Table of Appendix to ICAO Annex for the assignment of cruise levels in RVSM airspace?					Annex 2 Conclusion : ARTF 2/13
	Has the administration adopted adequate national contingency procedures?					Doc. 9574 Chapter 5 ICAO Doc 7030/4 Conclusion: ARTF 4/9 National RVSM Plan
	Have the procedures been duly supervised in order not to affect the safety in air operations?					Doc. 9574 Chapter 3
	Has ICAO guidance material been used in the preparation of procedures?					Conclusion: ARTF 2/13 National RVSM Plan
	The procedures and associated phraseology been included in the operational manual of the ATS unit?					Doc. 9574 Chapter 5 Conclusion: ARTF 2/13 National RVSM Plan
	Has ATC procedures been reviewed with operational personnel from ATC units?					Doc. 9574 Chapter 5 Conclusion: ARTF 3/6 National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Air Traffic Management						
	Have the procedures affecting adjacent ATS been duly coordinated, approved and included in the letters of operational agreement?					Doc. 9574 Chapter 5 Conclusion: ARTF 4/11 National RVSM Plan
	Have ATC procedures and associated phraseology been subject to simulations?					Doc. 9574 Chapter 5 Conclusion : ARTF 3/6 National RVSM Plan
	Are RVSM ATC procedures being disseminated by the adequate means?					Conclusion: ARTF 4/11
	Has the administration analysed the impact it would have in RVSM implementation if the changes required have not been taken into account?					Doc. 9574 Chapters 3/5. National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Air Traffic Management						
6. ATC Equipment	Does your administration has a modification plan of ATC equipment as a result of RVSM?					Doc. 9574 Chap. 5 Conclusion: ARTF2/13 National RVSM Plan
	Has your administration ensured that modifications in ATC equipment are appropriate?					Doc. 9574 Chap. 3 Conclusion: ARTF 4/11
	Do changes circumscribe to FDPS?					Doc. 9574 Chap. 3 National RVSM Plan
	Do changes circumscribe to RDPS?					Doc. 9574 Chap. 3 National RVSM Plan
	Do changes circumscribe to visualizing?					Doc. 9574 Chap. 3 National RVSM Plan
	Do changes circumscribe to STCA?					Doc. 9574 Chap. 3 National RVSM Plan
	Do changes circumscribe to MTCA?					Doc. 9574 Chap. 3 National RVSM Plan
	Do changes circumscribe to the systems software?					Doc. 9574 Chap. 3 National RVSM Plan
	Do changes circumscribe to ATC simulators?					Doc. 9574 Chap. 3 National RVSM Plan
	Does your administration have a contingency plan in case of delays in case of suffering delays in ATC equipment updating?					Doc. 9574 Chap. 5

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Air Traffic Management						
7. RVSM ATCO Training	Has an RVSM training program been prepared for ATCOs?					Doc. 9574 Chap. 5 Conclusion: ARTF 3/6
	Is the program addressed for all ATC personnel?					Doc. 9574 Chap. 5 Conclusion: ARTF4/11
	Shall the program be completed before the RVSM implementation dated 19 January 2006? If such were the case, indicate finalization date of training program.					Conclusion: APIRG 14/21 Doc. 9574 Chap. 5 National RVSM Plan
	Does the program contemplate aspects related with the responsibilities of ATCOs?					Doc. 9574 Chap. 5 National RVSM Plan
	Does the program have RVSM training material?					Doc. 9574 Chap. 5 Conclusion: ARTF2/13 National RVSM Plan
	Which documentation did the administration use to elaborate RVSM?					Doc. 9574 Chap. 5 National RVSM Plan
	Has the training material been prepared under strict control and approved by the Operational Unit or the corresponding training centre?					Doc. 9574 Chap. 5 Conclusion: ARTF 3/6 National RVSM Plan
	Has OJT been programmed? When will this program end?					Doc. 9574 Chap. 5 National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
Air Traffic Management						
	Does the administration ensure that the personnel training is appropriate and is carried out professionally?					Doc. 9574 Chap. 5 National RVSM Plan
	Do instructors have training and sufficient knowledge of RVSM Operations and do/did they have experience enough?					Doc. 9574 Chap. 5 National RVSM Plan
	Are instructors used in training or were they qualified to provide OJT training?					Doc. 9574 Chap. 5 National RVSM Plan
	May the administration ensure that the necessary time is or was used for an appropriate training?					Doc. 9574 Chap. 5 National RVSM Plan
	Does your administration foresee to establish adequate refreshing courses?					Doc. 9574 Chap. 5 National RVSM Plan
	Has your administration analysed the impact it would have in RVSM implementation if no personnel training requirements were taken into account?					Doc. 9574 Chap. 5 National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
RVSM Safety Assurance						
8. RVSM Safety Assurance from FL 290 to FL 410 inclusive	Has your Administration implemented your RVSM National Safety Plan?					Doc. 9574 Chap. 3 Conclusion: ARTF 4/18 & ARTF 4/19
	Is the National RVSM Safety plan harmonized with the AFI RVSM Safety Policy?					Conclusion: ARTF 4/11
	Has your Administration submitted a National RVSM Safety plan to ICAO Regional Program Office?					Conclusion: ARTF 4/11
	Has your Administration informed National Operators of RVSM Implementation requirements?					National RVSM Plan
	Has your Administration adopted TGL6 Revision 1 for approval of operators/aircraft for RVSM Operations?					Doc. 9574 Chapter 3 Conclusion: ARTF 4/7
	Has your administration implemented the National RVSM Operator/ Aircraft approval Program?					Doc. 9574 Chap. Conclusion: ARTF 4/12
	Has your administration disseminated the National RVSM Implementation Program to all stakeholders?					Conclusion: ARTF4/11
	Has your administration implemented the National RVSM ATS Training Program?					ICAO Doc 7030/4 Conclusion: ARTF 2/7 & ARTF 4/6 National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
RVSM Safety Assurance						
	Has your administration published guidelines for RVSM Pilot Training?					Conclusion: ARTF 4/11 National RVSM Plan
	Has your administration developed a program for changes to ATC equipment to support the implementation of RVSM?					Conclusion: ARTF 4/11 National RVSM Plan
	Has the changes to ATS Equipment satisfactorily been installed?					Conclusion: ARTF4/17 National RVSM Plan
	Has the changes to ATS Procedures been approved?					Conclusion: ARTF 4/5 & 4/17
	Has your administration published the procedures to accommodate aircraft in RVSM airspace?					Conclusion: ARTF 4/8 & 4/9 National RVSM Plan
	Has the ATC Manual been approved?					Conclusion: ARTF 2/7 & ARTF4/11 National RVSM Plan
	Is the ATC Manual consistent with ICAO Doc 7030/4?					Conclusion: ARTF 4/9
	Has your administration coordinated the procedures required for RVSM at the ACC with adjacent ACCs?					

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
RVSM Safety Assurance						
	Has your administration amended the required Letters of Agreement (LoA) with adjacent ACCs for RVSM Operations?					Conclusion: ARTF 4/11
	Has the ATSU Operations Manual been amended to include changes as a result of RVSM?					
	Has your administration approved the changes to airspace design to support the implementation of RVSM?					
	Has your administration developed special procedures to enable safe switchover to RVSM?					
	Has your administration developed a program for ATC to report operational data errors?					Conclusion: ARTF 4/4

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
RVSM Monitoring						
9. RVSM Operations Monitoring	Has the administration established adequate measures so that there is a monitoring before, during and after RVSM implementation in order to verify that the safety level is met?					Annex 11 Para. 2.26 Conclusion: ARTF 2/1 Conclusion: ARTF 4/4 National RVSM Plan
	Does the administration demand the operators/users the presentation of a monitoring program of aircraft for its approval?					
	Has the administration implemented a data collection program of large height deviations (LHD)?					Conclusion: ARTF 4/4
	Is this information submitted to ARMA monthly basis?					Conclusion: ARTF 4/4
	Is there a database with such information?					Conclusion: ARTF 4/4 National RVSM Plan
	Has the administration implemented a monthly data collection program for errors in the ATC communications circuit?					Doc. 9574 Chapter 5 National RVSM Plan
	Does the administration have a database with such information?					Conclusion: ARTF 4/4
	Is the information submitted to ARMA on the total of IFR movements on a monthly basis?					Conclusion: ARTF 4/4

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
RVSM Monitoring						
	Is there a database with such information?					Conclusion: ARTF 4/4
	Is information related to turbulence reports submitted to ARMA?					Conclusion: ARTF 4/4
	Is there a database with such information?					Conclusion: ARTF 4/4
	Has the administration established a continuous monitoring of the system?					Annex 11 para. 2.26 Doc. 9574 Chapter 6
	Has the administration assessed the impact that the lack of a continuous monitoring program and RVSM operations monitoring would have in air safety?					National RVSM Plan

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
RVSM Switch-Over						
10. RVSM Switchover	Has your administration adopted or will it adopt the measures to ensure a safe and effective transition to RVSM?					Doc. 9574 Chapter 5 National RVSM Plan Conclusion: ARTF4/11
	Have special procedures been established for the switchover period?					Doc. 9574 Chapter 5 National RVSM Plan
	Are contingency plan adequate for the switchover period?					Doc. 9574 Chapter 5 National RVSM Plan
	Has the administration foreseen the information process to ARMA during the next tour for RVSM implementation?					Doc. 9574 Chapter 5 National RVSM Plan
	Has the administration foreseen the information process to ARMA during the following 12 and 24 hours after RVSM implementation?					Doc. 9574 Chapter 5 National RVSM Plan)
	Has the administration assessed the impact that the lack of an RVSM transition plan and associated contingency measures could have in safety?					National RVSM Plan.

SUBJECT	ITEMS ASSESSED	TD	DC	NA	REMARKS	Ref. ICAO Regional/National Doc
RVSM Resources						
11. Assignment of Resources for the Implementation of RVSM program	Have adequate measures been adopted in order to have the necessary resources for a successful RVSM implementation?					Conclusion: ARTF 4/11 National RVSM Plan
	For changes in ATC equipment?					Conclusion: ARTF 4/17 & 4/18
	For personnel training and associated material?					Conclusion: ARTF 4/17 & 4/18
	For training of OPS/Airworthiness inspectors?					Conclusion: ARTF 4/17 & 4/18
	To face administrative costs?					National RVSM Plan
	Has the administration evaluated the impact that the lack of assignment of sufficient resources in the RVSM national implementation program would have in air safety?					National RVSM Plan

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STATUS OF AFI RVSM STATES RVSM READINESS SURVEY

STATES	NPM	AIC	LOA	State Plan	AFI Safety Policy	ATC Manual	AC RVSM Readiness	ATC Training	Pilot Training	State AC Approval	Legislation	Safety Forms	Doc 7030	Military Ready	Seminar
Algeria	Y	Y					Y	Y				Y			Y
Angola	Y	Y					Y	Y				Y			Y
Benin		Y										Y			
Botswana	Y						Y	Y							Y
Burkina Faso		Y										Y			
Burundi												Y			
Cameroon	Y	Y					Y	Y				Y			Y
Cape Verde												Y			
Central African Republic		Y										Y			
Chad		Y										Y			
Congo		Y										Y			
Comores		Y										Y			
Cote d'Ivoire		Y													
DRC	Y											Y			
Djibouti	Y	Y										Y			Y
Egypt	Y											Y			Y
Ethiopia	Y	Y					Y	Y				Y			Y
Eritrea	Y	Y						Y				Y			
Equatorial Guinea		Y										Y			
Gabon	Y											Y			Y
Gambia	Y	Y						Y				Y			
Ghana	Y							Y				Y	Y		Y
Guinea		Y													
Guinea Bissau												Y			
Kenya	Y	Y						Y							Y
Lesotho	Y											Y	Y		

STATUS OF AFI RVSM STATES RVSSM READINESS SURVEY

STATES	NPM	AIC	LOA	State Plan	AFI Safety Policy	ATC Manual	AC RVSM Readiness	ATC Training	Pilot Training	State AC Approval	Legis lation	Safety Forms	Doc 7030	Military Ready	Seminar
Liberia	Y	Y						Y				Y			
Libya															
Madagascar	Y	Y					Y					Y			Y
Mali	Y	Y										Y			
Malawi	Y							Y				Y			
Mauritius	Y	Y		Y			Y	Y							Y
Morocco	Y	Y										Y			
Mozambique	Y							Y				Y			Y
Namibia	Y							Y				Y			
Niger	Y	Y										Y			
Nigeria	Y	Y		Y				Y				Y			Y
Réunion	Y											Y			
Rwanda	Y	Y						Y				Y			
Sao Tome and Principe	Y														Y
Senegal	Y	Y										Y			Y
Seychelles	Y														
Sierra Leone	Y														
Somalia (CACAS)	Y							Y							Y
South Africa	Y	Y					Y	Y				Y			Y
Sudan	Y	Y		Y	Y	Y		Y							
Swaziland	Y	Y						Y				Y			
Tanzania	Y	Y		Y			Y	Y				Y			Y
Tunisia	Y	Y		Y											
Togo	Y	Y										Y			
Uganda	Y	Y					Y	Y				Y			
Zambia	Y	Y										Y			Y
Zimbabwe	Y	Y					Y	Y				Y			Y

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Version 0.1 - 12/05/05
by TLE, JLA, RBE, RRA

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AFI RVSM PROGRAMME

FUNCTIONAL HAZARD ASSESSMENT

APPROVAL

	Name	Fonction	Date / Visa
Written by	Thierry LELIEVRE Julien LAPIE Richard BEAULIEU Rodolphe RATTIER	ALTRAN TECHNOLOGIES AFI RVSM FHA Project Team	12/05/2005
Revised by			
Approved by			

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Document change record

The following table records the complete history of the successive editions of the present document:

Edition	Date	Reason for change	Sections / Pages affected	Author(s)
0.1	12/04/05	Draft issue for initial review Circulated to AFI RVSM Task Force Members for comments	All	ALTRAN TECHNOLOGIES AFI RVSM FHA project team: - Thierry LELIEVRE - Julien LAPIE - Richard BEAULIEU - Rodolphe RATTIER

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1. INTRODUCTION

1.1. Purpose

This document constitutes the **Functional Hazard Assessment (FHA)** developed for the **AFI Reduced Vertical Separation Minima (RVSM) Programme**.

The FHA is part of the overall activities of the RVSM Safety Sub-Programme and constitutes one of the main deliverables required by the AFI RVSM Safety Policy **[1]**.

1.2. Background

In 2001, APIRG/13 endorsed the objectives of capacity and potential economy benefits associated with future implementation of a 1 000 ft reduced vertical separation minimum in the AFI Region and, therefore, conclude that such implementation planning should be progressed as a priority item.

It was recognized that a number of complex issues need to be addressed, including meteorological and topographical considerations, aircraft equipment and air traffic control questions and that the successful and timely implementation of RVSM would be dependent on the establishment of a Program Office to act as the RVSM Implementation focal point and to report to the AFI RVSM Task Force (ARTF).

APIRG/14 mandated the ARTF to develop a strategy plan for RVSM implementation in the Region. The AFI RVSM Strategic Action Plan **[4]** was indeed developed by the TF/2. It can be summarised into five sub-programs, including the Safety Assurance sub-program which aims to undertake all the necessary activities to ensure that the agreed safety objectives are met. These AFI RVSM Safety objectives are developed in the AFI RVSM Safety Policy which safety regulate the RVSM Program.

The safety policy requires six major deliverables :

- the Safety Policy itself
- the Functional Hazard Assessment (FHA)
- the Collision Risk Assessment (CRA)
- the National Safety Plans (NSP)
- the Pre-Implementation Safety Case (PISC)
- the Post-Implementation Safety Case (POSC)

The FHA results will be used as inputs to the PISC and the NSPs as appropriate. The PISC aims to provide the assurance that the Safety Objectives stated in the policy are achieved. It will require approval by the ICAO Air Navigation Council (ANC).

1.3. AFI RVSM FHA scope

The AFI RVSM Safety Policy **[1]** requires the AFI RVSM FHA "to look at the whole RVSM concept" and to cover :

- The situation that RVSM is operational one year after its introduction: the AFI RVSM Core Airspace
- The particular situation in States which have to ensure the transition between RVSM and non-RVSM airspaces: the AFI RVSM Transition Airspace
- The change-over on the day of RVSM introduction : the AFI RVSM Switch-over period

Since the CAR/SAM Region has introduced RVSM in January 2005, the AFI Region is the last ICAO Region to move towards RVSM, meaning that transition airspaces are no longer needed.

The initial scope of the FHA has thus been amended during the project in accordance with ICAO and the AFI RVSM Monitoring Agency (ARMA):

The AFI RVSM FHA covers:

- ✈ **"The AFI RVSM Core Airspace"** which addresses RVSM operations in a mature situation;
- ✈ **"The AFI RVSM Switch-Over Period"** which addresses the specific period of time of 24 hours before and after the T0.

The work completed for the transition airspaces is not included in this report and is available on the report of the initial brainstorming session **[12]**.

1.4. AFI RVSM FHA Objectives

The main objectives of the AFI RVSM FHA are to:

- ✈ Identify and classify all **hazards and risks associated with RVSM**;
- ✈ Specify the **AFI RVSM FHA Safety objectives** related to the hazards identified;
- ✈ Specify the **AFI RVSM FHA Safety requirements** to be met by the AFI RVSM System;
- ✈ Allocate the safety requirements to the high-level elements of the AFI RVSM System

The AFI RVSM system consists of the AFI Air Navigation System elements involved in RVSM operations, a 'system' being considered to consist of three elements: people, equipment and procedures.

It should be noted that the demonstration of compliance of the System elements to the safety requirements is out of scope of the AFI RVSM FHA.

1.5. Approach and methodology

The AFI RVSM FHA was developed in compliance with the **Safety Assessment Methodology** (SAM methodology) **[18]** developed by the EUROCONTROL Safety & Quality Management and Standardisation Unit.

Referring to the SAM process:

The **AFI RVSM FHA** consists of :

✈ the **SAM Functional Hazard Analysis** and of,

✈ the first steps of the **SAM Preliminary System Safety Assessment**

Indeed, the risk mitigation strategy et the allocation of the requirements, that correspond to the first steps of the SAM PSSA, are part of the AFI RVSM FHA objectives.

The methodology applied for the AFI RVSM FHA and the links with the SAM process are provided in **Annex C**. The associated traceability framework is presented in **Annex F**.

1.5.1. Overall Inputs

1.5.1.1. System Description

At the beginning of the AFI RVSM FHA project, no description of the AFI RVSM System and of the associated concept of operations were available.

The high-level description of the AFI RVSM System developed during the project is presented in **section 3**.

Operational scenarios and associated operating methods that reflect how RVSM will be operated have been developed by the ALTRAN TECHNOLOGIES team and agreed during brainstorming sessions. They are presented in **Appendix C**.

In addition, assumptions have been made on the System. They are provided in **section 2**.

1.5.1.2. Operational Environment Description (OED)

At the beginning of the project, no basic description of the current system and of the associated environment was available.

The environment has been described through “environmental types” that have been developed by the ALTRAN TECHNOLOGIES team and agreed during brainstorming sessions. They are presented in **section 3**.

In addition, assumptions have been made. They are provided in **section 2**.

1.5.1.3. Regulatory Framework

The process is based on two main inputs that are the **Severity Classification and Risk Classification Schemes**.

They provide respectively:

- the framework to assign a severity class to a given hazard according to its effects on the safety of RVSM operations
- the risk tolerance criteria by giving the coherence between severity classes and safety objectives.

These schemes have been approved by the AFI RVSM TF/5 of November 2005 and are respectively presented in **Annex D** and **Annex E**.

1.5.1.4. Applicable standards

Applicable standards are provided in **Annex A.2**.

1.5.1.5. Other inputs

Documents from other RVSM programmes have been used as reference documents. They are presented in **Annex A.**

1.5.2. Brainstorming sessions

Main of the tasks have been carried out during structured brainstorming sessions attended by a various ranges of experts who will be involved in the AFI RVSM operations.

The following figure presents these tasks and the links with ALTRAN Technologies analysis:

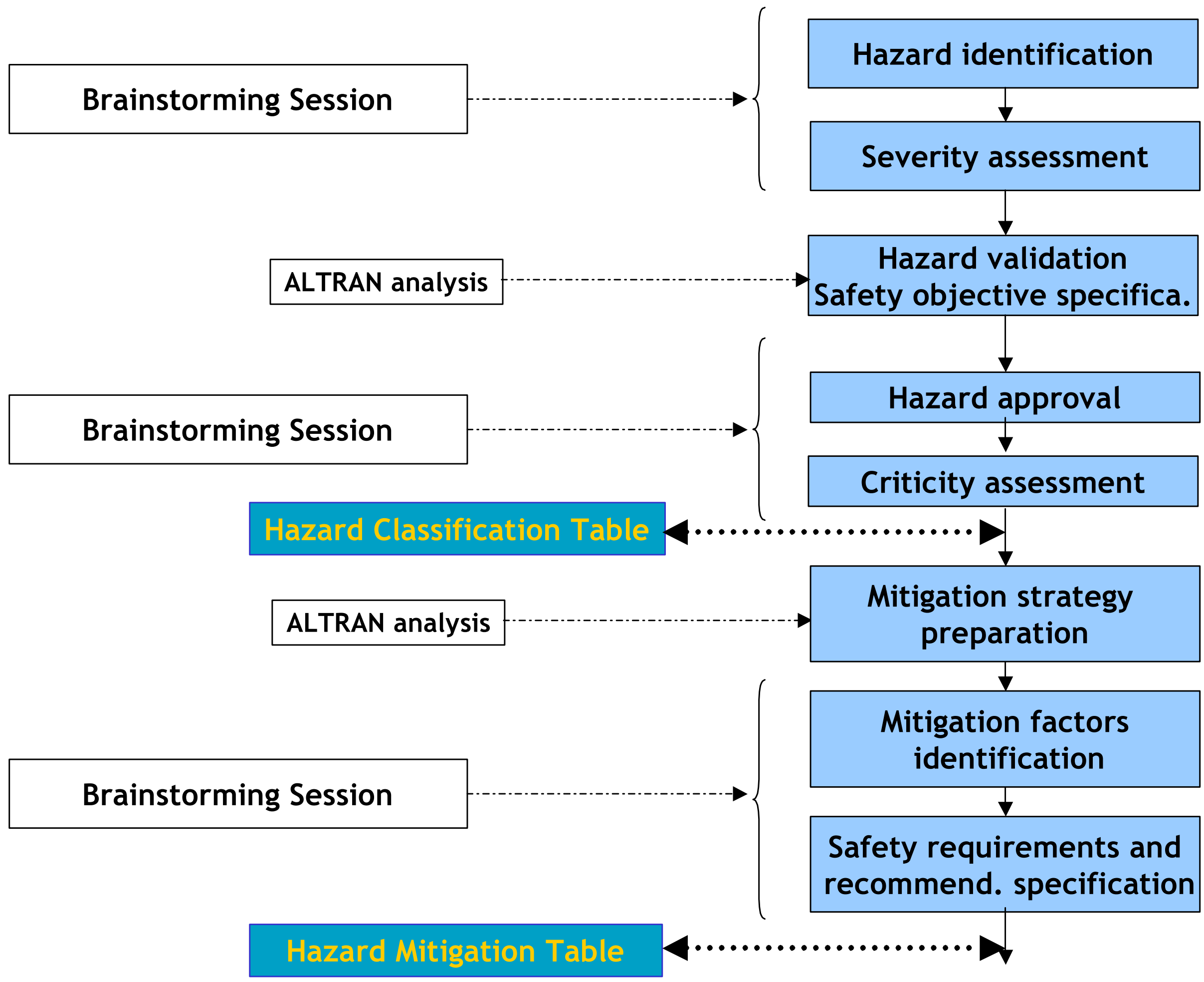

Figure 1: Methodological framework (brainstorming sessions)

The **Appendix A** describes how these sessions have been prepared and performed. The composition of the brainstorming group is provided in **Appendix B**.

1.5.3. AFI RVSM FHA outcomes

The AFI RVSM FHA outputs:

- Regarding the **Hazard Assessment Process:**
  - The classification of the identified hazards
  - The AFI RVSM FHA Safety Objectives

The hazards identified, their severity classes and assigned safety objectives are presented in the **Hazard Classification Tables** in **Appendix D.**

- Regarding the **Risk mitigation Strategy:**
  - The AFI RVSM FHA Safety Requirements
  - The allocation of the AFI RVSM Safety Requirements to the high-level elements of the AFI RVSM System
  - A list of safety recommendations

The safety requirements and recommendations and their associated mitigation factors are presented in the **Hazard Mitigation Tables** provided in **Appendix E**.

The allocation of the safety requirements is presented in the **Allocation Tables** provided in **Appendix F**.

The allocated safety requirements constitute the main results of the AFI RVSM FHA. They constitutes the minimum requirements to be satisfied by the AFI RVSM system elements. They will be used as input where appropriate for the PISC and for the National Safety Plans, which aim to provide evidence of satisfaction.

All these results are described and discussed in **Section 4** for the AFI RVSM Core Airspace and in **section 5** for the AFI RVSM Switch-Over Period.

As the Switch-Period assessment objectives is to focus only on the initial implementation problems, all results of the core airspace are applicable to the Switch-Over period.

1.6. Structure of the document

The document is structured as follows:

- Section 1 provides an introduction
- Section 2 provides an high-level description of the AFI RVSM System
- Section 3 describes the AFI RVSM environmental types specified
- Section 4 presents the overall assumptions
- Section 5 describes and discusses the results for the AFI RVSM Core/Mature Airspace
- Section 6 describes and discusses the results for the AFI RVSM Switch-over Period
- Section 7 provides the conclusion

- Annex A provides a list of applicable and reference documents
- Annex B provides a glossary and a list of definitions
- Annex C presents the AFI RVSM FHA methodology
- Annex D presents the AFI RVSM Severity Classification Scheme
- Annex E presents the AFI RVSM Risk Classification Scheme
- Annex F provides the AFI RVSM FHA traceability framework

- Appendix A describes how the brainstorming sessions have been performed
- Appendix B provides the list of attendants to the brainstorming sessions
- Appendix C provides the operational scenarios assessed
- Appendix D provides the hazard classification tables
- Appendix E provides the hazard mitigation tables
- Appendix F provides the allocation tables

The document has been constructed in such a way that the sections presenting the results for the core/mature airspace and for the switch-over period (sections 5 and 6) can be read independently. This results in some few reiterations but supports the reader. Moreover, reader should keep in mind that results for the Core Airspace are applicable to the Switch-over Period.

The appendices are presented in separate documents also to facilitate flexibility of reading.

1.7. Reference and Applicable Documents

The list of reference and applicable documents is provided in **Annex A**.

1.8. Glossary and Definitions

A glossary and definitions are provided in **Annex B.**

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2. Overall Assumptions

This section provides the overall assumptions made during the AFI RVSM FHA process and that serve as a basis for the risk assessment.

These overall assumptions are applicable to both AFI RVSM Core/Mature Airspace and Switch-Over Period. The specific assumptions are presented in the related section.

2.1. Safety assumption

(a) All risks already present in CVSM today have been assessed as tolerable.

The AFI RVSM FHA focuses on the introduction of RVSM. It is assumed that all risks related to CVSM have been assessed as tolerable. For operational hazards associated, the question is then whether the introduction of RVSM will increase occurrence frequency or downgrade severity classification from that of today.

2.2. Operational assumptions

(b) All required training for pilots and controllers has been completed.

In order to fulfil the assumption that pilots and controllers have got used to operate within AFI RVSM airspace, it is required that all controllers and pilots have been properly trained. Further, the AFI RVSM FHA focuses on operational problems and not on problems related to lack of proper training or other teething initial problems.

(c) Operational procedures applicable within AFI RVSM airspace are defined in the AFI RVSM ATC Manual and in the ICAO Doc 4444 and Doc 7030/4.

These documents create the basis for applied operational procedures within AFI RVSM airspace. They are operational reference documents intended for the use by the people involved in RVSM operations. The ICAO Doc. 7030/4 document **[22]** provides contingency measures that can be used as mitigation factors to reduce hazard effects on the safety of RVSM operations.

(d) Letters of Agreements (LoAs) between all concerned ACCs and coordination procedures between adjacent sectors are in place.

The AFI RVSM FHA does not focus on procedural problems between different ACCs and assumes that all Letters of Agreements are in place and that all coordination procedures with adjacent sectors are in place and commonly used by the air traffic controllers.

(e) Civil/Military coordination is in place.

As with the co-ordination between sectors/ACCs, it is assumed that the co-ordination procedures between MIL and CIV units are in place and commonly used.

(f) Radio Communications failure contingencies are in place

The Radio Communication Failure (RCF) procedures to be applied within the AFI RVSM airspace will adhere to the ICAO Doc. 7030/4 document **[22]**. They shall be in place for the implementation of RVSM.

(g) Non RVSM approved State aircraft will operate within the AFI RVSM airspace.

Within the entire AFI RVSM airspace, State aircraft may operate without being RVSM approved. In that case, they will be given 2000 feet separation service.

(h) AFI RVSM airspaces are covered at least by one communication means

The AFI RVSM FHA focuses on communication failure problems. It is assumed that in every point of the AFI RVSM airspace, at least one A/G communication means is available between flight crew and air traffic controller.

(i) ARMA is operational

It is assumed that the AFI Regional Monitoring Agency is in place and operational.

(j) Ground-ground communications are available

As with the A/G communications, the AFI RVSM FHA focuses on failure problems for G/G communications. It assumes that controller to controller communications are available between all adjacent ACCs/sectors. The same for AFTN communications.

(k) Procedures to transit through the AFI RVSM airspace are in compliance with ICAO doc 7030

Non RVSM approved aircraft will be allowed to transit through the AFI RVSM airspace. It is assumed that the associated procedures are in compliance with ICAO doc 7030 **[22]**.

3. AFI RVSM SYSTEM

This section provides an overview of the AFI RVSM System.

3.1. System purpose

The purpose of the AFI RVSM (Reduced Vertical Separation Minima) System is to provide - between FL290 and FL410 inclusive – a 1000 feet vertical separation service to Civil and State RVSM approved aircraft and 2000 feet to State aircraft.

In other words, the purpose of the System is to provide six additional flight levels between FL290 and FL410.

Non-RVSM civil aircraft are not allowed to operate within the AFI RVSM Airspace but can transit through (descent from above FL410 to below FL290 or climb from below FL290 to above FL410) , provided the aircraft climbs or descends at no less than standard rate and does not stop at any intermediate flight level in RVSM airspace.

3.2. System boundaries

3.2.1. Geographical boundaries

The AFI FIRs where RVSM will be implemented within that area of the AFI region as identified by the RVSM Task Force.

3.2.2. Operational boundaries

RVSM will be provided between FL290 and FL410 inclusive.

3.3. AFI RVSM Environmental Types

3.3.1. Methodological rationale

The AFI operational environment (the ATM/CNS context) in which RVSM will be operated is inhomogeneous in terms of ATM procedures and CNS capabilities. As an example, the AFI FIRs offer different level of Air Traffic Services from Flight Information Services to radar ATC.

The identification of hazard consequences on the safety of RVSM operations depends on the environmental conditions, meaning that the gradation in terms of severity could differ from the different local systems (e.g the severity class of given hazard is dependent on the surveillance capabilities).

As a consequence, local RVSM systems - with common ATM/CNS characteristics are described through categories named as “Environmental Types”. These types of operational environments are specified for the AFI RVSM FHA purposes.

3.3.2. AFI RVSM Environmental Types

Among the different ATM/CNS characteristics that differ from FIR to FIR within the AFI Region (route network, traffic density and complexity, ATM services, CNS capabilities…), two of them have been pointed out by the working group as relevant factors to be considered when identifying and assessing the hazards:

- The ATS services provided (ATC or FIS)
- The surveillance capabilities (radar/ ADS) (Cf. above)

That results in four (4) Environmental Types:

Reference	Environnemental Conditions
ENV_1	Controlled airspace with radar or ADS surveillance capability. Surveillance enables the controller to detect incorrect aircraft movement.
ENV_2	Controlled airspace without radar and ADS surveillance capabilities. Surveillance is procedural and based on communications.
ENV_3	Non controlled (FIS) airspace with radar or ADS surveillance capability. Surveillance enables the controller to detect incorrect aircraft movement.
ENV_4	Non controlled (FIS) airspace without radar and ADS surveillance capabilities.

Table 1: AFI RVSM environmental types

As the AFI RVSM FHA results could rely on these environmental types, the traceability provides their references when appropriate.

3.4. ATC equipment element : surveillance capabilities

In today's AFI environment, the whole Region is not covered by radar or ADS surveillance. The main part of the FIRs provide procedural ATC or FIS without any display to the controller of the operational situation.

In that way, two different basic ATC equipment environments have been pointed out to support hazard identification and severity assessment.

3.4.1. Without radar and ADS surveillance capabilities

A basic ATC environment without radar ADS surveillance capabilities could be seen as follows:

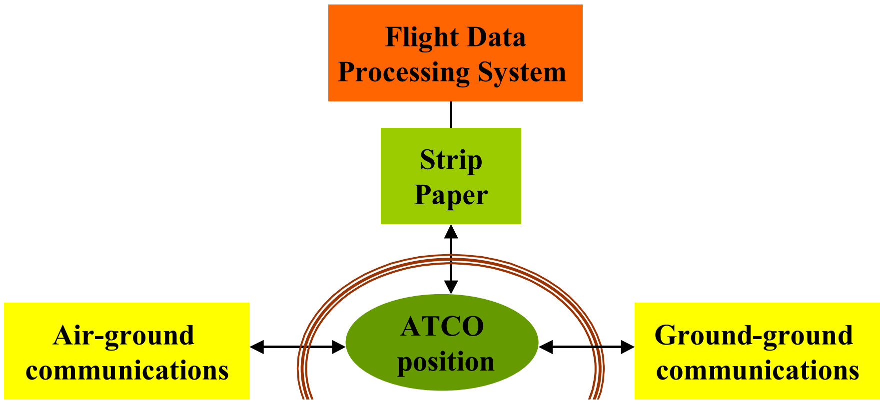


Figure 2 : Non radar/Non ADS basic ATC environment

3.4.2. With radar or ADS surveillance capability

A basic ATC environment with radar or ADS surveillance capabilities could be seen as follows:

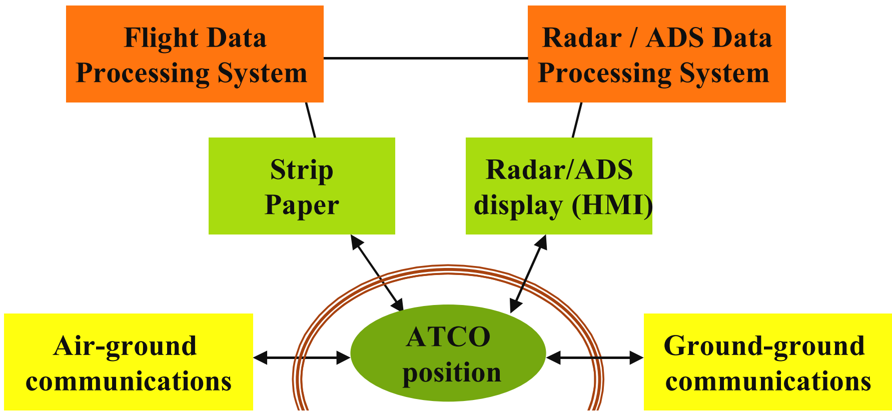


Figure 3 : Radar or ADS basic ATC environment

Note: Radar Data Processing System is only upstream the Radar HMI and is linked to FDPS for correlation purpose.

Radar or ADS display (HMI) acts as an environmental mitigation means, enabling Air Traffic Controller (ATCO) to detect incorrect aircraft movement. It can be used to minimise operational effects of the hazards resulting in an aircraft deviating from cleared FL level, and consequently to lower severity classes.

3.5. System definition

The AFI RVSM System is the part of the AFI Air Navigation System (ANS) relevant in operating RVSM. It consists of AFI ANS elements implicated in RVSM provision and is composed of three high-level components: equipment (ATM/CNS functional capabilities), people and procedures.

The high-level architecture of the AFI RVSM System can be seen as follows:

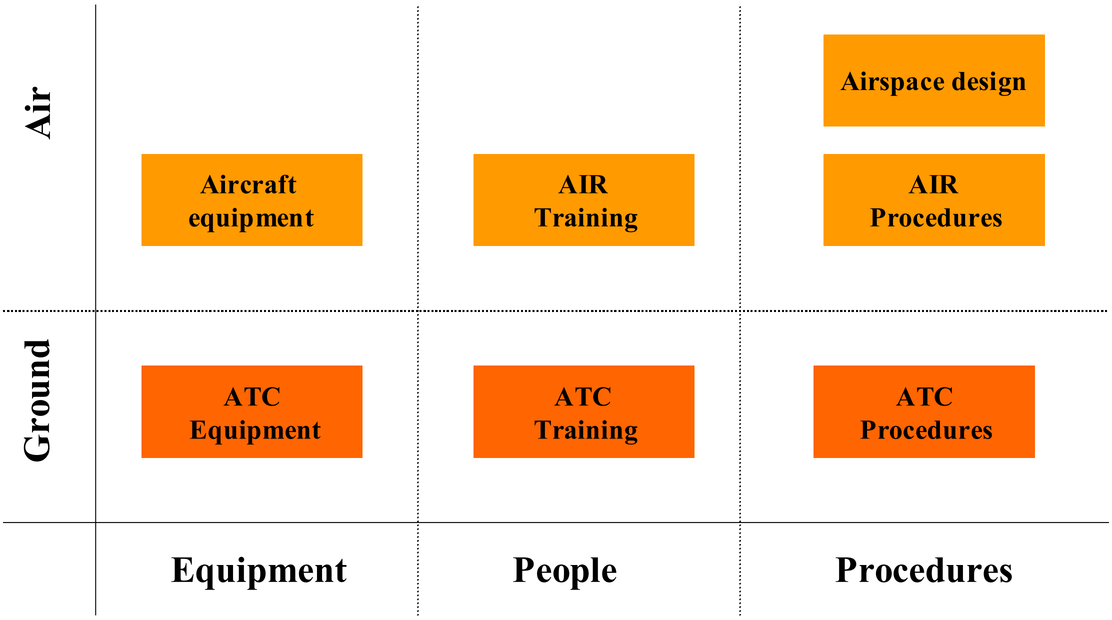


Figure 4 : AFI RVSM System high-level elements

The main elements are :

- AIR_DES : Airspace Design
- AIR_PRO : Air Procedures (Flight crew, operators, maintenance staff)
- AIR_TRA : Air staff Training (Flight crew, operators, maintenance staff)
- AIR_EQU : Aircraft Equipment
- ATC_PRO : ATC Procedures (ATCO, maintenance staff, military controllers)
- ATC_TRA : ATC Training (ATCO, maintenance staff, military controllers)
- ATC_EQU : ATC Equipment
- SYS_MON : System Monitoring

The System Monitoring element (SYS_MON) consists in the mechanisms specified to monitor the risks under RVSM.

This decomposition of the System serves as a basis for the allocation of the AFI RVSM FHA Safety Requirements.

4. AFI RVSM CORE/MATURE AIRSPACE

This section describes and discussed the results with regards to the AFI RVSM Core/Mature Airspace.

4.1. Introduction

The AFI RVSM Safety Policy **[1]** requires to "look at the whole RVSM concept" which includes the AFI RVSM Core/Mature Airspace.

The objective is to address the AFI RVSM airspace in a mature situation in order to focus on problems associated with high traffic density, multiple crossing with short distances to neighbouring FIR/UIR borders, change of ACC/UAC, weather phenomena… and not to focus on the initial implementation problems.

4.2. Inputs

This paragraph presents the results of the 'input capture process' presented in **Annex C**.

4.2.1. Assumptions

The eleven (11) overall assumptions are applicable to the Core/Mature airspace. (**section 2**)

In addition, the following specific assumption has been made according to the Safety Policy requirement to look at a mature situation:

(1) Time to be looked at is approximately one year after the implementation

It has been assumed that one year after implementation, all initial problems have been solved and both the pilots and controllers have got used to operate within AFI airspace.

4.2.2. Environmental types

The four (4) environmental types specified are applicable to the core/mature airspace. (**section 3**)

4.2.3. Operational scenarios

Nine (9) operational scenarios have been assessed, six (6) regarding normal RVSM operations and three (3) regarding abnormal operations. They reflects how RVSM will be operated in the core airspace.

Operating methods and graphical illustrations are provided in **Appendix C**.

4.2.3.1. Normal RVSM operations scenarios

CORE_NOM_1: Flying according to assigned flight level in RVSM core airspace

CORE_NOM_2: Change of flight level (descent/climb) inside RVSM core airspace

CORE_NOM_3: Change of ACC/UAC

CORE_NOM_4: Entrance to the RVSM core airspace

CORE_NOM_5: Exit RVSM core airspace

CORE_NOM_6: Crossing RVSM core airspace

4.2.3.2. Abnormal RVSM operations scenarios

CORE_ABN_1: Deviation from assigned flight level due to local weather phenomena

CORE_ABN_2: Deviation from assigned flight level due to adverse traffic conditions

CORE_ABN_3: Emergency descent

4.3. Hazard assessment

This paragraph presents the results of the 'Hazard Assessment process' presented in **Annex C.**

4.3.1. Hazard identification

The hazard identification was based on the developed operational scenarios by answering the following question: **what could go wrong?**

In that way, numerous hazardous situations were identified per operational scenarios. However, some of them were not related specifically to RVSM operations (e.g. Hijacking), and were discarded as out of scope of the FHA. In the same way, the hazards related to the initial implementation problems (e.g incorrect knowledge of procedures) were discarded as they were considered as out of scope of the AFI RVSM Core/Mature Airspace assessment.

In addition, some of hazards identified were inherent to normal flight and ATC operations and already exists in CVSM today. Their relevance have been assessed on an individual basis and discarded unless the implementation of RVSM will affect the risks associated (hazard's likelihood and/or severity)

The identification based on operational scenarios resulted in forty-two (42) hazards, named as 'identified hazard'. However, not all of these 42 hazards have been counted in the total number of hazards for the core/mature airspace. The reason is that some of them are 'repetitive', meaning that they are applicable to different scenarios. These repetitive hazards have been counted once in statistics. However, for traceability purposes, they remain in the hazard classification table presenting the results. This table provides a backtrace to the hazard references when appropriate and readers can refer to the report on the FHA session I **[12]** for the additional details.

Based on these principles, the hazard validation outputs twenty-eight **(28) operational hazards** that are presented and described in the **Hazard Classification Table** in **Appendix D.**

They address variously:

- equipment failures (aircraft and ground failures),
- human errors (controller and pilot) including coordination problems,
- problems related to flight plan,
- bad weather conditions and vortices…

4.3.2. Severity assessment

The severity of the 28 hazards have been assessed in the worst-credible conditions. The assessment was made in accordance with the **AFI RVSM Severity Classification Scheme** (refer to **Annex D**) and based on the operational expertise of the working group.

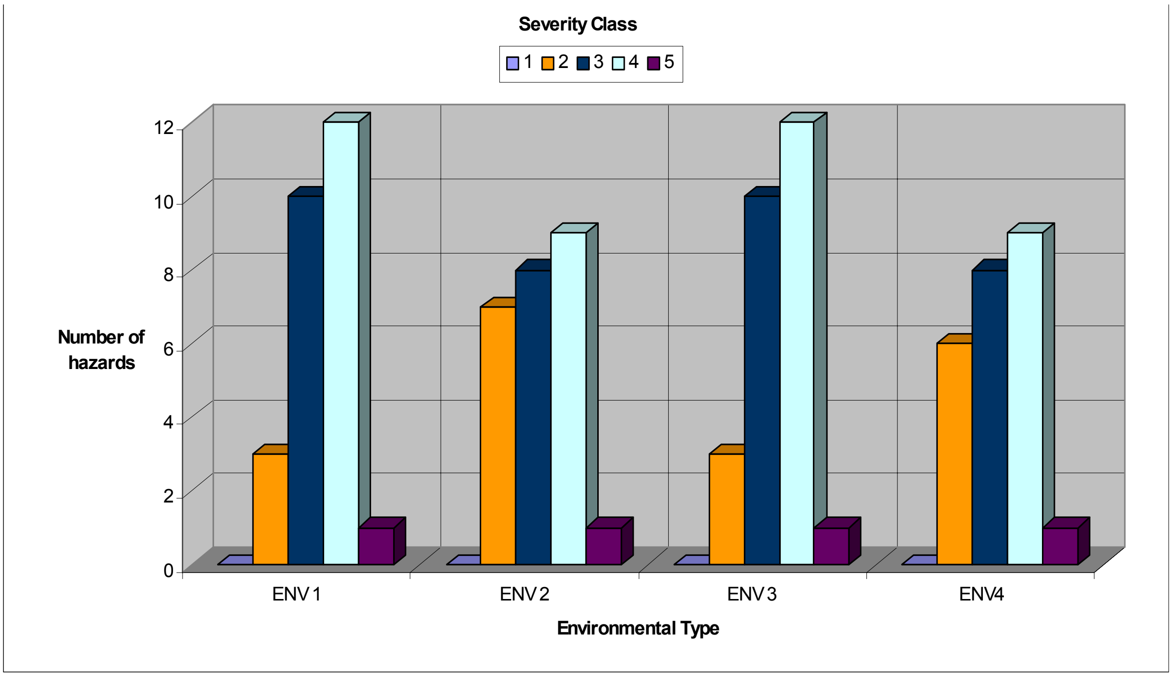
A severity class was thus given to each hazard identified. As the severity could depend on the conditions under which the hazard occurs, different severity classes have been assigned according to the environmental type considered.

'Existing' mitigation factors have been taken into consideration when assessing the severity, as means to reduce hazard effects. These factors includes the mitigations that already exists today in CVSM or the RVSM mitigations already planned and taken in assumptions for the FHA (refer to **section 2**). This especially concerns contingencies.

As far as 'repetitive' hazards are concerned, during the hazard validation process, the worst severity was given among the ones assigned per operational scenario.

The results are presented in the **hazard classification table** in **Appendix D** which provides the severity per environmental type and the rationale associated.

The severity distribution per environmental type is graphically illustrated as follows:



✈ 28 Approved Hazards

Figure 5: Hazard severity distribution (Core airspace)

The distribution is centred on severity 3 and 4 for ENV_1 and ENV_3, and on severity 2 and 3 for ENV_2 and ENV_3, reflecting that in airspace with surveillance capabilities, the severity class of a given hazard is less severe than in an airspace without surveillance capabilities.

4.3.3. Safety objectives and hazard criticity

4.3.3.1. Safety objectives

Safety objectives have been specified for each the hazard of severity 1, 2 and 3.

They represent the maximum likelihood at which these hazards could tolerably occur. They have been derived from the severity class according to the **AFI RVSM Risk Classification Scheme** provided in **Annex E**.

Different objectives have been specified when the severity class differed from the environmental type.

The results are presented in the **Hazard Classification Table** provided in **Appendix D**.

4.3.3.2. Hazard criticity

As the meeting of the safety objective ensures that the risk is tolerable, the hazard criticity has been assessed.

Hazards that do not achieved their safety objectives have been considered as 'safety critical'. They have required an appropriate further mitigation. This mitigation does not exist today or is not planned and shall be developed.

Hazards that achieve their safety objectives have been considered as 'non safety critical'. They do not constitute a safety issue and the 'existing' mitigation is considered to be sufficient. This includes the hazards of severity 4 and 5.

This criticity assessment was a subjective statement based on the brainstorming group experience. When any doubt of the objective achievement was raised, the hazard was categorised as 'safety critical'. On the other side, when a safety objective was estimated to be met, arguments have been developed and included in the rationale.

The results are presented in the **Hazard Classification table** provided in **Appendix D** and can be summarised as follows:

Environmental type	Before mitigation*	
	Non safety critical	Safety critical
ENV_1	13	9
ENV_2	11	9
ENV_3	13	8
ENV_4	11	8

Table 2: Hazard criticity before mitigation (Core Airspace)

Note: the number of hazards for a given environmental type can differ from the total of 28 hazards, as some of these are not applicable in all the environments.

**: as explained before, 'before mitigation' should be understood as 'with taking only into consideration the mitigation means that already exist today and the RVSM mitigations already planned and taken in assumptions for the AFI RVSM FHA'.*

4.4. Risk Mitigation strategy

This paragraph presents the results of the Risk Mitigation Strategy as presented in **Annex C.**

4.4.1. Objectives and approach

The risk mitigation strategy consists of developing 'new' (in opposition to 'existing') mitigation means to ensure tolerability of the risks with regards to the AFI RVSM Risk Classification Scheme.

In other words, it consists of identifying RVSM mitigations for the 'safety critical' hazards and of specifying appropriate safety requirements. The compliance to these requirements, by the appropriate elements of the AFI RVSM System, ensures risk tolerability.

Three mitigation approaches have been considered:

- Risk elimination (elimination of the hazard)
- Risk reduction (reduction of the hazard likelihood)
- Risk control (control of the hazard severity)

The strategies considered by the AFI RVSM FHA Brainstorming group differ from the hazards, the objective being to attempt to eliminate the associated risks in a cost-effective and short-term manner when possible, or to develop a strategy based on a combination of risk reduction and risk control.

Safety requirements are also specified for 'non safety critical' hazards. Indeed, some of these hazards were considered as non safety critical whereas their severity classes were dependent on 'existing' RVSM mitigations (already known and planned) and the meeting of their safety objective were dependent on the assumptions. The assumptions and RVSM mitigations used in severity and criticity assessments were thus also derived into safety requirements, the tolerability of the risks being dependent on their proper implementation.

4.4.2. Safety requirements/recommendations specification

One hundred and four (104) safety requirements have been specified for the twenty eight (28) hazards identified and classified for the Core Airspace. They represent the sufficient mitigation to consider the associated risks as tolerable, except for hazard AH_{core}_11 which remains safety critical after mitigation in ENV_2.

All of the 28 risks (except AH_{core}_11 in ENV_2) for the AFI RVSM core Airspace are considered as tolerable after mitigation

In addition to the safety requirements, sixteen (16) safety recommendations have been specified.

The mitigation strategy (mitigation factors and derived requirements and recommendations) for each hazard is presented in the **Hazard Mitigation Table** provided in **Appendix E**.

The applicability of the requirements could depend on the environmental type (as indicated in the table) but also on the existing equipment. As examples, the requirement Req $_{Core}$_32 "Existing STCA capabilities shall be updated to be compliant with RVSM" is only applicable if STCA capabilities are implemented today, and the requirement Req $_{Core}$_28 "Crosscheck between controllers shall be performed" is only applicable when ATC resources allows such a crosscheck.

In addition, some mitigation factors that are common to different hazards have been derived into both requirement and recommendation. In that case, only the derived requirement have been considered for all of the hazards, meaning that some requirements could appear in the safety recommendations section of the table.

4.4.3. Allocation of safety requirements

The safety requirements have been allocated to the high-level elements of the AFI RVSM System described in **Section 3**.

The results are presented in the Allocation Table provided in **Appendix F** and can be summarised as follows:

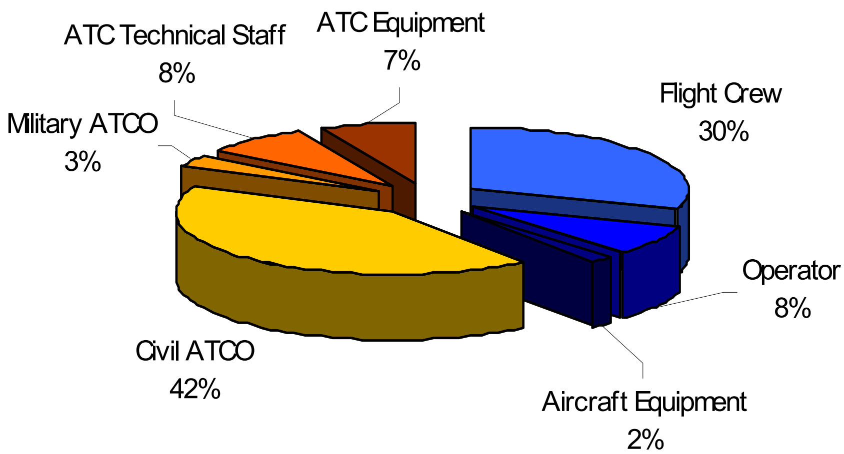


Figure 6: Allocation results (Core Airspace)

It should be noted that some requirements are allocated to different elements. Moreover, no requirement has been allocated to the Airspace Design element of the System.

The following paragraphs present briefly the results for each relevant sub-element of the AFI RVSM System. These results are not exhaustively described and readers can refer to the Allocation Table for the complete details. Applicability of requirements is not discussed here and only the contents (from a high-level point of view) and references of safety requirements are provided.

4.4.3.1. Air Component

The Air Component corresponds to the AIR_EQU, AIR_PRO and AIR_TRA elements of the AFI RVSM System.

4.4.3.1.1. Flight Crew (AIR_PRO and AIR_TRA)

Thirty eight (38) safety requirements are to be satisfied by the Flight Crew sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Flight Crew		
Normal operations	Procedures	Req_{core}_29, Req_{core}_41, Req_{core}_60, Req_{core}_65, Req_{core}_72, Req_{core}_87, Req_{core}_90
	Training	Req_{core}_8, Req_{core}_25, Req_{core}_31, Req_{core}_33, Req_{core}_42, Req_{core}_61, Req_{core}_64, Req_{core}_87, Req_{core}_89, Req_{core}_97
In-flight contingencies	Procedures	Req_{core}_2, Req_{core}_3, Req_{core}_4, Req_{core}_9, Req_{core}_69, Req_{core}_75, Req_{core}_80, Req_{core}_83, Req_{core}_84, Req_{core}_98
	Training	Req_{core}_6, Req_{core}_8, Req_{core}_11, Req_{core}_20, Req_{core}_68, Req_{core}_71, Req_{core}_77, Req_{core}_82, Req_{core}_85, Req_{core}_100
Suspension of RVSM	Procedures	Req_{core}_101
	Training	Req_{core}_104

Table 3: Flight Crew requirements (Core airspace)

4.4.3.1.2. Operators (AIR_PRO, AIR_TRA and AIR_EQU)

Ten (10) safety requirements are to be satisfied by the Operator sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Operators		
RVSM Approval	Procedures Training Equipment	Req_{core}_1
Flight planning	Procedures	Req_{core}_65, Req_{core}_66, Req_{core}_72, Req_{core}_73
	Training	Req_{core}_67, Req_{core}_74
	Equipment	Req_{core}_65, Req_{core}_72
Flight plan to ATC	Procedures	Req_{core}_57, Req_{core}_58
	Training	Req_{core}_57, Req_{core}_59
	Equipment	Req_{core}_57

Table 4: Operator requirements (Core airspace)

4.4.3.1.3. Aircraft Equipment (AIR_EQU)

Two (2) safety requirements are allocated to the Aircraft Equipment element, representing how airborne systems contribute to the risk mitigation strategy.

Results can be summarised as follows:

Aircraft Equipment		
RVSM Approval	Procedures Training Equipment	Req_{core}_1
Carriage of ACAS II (TCAS version 7.00)	Equipment	Req_{core}_88

Table 5: Aircraft equipment requirements (Core airspace)

4.4.3.2. Ground Component

The Ground Component corresponds to the ATC_EQU, ATC_PRO and ATC_TRA elements of the AFI RVSM System.

4.4.3.2.1. Civil ATCO (ATC_PRO and ATC_TRA)

Fifty three (53) safety requirements are to be satisfied by the civil ATCO sub-element, representing its contribution to the risk mitigation strategy.

Civil ATCO		
Normal operations (including coordination)	Procedures	Req_{core}_16, Req_{core}_28, Req_{core}_29, Req_{core}_37, Req_{core}_39, Req_{core}_41, Req_{core}_65, Req_{core}_72, Req_{core}_78, Req_{core}_87, Req_{core}_91
	Training	Req_{core}_7, Req_{core}_17, Req_{core}_24, Req_{core}_30 (ENV_1 and ENV_3 only), Req_{core}_34 (ENV_2 and ENV_4 only), Req_{core}_36, Req_{core}_40, Req_{core}_63, Req_{core}_79, Req_{core}_65, Req_{core}_87, Req_{core}_92
Contingencies	Procedures	Req_{core}_1, Req_{core}_3, Req_{core}_4, Req_{core}_9, Req_{core}_18, Req_{core}_43 (ENV_1 and ENV_3 only), Req_{core}_50 (ENV_1 and ENV_3 only), Req_{core}_54, Req_{core}_56, Req_{core}_62, Req_{core}_69, Req_{core}_75, Req_{core}_80, Req_{core}_84, Req_{core}_94, Req_{core}_98
	Training	Req_{core}_5, Req_{core}_7, Req_{core}_10, Req_{core}_19, Req_{core}_44, Req_{core}_47, Req_{core}_51 (ENV_1 and ENV_3 only), Req_{core}_55, Req_{core}_70, Req_{core}_76, Req_{core}_81, Req_{core}_86, Req_{core}_95, Req_{core}_99
Suspension of RVSM	Procedures	Req_{core}_101, Req_{core}_102
	Training	Req_{core}_104

Table 6: Civil ATCO requirements (Core airspace)

4.4.3.2.2. Military ATCO (ATC_PRO and ATC_TRA)

Four (4) safety requirements are to be satisfied by the military ATCO sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Military ATCO		
Civil-military coordination operations	Procedures	Req_{core}_91
	Training	Req_{core}_93
Contingencies	Procedures	Req_{core}_94
	Training	Req_{core}_96

Table 7: Military ATCO requirements (Core airspace)

4.4.3.2.3. Technical maintenance staff (ATC_PRO and ATC_TRA)

Ten (10) safety requirements are to be satisfied by the technical maintenance staff sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Technical ATC staff		
Maintenance	Procedures	Req_{core}_13, Req_{core}_21, Req_{core}_45 (ENV_1 and ENV_3), Req_{core}_48, Req_{core}_52 (ENV_1 and ENV_3)
	Training	Req_{core}_14, Req_{core}_22, Req_{core}_46 (ENV_1 and ENV_3), Req_{core}_49, Req_{core}_53 (ENV_1 and ENV_3)

Table 8: Technical ATC staff requirements (Core airspace)

4.4.3.2.4. Ground Equipment (ATC_EQU)

Nine (9) safety requirements are allocated to the Ground Equipment element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

ATC Equipment	
A/G communications systems designed to ensure a total coverage of the RVSM Airspace with a minimum MTBF	Req_{core}_12
ATS/DS communications designed to ensure point-to-point communications between all adjacent ACCs with a minimum MTBF	Req_{core}_15 (ENV_1 and ENV_3), Req_{core}_23 (ENV_2 and ENV_4)
The implementation of suitable and reliable communications means (e.g VSAT, VHF…)	Req_{core}_38
Inclusion of RVSM Status within the strip	Req_{core}_26
Display of RVSM on radar or ADS HMI	Req_{core}_27 (ENV_1 and ENV_3)
Update of existing SCTA capabilities	Req_{core}_32
Weather forecast	Req_{core}_65, Req_{core}_72

Table 9: ATC Equipment requirements (Core airspace)

4.5. Residual risk

The risk related to AH_{core}_11 'pilot deviates from clearance' remains not tolerable in ENV_2 after mitigation.

That means that the proposed mitigation is not sufficient to consider the risk as tolerable.

Indeed, the severity class of 2 was considered to remain the same after mitigation and the two requirements (Req_{Core}_25 and 29) issued from the risk reduction strategy are not sufficient to consider the safety objective of Extremely Remote (once per year in the AFI RVSM Airspace) as achieved.

This residual risk requires the attention of the AFI RVSM Programme and further assessment to be conducted during the development of the Pre-Implementation Implementation Safety-Case.

4.6. Conclusion

As a conclusion, 28 risks under RVSM mature operations (AFI RVSM Core Airspace) have been identified, assessed and classified.

27 risks are considered tolerable after mitigation. That means that the 27 hazards associated are considered as not safety critical provided the elements of the AFI RVSM System satisfy the 104 associated safety requirements. These safety requirements constitutes with the hazard classification the main results of the AFI RVSM FHA.

The hazard AH_{core}_11 'pilot deviates from clearance' remains safety critical after mitigation in environmental type ENV_2. The Pre-Implementation Safety Case (PISC) is invited to look further into this hazard to ensure a proper resolution before the RVSM Implementation.

In addition, 16 safety recommendations have been specified.

The ARTF/6 is invited to confirm the usability of the two following requirements:

- Req_{Core}_12 : "Air/Ground Communication system shall be designed to ensure a total coverage of the RVSM Airspace with a minimum MTBF of 2 months for a given FIR" : the risk reduction strategy is based on a MTBF of 2 months and the ARTF/6 is invited to confirm the compliancy with SARPS. (associated hazard : H_{core}_07)
- Req_{Core}_88 : "Aircraft shall be equipped with ACAS II (TCAS version 7.00)" : the risk elimination is based on the use of ACAS II (TCAS version 7.00) and the ARTF/6 is invited to confirm its usability (associated hazard : H_{core}_25)

The results provided take into consideration these two requirements. In the case they are not confirmed and validated by ARTF/6, the criticity of the hazards H_{core}_07 and H_{core}_25 shall be reassessed.

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5. AFI RVSM SWITCH-OVER PERIOD

This section describes and discussed the results with regards to the AFI RVSM Switch-Over Period.

5.1. Introduction

The AFI RVSM Safety Policy **[1]** requires to "look at the whole RVSM concept" which includes the AFI RVSM Switch-Over Period.

The objective is to focus on the specific problems related to the period immediately before and after the introduction of RVSM, which is taken to be approximately 24 hours before and after the agreed RVSM implementation time (ToS). That includes initial problems as incorrect knowledge of the new RVSM procedures, lack of training, problems related to the change of FLAS … that were out of scope of the AFI RVSM Core Airspace assessment.

5.2. Inputs

This paragraph presents the results of the 'input capture process' presented in **Annex C**.

5.2.1. Assumptions

The eleven (11) overall assumptions are applicable to the Switch-Over period. (**section 2**)

In addition, five (5) assumptions related to the specific aspects of the switch-over period have been made:

(1) Filed FPL are in accordance with the different airspace status crossed during the switchover period

It is assumed that FPL are filed in accordance with the different airspace status crossed during the switchover period, especially regarding the aircraft RVSM approval status and flight levels (compliance to the FLAS)

(2) After change to RVSM, regression to CVSM will not be possible

It is assumed that after Time of Switch Over, reversion to CVSM operations will not be possible.

(3) RVSM approval status is checked by the controller at ToS

It is assumed at Time of Switch-Over (ToS), after the appropriate broadcasting procedures, the RVSM approval status will be checked by the pilot and the controller. This procedure is applicable to all the aircraft under the responsibility of the controller at ToS.

(4) The ATC and technical teams are reinforced for the switch-over period

It is assumed that the ATC and technical teams are reinforced for the switch-over period, allowing to fix technical failures and problems more quickly, to reduce controller human errors due to the application of the new (RVSM) procedures and to detect more quickly such errors if they occur.

(5) Date and time of the Switch Over are unique and applicable for all the AFI FIRs

It is assumed that the the AFI FIRs will implement RVSM at the same date and time.

5.2.2. Environmental types

The four (4) environmental types specified are applicable to the switch-over period (**section 3**).

5.2.3. Operational scenarios

Seven (7) operational scenarios have been assessed. Operating methods and graphical illustrations are provided in **Appendix C**. They reflects operations during transition from CVSM to RVSM.

SWIT_NOM_1a: RVSM aircraft flying at T0

SWIT_NOM_1b: Non RVSM State aircraft fliying at T0

SWIT_NOM_2a: Non RVSM civil aircraft flying at T0 (scenario a)

SWIT_NOM_2b: Non RVSM civil aircraft flying at T0 (scenario b)

SWIT_NOM_3: State of RVSM civil aircraft taking off after T0

SWIT_NOM_4a: Non RVSM civil aircraft taking off after T0 (scenario a)

SWIT_NOM_4b: Non RVSM civil aircraft taking off after T0 (scenario b)

5.3. Hazard assessment

This paragraph presents the results of the 'Hazard Assessment process' presented in **Annex C.**

5.3.1. Hazard identification

The hazard identification was based on the developed operational scenarios by answering the following question: **what could go wrong?**

In that way, numerous hazardous situations were identified per operational scenarios. However, as for the AFI RVSM core airspace, some of them were not related specifically to RVSM operations (e.g. Hijacking), and were discarded as they were considered as out of scope of the FHA.

In the same way, the hazards not specifically related to the initial implementation problems (e.g airborne equipment failures are independent from the ATS and separation services provided) and that were already assessed for the core airspace, were discarded as out of scope of the AFI RVSM Switch-Over period assessment unless:

- the specific period of change-over will affect in some way the risks associated (severity or likelihood)
- the hazards or some of their causes were not addressed during the core airspace assessment due to the specific assumptions made (e.g non compliance to LoA)

Based on these principles, the hazard identification has outcome twenty **(20) operational hazards** that are presented and described in the **Hazard Classification Table** in **Appendix D.**

Historically, 19 hazards have been initially identified and the hazard AH_{swit}_20 "Pilot does not leave the FL band 410 and above before ToS" has been added during the risk mitigation strategy definition as resulting from safety requirement suspending non RVSM civil operations above FL410 during a certain period of time after ToS.

These 20 hazards address variously:

- equipment failures (ground failures only),
- human errors (controller and pilot) including RVSM-CVSM transition operations problems (change of FL, exit of RVSM airspace for non RVSM civil aircraft…), incorrect flight planning…
- problems related to flight plan (incorrect RVSM status…)
- problems resulting from high-traffic density during the Switch-over period
- bad weather conditions and vortices…

5.3.2. Severity assessment

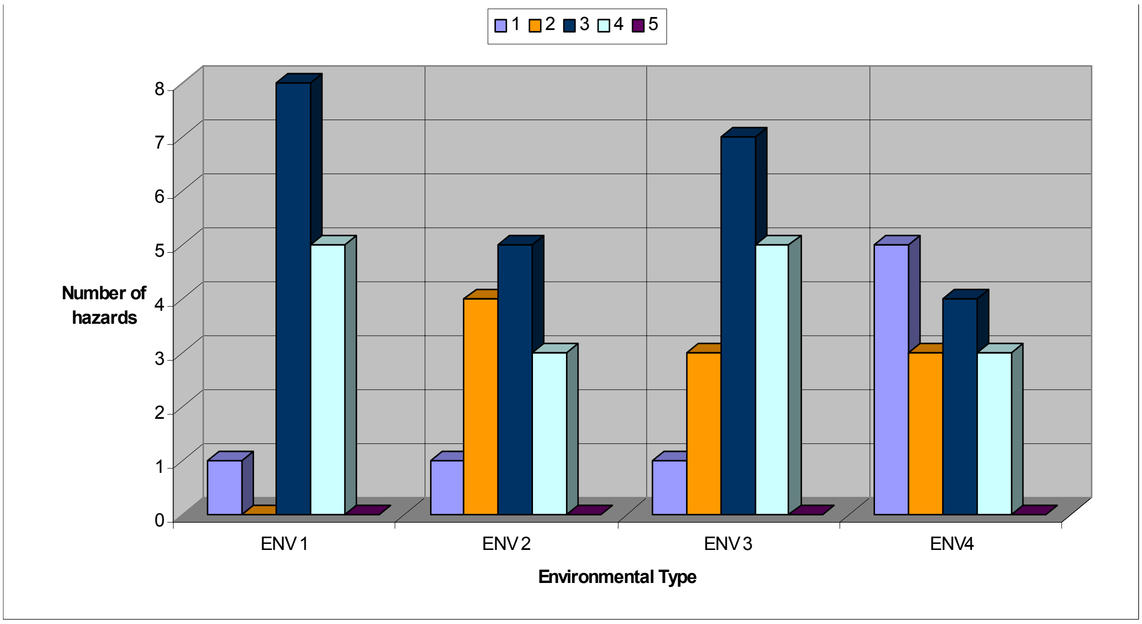
The severity of the 20 hazards have been assessed in the worst-credible conditions. The assessment was made in accordance with the **AFI RVSM Severity Classification Scheme** (refer to **Annex D**) and based on the operational expertise of the working group.

A severity class was thus given to each hazard identified. As the severity could depend on the conditions under which the hazard occurs, different severity classes have been assigned according to the environmental type considered.

'Existing' mitigation factors have been taken into consideration when assessing the severity, as means to reduce hazard effects. These factors include the mitigations that already exists today in CVSM or the RVSM mitigations already planned and taken in assumptions for the FHA (refer to **section 2** and assumptions specific to the switch-over period described above). This especially concerns contingencies and reinforcement of technical and operational ATC team for the switch-over period.

The results are presented in the **hazard classification table** in **Appendix D** which provides the severity per environmental type and the rationale associated.

The severity distribution per environmental type is graphically illustrated as follows:



✈ 20 Approved Hazards

Figure 7: Hazard severity distribuion (Switch-Over Period)

5.3.3. Safety objectives and hazard criticity

5.3.3.1. Safety objectives

Safety objectives have been specified for each the hazard of severity 1, 2 and 3.

They represent the maximum likelihood at which these hazards could tolerably occur. They have been derived from the severity class according to the **AFI RVSM Risk Classification Scheme** provided in **Annex E**.

Different objectives have been specified when the severity class differed from the environmental type.

The results are presented in the **Hazard Classification Table** provided in **Appendix D**.

5.3.3.2. Hazard criticity

As the meeting of the safety objective ensures that the risk is tolerable, the hazard criticity has been assessed.

Hazards that do not achieved their safety objectives have been considered as ‘safety critical’. They have required an appropriate further mitigation. This mitigation does not exist today or is not planned and shall be developed.

Hazards that achieve their safety objectives have been considered as ‘non safety critical’. They do not constitute a safety issue and the ‘existing’ mitigation is considered to be sufficient. This includes the hazards of severity 4 and 5.

This criticity assessment was a subjective statement based on the brainstorming group experience. When any doubt of the objective achievement was raised, the hazard was categorised as ‘safety critical’. On the other side, when a safety objective was estimated to be met, arguments have been developed and included in the rationale.

The results are presented in the **Hazard Classification table** provided in **Appendix D** and can be summarised as follows:

Environmental type	Before mitigation*	
	Non safety critical	Safety critical
ENV_1	8	6
ENV_2	8	5
ENV_3	9	7
ENV_4	9	6

Table 10: Hazard criticity before mitigation (Switch-Over Period)

Note: the number of hazards for a given environmental type can differ from the total of 20 hazards, as some of these are not applicable in all the environments.

Note 2: as explained before, ‘before mitigation’ should be understood as ‘with taking only into consideration the mitigation means that already exist today and the RVSM mitigations already planned and taken in assumptions for the AFI RVSM FHA’.

5.4. Risk Mitigation strategy

This paragraph presents the results of the Risk Mitigation Strategy as presented in **Annex C.**

5.4.1. Objectives and approach

The risk mitigation strategy consists of developing 'new' (in opposition to 'existing') mitigation means to ensure tolerability of the risks with regards to the AFI RVSM Risk Classification Scheme.

In other words, it consists of identifying RVSM mitigations for the 'safety critical' hazards and of specifying appropriate safety requirements. The compliance to these requirements, by the appropriate elements of the AFI RVSM System, ensures risk tolerability.

Three mitigation approaches have been considered:

- Risk elimination (elimination of the hazard)
- Risk reduction (reduction of the hazard likelihood)
- Risk control (control of the hazard severity)

The strategies considered by the AFI RVSM FHA Brainstorming group differ from the hazards, the objective being to attempt to eliminate the associated risks in a cost-effective and short-term manner when possible, or to develop a strategy based on a combination of risk reduction and risk control.

Safety requirements are also specified for 'non safety critical' hazards. Indeed, some of these hazards were considered as non safety critical whereas their severity classes were dependent on 'existing' RVSM mitigations (already known and planned) and the meeting of their safety objective were dependent on the assumptions. The assumptions and RVSM mitigations used in severity and criticity assessments were thus also derived into safety requirements, the tolerability of the risks being dependent on their proper implementation.

5.4.2. Safety requirements/recommendations specification

Sixty-three (63) safety requirements have been specified for the twenty (20) hazards identified and classified for the Switch-Over period. They represent the sufficient mitigation to consider the associated risks as tolerable.

All of the 20 risks under the Switch-Over Period are considered as tolerable after mitigation

Three (3) safety recommendations have also been specified. They address military exercise during the switch-over period.

In addition, it should be remind that, according to the methodology used for hazard identification and explained above, all the safety requirements and recommendations applicable for the Core Airspace are also applicable to the Switch-Over period.

The mitigation strategy (mitigation factors and derived safety requirements and recommendations) for each hazard is presented in the **Hazard Mitigation Table** provided in **Appendix E**.

It should be noted that the applicability of the requirements could depend on the environmental type as mentioned in the table.

5.4.3. Allocation of safety requirements

The safety requirements have been allocated to the high-level elements of the AFI RVSM System described in **Section 3**.

The results are presented in the Allocation Table provided in **Appendix F** and can be summarised as follows:

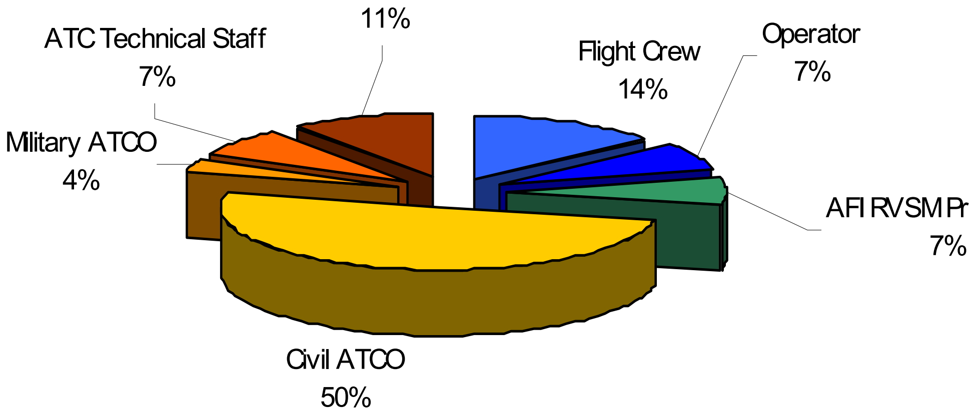


Figure 8: Allocation results (Switch-over Period)

It should be noted that some requirements are allocated to different elements and that no requirement has been allocated to the Airspace Design and Aircraft Equipment element of the System. Moreover, some requirements have been allocated to the “RVSM Programme element” meaning that the RVSM Program shall take appropriate actions with regards to their satisfaction.

The following paragraphs present briefly the results for each relevant sub-element of the AFI RVSM System. These results are not exhaustively described and readers can refer to the Allocation Table for the complete details. Applicability of requirements is not discussed here and only the contents (from a high-level point of view) and references of safety requirements are provided.

5.4.3.1. Air Component

The Air Component corresponds to the AIR_EQU, AIR_PRO and AIR_TRA elements of the AFI RVSM System.

5.4.3.1.1. Flight Crew (AIR_PRO and AIR_TRA)

Twelve (12) safety requirements are to be satisfied by the Flight Crew sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Flight Crew	
Awareness campaigns and training	Req_{swit}_1, Req_{swit}_5, Req_{swit}_6, Req_{swit}_13, Req_{swit}_20, Req_{swit}_23, Req_{swit}_24, Req_{swit}_26, Req_{swit}_35, Req_{swit}_36
Procedures	Req_{swit}_11, Req_{swit}_18, Req_{swit}_24, Req_{swit}_35, Req_{swit}_36

Table 11: Flight Crew requirements (Switch-over)

5.4.3.1.2. Operators (AIR_PRO, AIR_TRA and AIR_EQU)

Six (6) safety requirements are to be satisfied by the Operator sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Operators	
Flight planning	Req_{swit}_10, Req_{swit}_24, Req_{swit}_25, Req_{swit}_33, Req_{swit}_38, Req_{swit}_62

Table 12: Operator requirements (Switch-over)

5.4.3.2. Ground Component

The Ground Component corresponds to the ATC_EQU, ATC_PRO and ATC_TRA elements of the AFI RVSM System.

5.4.3.2.1. Civil ATCO (ATC_PRO and ATC_TRA)

Forty-three (43) safety requirements are to be satisfied by the civil ATC staff sub-element (ATC controller and operators), representing its contribution to the risk mitigation strategy.

Civil ATCO	
Procedures	Req_{swit}_3, Req_{swit}_7, Req_{swit}_8, Req_{swit}_10, Req_{swit}_11 (ENV_1 and ENV_2), Req_{swit}_14 (ENV_1 and ENV_2), Req_{swit}_16 (ENV_3 and ENV_4), Req_{swit}_18 (ENV_3 and ENV_4), Req_{swit}_21 (ENV_3 and ENV_4), Req_{swit}_24, Req_{swit}_25, Req_{swit}_29 (ENV_1 and ENV_2), Req_{swit}_31 (ENV_3 and ENV_4), Req_{swit}_35, Req_{swit}_36, Req_{swit}_38, Req_{swit}_43, Req_{swit}_46 (ENV_1 and ENV_3), Req_{swit}_47 (ENV_1 and ENV_3), Req_{swit}_53, Req_{swit}_56, Req_{swit}_61, Req_{swit}_63
Awareness campaign and training	Req_{swit}_1, Req_{swit}_3, Req_{swit}_4, Req_{swit}_6, Req_{swit}_9 (ENV_1 and ENV_2), Req_{swit}_12 (ENV_1 and ENV_2), Req_{swit}_15 (ENV_1 and ENV_2), Req_{swit}_17 (ENV_3 and ENV_4), Req_{swit}_19 (ENV_3 and ENV_4), Req_{swit}_22 (ENV_3 and ENV_4), Req_{swit}_24, Req_{swit}_27 (ENV_3 and ENV_4), Req_{swit}_28, Req_{swit}_30 (ENV_1 and ENV_2), Req_{swit}_32 (ENV_3 and ENV_4), Req_{swit}_34 (ENV_3 and ENV_4), Req_{swit}_35, Req_{swit}_36, Req_{swit}_46 (ENV_1 and ENV_3), Req_{swit}_47 (ENV_1 and ENV_3), Req_{swit}_50, Req_{swit}_54, Req_{swit}_55, Req_{swit}_57, Req_{swit}_59, Req_{swit}_63

Table 13: Civil ATCO requirements (Switch-Over)

5.4.3.2.2. Military ATCO (ATC_PRO and ATC_TRA)

Three (3) safety requirements are to be satisfied by the military ATCO sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Military ATCO	
Civil military coordination procedures	Req_{swit}_56
Training	Req_{swit}_58, Req_{swit}_59

Table 14: Military ATCO requirements (Switch-over)

5.4.3.2.3. Technical ATC staff (ATC_PRO and ATC_TRA)

Six (6) safety requirements are to be satisfied by the technical maintenance staff sub-element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

Technical ATC staff	
Procedures	Req_{swit}_45, Req_{swit}_50
Training	Req_{swit}_44, Req_{swit}_48, Req_{swit}_49, Req_{swit}_51

Table 15: Technical ATC staff requirements (Switch-over)

5.4.3.2.4. Ground Equipment (ATC_EQU)

Nine (9) safety requirements are allocated to the Ground Equipment element, representing its contribution to the risk mitigation strategy.

Results can be summarised as follows:

ATC Equipment
Req_{swit}_2, Req_{swit}_34 (ENV_3 and ENV_4), Req_{swit}_38, Req_{swit}_42, Req_{swit}_43, Req_{swit}_48 (ENV_1 and ENV_3), Req_{swit}_49 (ENV_1 and ENV_3), Req_{swit}_51, Req_{swit}_63.

Table 16: ATC Equipment requirements (Switch-over)

5.4.3.3. AFI RVSM Programme

Six (6) safety requirements require attention and appropriate actions by the AFI RVSM Program:

AFI RVSM Programme
Req_{swit}_37, Req_{swit}_39, Req_{swit}_40, Req_{swit}_41, Req_{swit}_52, Req_{swit}_60

Table 17: AFI RVSM Programme requirements (Switch-over)

5.5. Residual risk

None of the 20 risks is considered as not tolerable after mitigation, meaning that there is no residual risk for the Switch-Over Period.

5.6. Conclusion

As a conclusion, 20 risks under AFI RVSM Switch-Over Period (CVSM-RVSM transition operations) have been identified, assessed and classified.

All of them are considered tolerable after mitigation, meaning that the hazards associated are considered as not safety critical provided the elements of the AFI RVSM System satisfy the associated safety requirements (the 63 specified for the switch-over period and the 104 specified for the core airspace that are also applicable for the change-over)

These safety requirements constitutes with the hazard classification the main results of the AFI RVSM FHA.

In addition, 3 safety recommendations have been specified.

However, the ARTF/6 is invited to confirm the following elements:

- Req $_{Swit}$_24 Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0: the risk control strategy is based on the suspension of these FL during a specific period of time after the ToS (associated hazard : AH$_{swit}$_05/07/08/09/17/18/20) and the ARTF/6 is invited to confirm the usability of the requirement and to determine the period of time for the FLs suspension
- Req $_{Swit}$_40 Traffic density shall be limited during switch-over period as appropriate : the risk elimination is based on the capability to define an appropriate low traffic density and complexity for the switch-over period (associated hazard : AH$_{swit}$_12)
- Req $_{Swit}$_25 A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours : ARTF/6 is invited to determine the period of time (associated hazards : AH$_{swit}$_05/07/08/09/17/18/20)
- Req $_{Swit}$_35 Transit of non-RVSM civil a/c shall be suspended for a period of XX hours after T0 : ARTF/6 is invited to determine the period of time (associated hazards : H$_{swit}$_10/11)
- Req $_{Swit}$_36 Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0 : ARTF/6 is invited to determine the period of time (associated hazards : H$_{swit}$_10/11)

The results provided take into consideration the requirements Req $_{Swit}$_24 and Req $_{Swit}$_40. In the case they are not confirmed and validated by ARTF/6, the criticity of the hazards H$_{swit}$_05/07/08/09/17/18/20 and H$_{swit}$_12 shall be reassessed.

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6. CONCLUSION

The AFI RVSM Functional Hazard Assessment (FHA) has covered:

- "The AFI RVSM Core Airspace" which addresses RVSM operations in a mature situation;
- "The AFI RVSM Switch-Over Period" which addresses the specific period of time of 24 hours before and after the T0.

The work has been performed through structured brainstorming sessions that were attended by experts representing the various groups of people who will design or develop as well as work with the future AFI RVSM system, ensuring representative and complete outcomes.

Twenty eight (28) hazards for the core airspace and twenty (20) hazards for the switch-over period have been identified, assessed and classified.

All the risks identified for the AFI RVSM Core Airspace (except AH_{core}_11 in ENV_2) and Switch-Over Period have been assessed as tolerable provided the proposed mitigation is implemented

The risk mitigation strategy has introduced a set of 104 safety requirements for the core airspace and 63 for the switch-over period, allowing to consider all the hazards as not safety critical, except for the hazard AH_{core}_11 'pilot deviates from clearance'.

Indeed, although classified as non safety critical in the ENV_1, this hazard remains safety critical in ENV_2 (ATC environment without surveillance capabilities) even with taking into consideration the proposed mitigation. That means that the risk under AH_{core}_11 has been assessed as not tolerable within ENV_2.

The AFI RVSM Programme is invited to look further into the hazard AH_{core}_11 "pilot deviates from clearance" to ensure a proper resolution before RVSM Implementation.

In addition, a set of safety recommendations have been specified.

The ARTF/6 is invited to review the results of this FHA, to confirm the mitigation strategy by validating the following elements:

- Req_{Core}_12 : "Air/Ground Communication system shall be designed to ensure a total coverage of the RVSM Airspace with a minimum MTBF of 2 months for a given FIR" : the risk reduction strategy is based on a MTBF of 2 months and the ARTF/6 is invited to confirm the compliancy with SARPS. (associated hazard : H_{core}_07)
- Req_{Core}_88 : "Aircraft shall be equipped with ACAS II (TCAS version 7.00)" : the risk elimination is based on the use of ACAS II (TCAS version 7.00) and the ARTF/6 is invited to confirm its usability (associated hazard : H_{core}_25)
- Req $_{Swit}$_24 Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0: the risk control strategy is based on the suspension of these FL during a specific period of time after the ToS (associated hazard : AH_{swit}_05/07/08/09/17/18/20) and the ARTF/6 is invited to confirm the usability of the requirement and to determine the period of time for the FLs suspension
- Req $_{Swit}$_40 Traffic density shall be limited during switch-over period as appropriate : the risk elimination is based on the capability to define an appropriate low traffic density and complexity for the switch-over period (associated hazard : AH_{swit}_12)
- Req $_{Swit}$_25 A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours : ARTF/6 is invited to determine the period of time (associated hazards : AH_{swit}_05/07/08/09/17/18/20)
- Req $_{Swit}$_35 Transit of non-RVSM civil a/c shall be suspended for a period of XX hours after T0 : ARTF/6 is invited to determine the period of time (associated hazards : H_{swit}_10/11)
- Req $_{Swit}$_36 Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0 : ARTF/6 is invited to determine the period of time (associated hazards : H_{swit}_10/11)

Annex A: Reference and Applicable Documents

A.1 AFI RVSM references and applicable documents

AFI RVSM Program documents

1. AFI Reduced Vertical Separation Minimum (RVSM) RVSM Safety Policy, 30 July 2004, ARPO/ICAO
2. Strategic/Action Plan for Implementation of Reduced Vertical Separation Minima in the AFI Region, 23 April 2004, ARPO/ICAO
3. Specimen of National Safety Plan for Implementation of RVSM, 30 April 2004, ARPO/ICAO
4. Safety Plan for the Implementation of RVSM, 30 July 2004, ARPO/ICAO
5. ATC Operation Manual for Implementation of RVSM, ARPO/ICAO
6. AFI ATS RVSM Training Guidance Material, Draft
7. Handbook for AFI RMA supporting implementation and continued safe use of RVSM, February 2004;
8. Guidance Material for Airworthiness and Operational Approval;
9. JAA Temporary Guidance Leaflet No.6 (TGL 6) Guidance Material on the approval of aircraft and operators for flight in airspace above F290 where a 300m (1,000ft) vertical separation minima is applied.
10. Specimen AIC on RVSM
11. Specimen NOTAM on RVSM;

AFI RVSM FHA Project documents

12. Report on the initial AFI RVSM FHA Brainstorming Session – Edition 0.1 – 14 December 2004, ALTRAN TECHNOLOGIES – CNS/ATM Division
13. Report on the second AFI RVSM FHA Brainstorming Session – Edition 0.1 – 14 February 2005, ALTRAN TECHNOLOGIES – CNS/ATM Division
14. Report on the third brainstorming session AFI RVSM FHA Brainstorming Session – Edition 0.1 – 12 April 2005, ALTRAN TECHNOLOGIES – CNS/ATM Division
15. Guidelines for Initial Brainstorming Session – AFI RVSM Functional Hazard Analysis (FHA), Edition 0.1 – 27 October 2005, ALTRAN TECHNOLOGIES - CNS/ATM Division
16. Guidelines for the second Brainstorming Session – AFI RVSM Functional Hazard Analysis (FHA), Edition 0.1 – 26 January 2005, ALTRAN TECHNOLOGIES - CNS/ATM Division
17. Guidelines for the third Brainstorming Session – AFI RVSM Functional Hazard Analysis (FHA), Edition 0.1 – 28 March 2005, ALTRAN TECHNOLOGIES - CNS/ATM Division

EUROCONTROL SAM Methodology

18. EUROCONTROL Air Navigation System Safety Assessment Methodology, version 2.0, 20 April 2004

A.2 ICAO references and applicable documents

19. Manual on Implementation of a 300 m (1000 ft) Vertical separation Minimum Between FL290 and FL410 inclusive, Doc 9574 AN/934, Second edition - 2002, International Civil Aviation Organisation.
20. ICAO Procedures for Air Navigation Services/Air Traffic Management (PANS/ATM), Doc 4444;
21. Annex 11, Air Traffic Services, ICAO, Montreal, Thirteenth Edition, July 2001.
22. ICAO Doc. 7030/4 Regional Supplementary Procedures, June 2004;
23. ICAO Doc 9536, Review of the General Concept of Separation Panel, 6th Meeting, report, Volume 2. 1988;
24. ICAO Doc 9572, Review of the General Concept of Separation Panel, 7th Meeting, report, 1990;
25. ICAO. Doc 9426, Air Traffic Services Planning Manual, 1984;

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Annex B : Glossary and Definitions

B.1 Glossary

AAD	Assigned Altitude Deviation
ACAS	Airborne Collision Avoidance System
ACC	Area Control Centre
AD	Altitude Deviation
ADR	Altitude Deviation Report
AFI	African and Indian Ocean Region (of ICAO)
AFS	Aeronautical Fixed Service
AFTN	Aeronautical Fixed Telecommunication Network
A/G	Air/Ground
AIC	Aeronautical Information Circular
AMS	Aeronautical Mobile Service
ANS	Air Navigation System
APIRG	AFI Planning and Implementation Regional Group
ARMA	AFI RVSM Monitoring Agency
ARPO	AFI RVSM Programme Office
ARTF	AFI RVSM Task Force
ASE	Altimetry System Error
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATNS	Air Traffic Navigation Services
ATS	Air Traffic Services
CAA	Civil Aviation Authority
CFMU	Central Flow Management Unit
CFL	Cleared Flight Level
CFP	Current Flight Plan
CHG	Change message
CNS	Communication Navigation Surveillance
COPS	Co-ordination Points
CRA	Collision Risk Assessment
CRM	Collision Risk Model
CVSM	Conventional Vertical Separation Minimum
DS	Direct Speech
EATMP	European Air Traffic Management Programme
ESARR	EUROCONTROL Safety Regulatory Requirement
FC	Flight Crew
FDPS	Flight Data Processing System
FHA	Functional Hazard Assessment / Analysis
FIR	Flight Information Region
FL	Flight Level
FLOS	Flight Level Orientation Scheme
FPL	Flight Plan
FTE	Flight Technical Error
G/G	Ground/Ground

GMU	GPS Height Monitoring Unit
GPS	Global Positioning System
HF	High Frequency
HMI	Human Machine Interface
HMU	Height Monitoring Unit
ICAO	International Civil Aviation Organisation
IFBP	In-Flight Broadcast Procedures
JAA	Joint Aviation Authorities
LoA	Letter of Agreement
MASPS	Minimum Aircraft System Performance Specification
MEL	Minimum Equipment List
MNPS	Minimum Navigation Performance Specification
MTO	Meteo
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NAT	North Atlantic Region (of ICAO)
NOTAM	Notice to Airmen
NPM	National Program Manager
NSP	National Safety Plan
OED	Operational Environment Description
PISC	Pre Implementation Safety Case
POSC	Post Implementation Safety Case
PSSA	Preliminary System Safety Assessment
RDPS	Radar Data Processing System
RGCSP	Review of the General Concept of Separation Panel (of ICAO)
RMA	Regional Monitoring Agency
RVSM	Reduced Vertical Separation Minimum
R/T	Radio Telephony
SAM	Safety Assessment Methodology (Eurocontrol)
SSA	System Safety Assessment
STCA	Short Term Conflict Alert
TCAS	Traffic Alert and Collision Avoidance System
TF	Task Force
TLS	Target Level of Safety
ToS	Time of Switchover
TVE	Total Vertical Error
UAC	Upper Area Control Centre
UIR	Upper Flight Information Region
VHF	Very High Frequency
VSM	Vertical Separation Minimum

B.2 Terms and Definitions

A	
Acceptable	Risk level specified by the risk acceptance criteria
Acceptable risk	Risk assessed as acceptable
Air Navigation System	The aggregate of organisations, people, infrastructure, equipment, procedures, rules and information used to provide the Airspace Users Air Navigation Services in order to ensure the safety, regularity and efficiency of international air navigation.
Assessment	An evaluation based on engineering, operational judgment and/or analysis methods
Assumption	Statement, principle and/or premises offered without proof.
Assurance	All planned and systematic actions necessary to provide adequate confidence that a product or service satisfies given requirements.
ATM Service	A service for the purpose of ATM
ATM System	ATM System is a part of ANS System composed of a Ground Based ATM component and an airborne ATM component. It includes the three constituent elements: human, procedures and equipment (hardware and software). The ATM system assumes the existence of a supporting CNS system.
ATM	The aggregation of ground based (comprising variously ATS, ASM, ATFM) and airborne functions required ensuring the safe and efficient movement of aircraft during all appropriate phases of operations.
Air Traffic Services	A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service). [ICAO]
C	
CNS System	All the hardware and software that make up a function, tool or application that is used to provide one or more air traffic management services. The CNS system is an enabler to the provision of ATM services.
Collision Risk	The expected number of mid-air aircraft accidents in a prescribed volume of airspace for a specific number of flight hours due to loss of planned separation.
Contingency	A description of any emergency measure that could be taken in the event the hazard arises.
Credible	Realistic, reasonably pessimistic. It implies a believable scenario.
E	
Environmental mitigation mean	Relevant mitigation mean, that could be specific to a particular RVSM environmental type, which must be accounted for in order to assign the severity class of a hazard. It includes contingencies.
Environmental Type	Classification of AFI local RVSM systems according to a set of ATM/CNS characteristics relevant for safety assessment
Extremely improbable	Not expected to happen more than exceptionally and in some specific circumstances throughout the AFI RVSM system.
Extremely remote	Expected to happen sometimes throughout the AFI RVSM system.
F	
Failure	The inability of any component of the ATM System to perform its intended function or to perform it correctly within specified limits.
Flight Technical Error	The difference between the altitude indicated by the altimeter display being used to control the aircraft and the assigned altitude/flight level.
H	
Hazard	Any condition, event, or circumstance, which could induce an accident. A potentially unsafe condition. A situation which has the potential to lead to harm.

Height Keeping Performance	The observed performance of an aircraft with respect to adherence to cleared flight level.
M	
Mitigation	Steps taken to control or prevent a hazard from causing harm and reduce risk to a tolerable or acceptable level.
Mitigation mean	The mean by which a risk can be lowered to a tolerable or acceptable level as determined by the risk tolerance/acceptance criteria. There are two kinds of mitigation means: environmental (existing) mitigation means and mitigation means to be developed (safety requirements)
O	
Operating Method	Operating mode of successive controller/pilot tasks associated to the procedures applicable in a given operational scenario. It reflects how RVSM is operated under given operational situations.
Operational Scenario	Operational situations when operating RVSM. The identification of hazard is based on operational scenario and associated operating method.
P	
Probable	Expected to happen often throughout the AFI RVSM system.
Procedures	Written procedures and instructions used by ATC personnel in the pursuance of their duties directly in connection with the provision of the ATM services.
R	
Remote	Expected to happen several times throughout the AFI RVSM system.
Repetitive hazard	Hazard that has been identified in different operational scenarios.
Residual risk	Risk that is considered as not tolerable after the defined mitigation strategy
Risk	The combination of the overall probability, or frequency of occurrence of a defined hazard and the magnitude of the effects of the occurrence.
Risk assessment	Assessment to establish that the achieved or perceived risk is acceptable or tolerable.
Risk classification scheme	Scheme providing relationship between severity class and probability classification. It associates a severity class, as assessed thanks to the severity classification scheme, with a tolerable probability (i.e., a maximum tolerable probability of ATM directly contributing to safety occurrences) to show that the more severe the effect of the hazard the less desirable it is that the hazard occurs. The boundary between tolerable and non tolerable risk areas is defined by the risk tolerance criteria.
Risk mitigation strategy	Mitigation strategy that aims to control or prevent a hazard and to reduce risk to a tolerable or an acceptable level. It consists in specifying safety requirements that are derived from the possible elimination/reduction/control factors.
RVSM Core Airspace	Airspace where operating RVSM is mature.
RVSM Switch Over	It includes the specific aspects related to the period immediately before and after the introduction of RVSM, which is taken to be approximately 24 hours before and 24 hours after the agreed RVSM implementation time.
RVSM System	RVSM System is a part of the AFI ATM System. It includes the ATM components (people, procedures and equipment) relevant in operating RVSM.
RVSM System Characteristic	Particular ATM/CNS attribute of the RVSM System that is strategic in nature and may contribute to providing a mitigation strategy. Usually constrained by airspace structure, separation minima, air traffic complexity, CNS capabilities and other factors affecting the application of ATS procedures.
RVSM System Element	RVSM System includes three high-level elements: people, procedures and equipment (hardware and software).
RVSM Transition Airspace	Airspace where RVSM – Non RVSM transitions are performed.
S	

Safety	Freedom from unacceptable risk.
Safety Assurance	All planned and systematic actions necessary to provide adequate confidence that a product, a service, an organisation or a system achieves acceptable or tolerable level of safety.
Safety critical hazard	Hazard whose associated safety objective has been assessed as not achieved. The associated risk is not tolerable.
Safety Level ***(risk level)***	A level of how far safety is to be pursued in a given context, assessed with reference to an acceptable or tolerable risk.
Safety Objective	A safety objective is a planned safety goal. The achievement of an objective may be demonstrated by appropriate means. A safety objective is a qualitative or quantitative statement that defines the maximum frequency or probability at which a hazard can be expected to occur. Where appropriate, it also specifies a maximum exposure time.
Safety Requirement	A risk mitigation mean to be developed contributing to the tolerability of a risk. Safety requirements could be specified to better control a hazard (reduction of the effects), or to lessen the probability of occurrence of this hazard, in order to meet a safety objective. Safety requirements may take various forms, including organisational, operational, procedural, functional, performance, and interoperability requirements or environment characteristics.
Severity	Level of effect/consequences of hazards on the safety of flight operations (I.e., combining level of loss of separation and degree of ability to recover from the hazardous situation…).
Severity Class	Gradation, ranging from 1 (most severe) to 5 (least severe), as an expression of the magnitude of the effects of hazards on the safety of operations
Severity Classification Scheme	Framework for assessing the severity of effects of hazard in a specific environment of operations (environmental type). It provides a qualitative ranking scheme for the severity/magnitude of the effect of a hazard on the safety of operations.
System	A combination of physical components, procedures and human resources organised to perform a function.
T	
Target Level of Safety	A generic term representing the level of risk which is considered acceptable in particular circumstances [ICAO Doc. 9536 RGCSP/6 Vol.1]
Technical Height Keeping Performance (or error)	That part of the height-keeping performance (or error) which is attributable to the combination of ASE and autopilot performance in the vertical dimension.
TVE	The vertical geometric difference between the actual pressure altitude flown by an aircraft and its assigned pressure altitude (flight level).
Tolerable	Risk Level specified by the approved risk tolerance criteria
Tolerable risk	Risk assessed as tolerable
V	
Valid hazard	Hazard validated after taking into account its potential repetitiveness. The severity assigned to a valid hazard is the most severe of those that have been given in the different operational scenarios.
Validation	Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Vertical Collision Risk	That part of the overall Collision Risk which arises solely from two aircraft, which should be vertically separated, being at the same altitude.
Verification	Confirmation by examination and provision of objective evidence that the requirements have been fulfilled.
W	
Worst operational conditions	The most unfavourable conditions, e.g. extremely high levels of traffic or extreme weather disruption

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Annex C: AFI RVSM FHA Methodology

This section presents the methodology applied for the AFI RVSM FHA.

C.1 Introduction

The AFI RVSM Functional Hazard Assessment was developed in compliance with the **Safety Assessment Methodology (SAM)** developed by the EUROCONTROL Safety & Quality Management and Standardisation Unit.

The SAM methodology is laid down in the "EATMP Air Navigation System Safety Assessment Methodology" **[18]**.

If we refer to the SAM processes and deliverables, **the AFI RVSM FHA consists of**:

- the **SAM Functional Hazard Analysis (SAM FHA)** and of,
- the first steps of the **SAM Preliminary System Safety Assessment (SAM PSSA)**

Indeed, the risk mitigation strategy, that corresponds to the first steps of the SAM PSSA, is part of the AFI RVSM FHA objectives.

C.2 AFI RVSM FHA methodology overview

The AFI RVSM FHA methodology consists of three main processes:

- The **Input Capture process** which consists of fixing the proposed AFI RVSM concept and the operational environment in which it will be operated.
- The **Hazard Assessment process** (corresponding to the SAM FHA) which aims to:
  1. ***Identify Potential Hazards***: What could go wrong with the system and what could happen if it did?
  2. ***Identify Hazard Effects***: How does it affect the safety of operations, including the safety of aircraft operations?
  3. ***Assess Severity of Hazard Effects***: How severe would those effects be?
  4. ***Specify Safety Objectives:*** How often can we accept hazards to occur?
- **The Risk Mitigation strategy** (corresponding to the first steps of the SAM PSSA) which aims to:
  1. ***Apply Risk Mitigation Strategies***: What can be done to eliminate, reduce or control hazards and their effect(s)?
  2. ***Apportion Safety Objectives into Safety Requirements to System Elements***: What is the part of the safety objectives to be allocated to architectural elements of the system?

The following figure illustrates these processes and the correspondence with the SAM methodology.

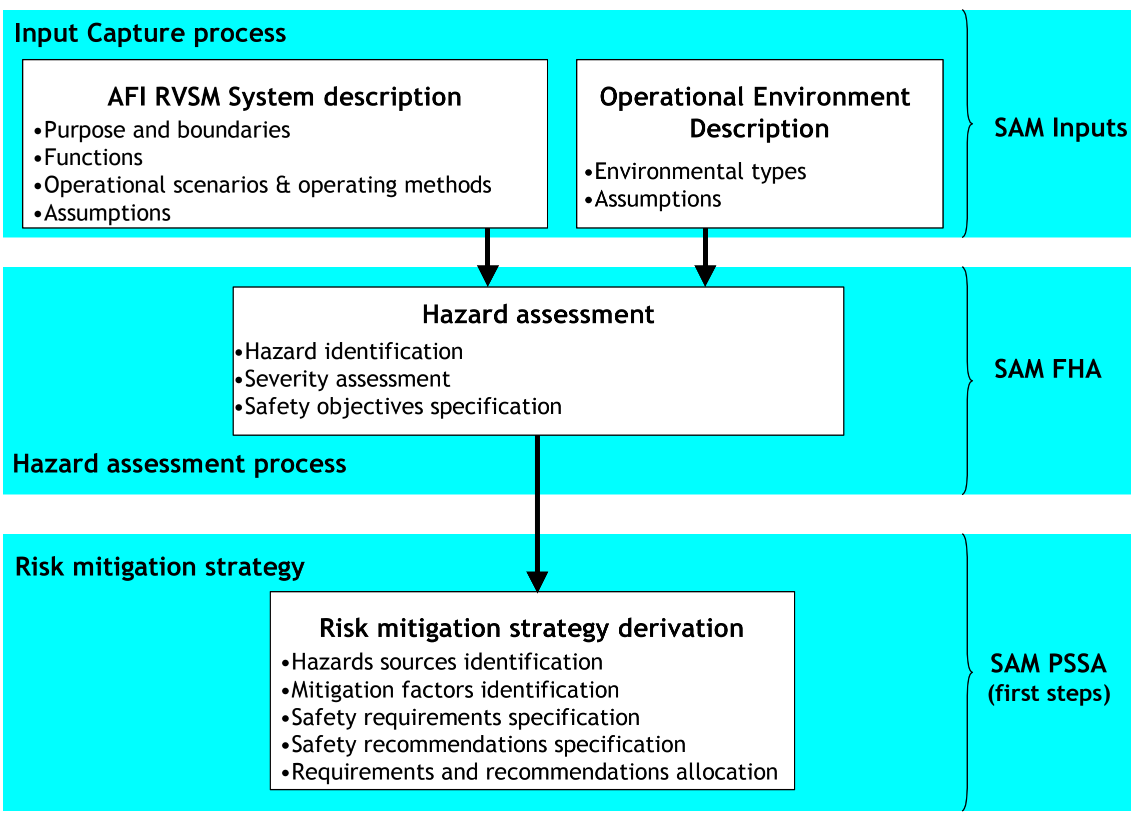

Figure 9 : AFI RVSM FHA methodology overview

C.3 Input Capture process

Objective

The objective of this process is to capture the operational environment of the proposed AFI RVSM System in order to make assumptions related to its functions, operational scenarios and environmental conditions. The assumptions made are reviewed all along the AFI RVSM FHA process.

Due to the inhomogeneous AFI operational environment, the AFI RVSM local airspaces with common ATM/CNS characteristics are described through Environmental Types. The rationale is that the hazard effects differ from the different operational conditions under which it could occur.

AFI RVSM System description

The aim is to provide a high-level description of the AFI RVSM system (functional equipment capabilities, people, procedures) composed of the AFI Air Navigation System components relevant in operating RVSM.

This description includes:

- Definition of the system purpose
- Definition of the system boundaries including:
  - Geographical boundaries (airspaces covered by the system)
  - Operational boundaries (where RVSM is operated and under which particular circumstances)
- Description of the operational scenarios (how RVSM will be operated) and associated operating methods
- Description of the system functions/architecture

AFI RVSM operational environment description (OED)

The objective is to provide a high-level description of the AFI RVSM operational environment, i.e. the ATM/CNS context into which RVSM will be operated.

This description include all the relevant characteristics when assessing the safety effects of the operational hazards, such as none exhaustively:

- Airspace characteristics (airspace classification, separation minima, route configuration and complexity, sectorisation, special use of airspace restrictions…)
- Traffic characteristics: complexity, density, track occupancy, military operations
- ATM/CNS capabilities: functionality, performance and limitations, level of automation, A/G and G/G communications capabilities, surveillance (radar , ADS..) capabilities…
- Aircraft performance and equipment: aircraft RVSM requirements
- Weather: local phenomena (turbulence, thunderstorms, sandstorms, volcanic ash…)

This serves as a basis for the specification of the AFI RVSM environmental types that represent the families under which the local RVSM Systems with common characteristics. The objective is to support hazard assessment by taking into consideration of the local conditions which differ from FIR to FIR.

Regulatory Framework

The objective is to specify the AFI RVSM FHA regulatory framework which is composed of:

- The **AFI RVSM Severity Classification scheme** which provides the criteria to assign a severity class to a given hazard.
- The **AFI RVSM Risk Classification Scheme** which provides the risk tolerance criteria and the framework to specify the safety objectives.

These schemes have been approved by the AFI RVSM TF/5 and are respectively provided in **Annex D** and in **Annex E**

Applicable standards

The objective is to identify all the standards applicable to the AFI RVSM System. This includes ICAO documents.

Others inputs

The objective is to identify any other inputs that serve as reference for AFI RVSM FHA. That includes experience gained from the others RVSM implementation.

C.4 Hazard Assessment process

Objective

The objectives of the hazard assessment process (that corresponds to the SAM FHA process) are:

- to identify hazard for each operational scenario,
- to assess hazard effects on the safety of RVSM operations,
- to specify a safety objective for each identified hazard according to the severity class.

Identification of operational hazards

What could go wrong?

The purpose of this task is to identify potential hazards. The identification is based on the operational scenarios identified and are related to the considered operating method.

This task is in particular performed through structured brainstorming sessions attended by operational experts with relevant experience in the AFI environment.

Assessment of hazard severity

What happens if the hazard occurs? How strongly the safe provision of RVSM will be affected by the hazard?

This task consists of assessing hazard consequences on the safety of RVSM operations. This is performed by considering the effects on the various components of the AFI RVSM system.

The effect magnitude scale has been divided into 5 severity class, ranking from 1 (most severe) to 5 (least severe) pointing out three major headings needed to be considered for a consistent assessment:

- Safety of RVSM service provision: effects on the ability to provide or maintain safe provision of RVSM, especially, impacts on separation margins,
- Working conditions: effects on the controller(s) and flight crew ability to cope with the reduction in functional capability, especially, impacts on their workload,
- Adverse operational and environmental conditions: effects on the ability for controller and/or flight crew to cope with adverse operational and environmental conditions.

The **AFI RVSM Severity Classification scheme** provided the criteria to assign a severity class to a given hazard.

Although criteria are developed, it remains a subjective evaluation to be performed through structured brainstorming sessions.

Specification of the AFI RVSM Safety Objectives

How safe shall the AFI RVSM system be? How often can we accept hazards to occur?

The risk classification scheme provides the framework to assign a safety objective to each identified hazard according to its severity class. This safety objective is expressed as a class of probability of occurrence that shall be met to ensure the tolerability of the risk associated.

C.5 Risk mitigation strategy

Objective

The objectives of the risk mitigation strategy (that correspond to the first steps of SAM PSSA process) are :

- To derive a shared risk mitigation strategy by identifying mitigations factors,
- To specify safety requirements ensuring that the safety objectives are met,
- To allocate the requirements to the high level elements of the AFI RVSM System.

Identification of mitigation factors:

What can be done to eliminate, reduce or control hazards and their effect(s)?

The purpose of the risk mitigation strategy is to develop mitigation means to ensure the tolerability of the risks identified. This is performed through the identification of the different factors which could contribute to:

- **Hazard elimination:** Hazards should, as far as it is consistent with operational objectives and environment constraints, be eliminated from the AFI RVSM System design, by the selection of the least hazardous design options and/or limiting operational usage.
- **Hazard reduction:** If hazards cannot be eliminated, attempts should be made to reduce the frequency with which these hazards are expected to occur. This also includes the reduction of the frequencies of the failure modes to occur and thus their contribution to hazard potential occurrence.
- **Hazard control :** For remaining hazards, the AFI RVSM System design shall ensure that, if a hazard does occur, it does not result in an intolerable risk by reducing the hazard effects. Hazard control requires recovery mechanisms and contingency procedures or the implementation of design features for a timely detection of critical failures.

Specification of AFI RVSM FHA safety requirements

What is the part of the safety objectives to be allocated to architectural elements of the AFI RVSM System? How mitigation factors are reflected through requirements to be achieved by the related elements of the System?

Once the mitigation factors have been identified, safety requirements are derived from. They reflects the mitigation means to be implemented and may take various forms, including organisational, operational, procedural, functional, environment characteristics…

Their specification, as well as the identification of the mitigation factors, is performed through structured brainstorming session.

Allocation of Safety Objectives and Requirements

The purpose of this process is to allocate the high-level the safety requirements to the components of the AFI RVSM System.

C.6 AFI RVSM FHA Outputs

The AFI RVSM FHA outputs:

- Regarding the **Input Capture Process:**
  - The list of the assumptions made
  - A high-level description of the AFI RVSM System
  - The environmental types specified
- Regarding the **Hazard Assessment Process:**
  - The classification of the identified hazards
  - The AFI RVSM FHA Safety Objectives
- Regarding the **Risk mitigation Strategy:**
  - The AFI RVSM FHA Safety Requirements
  - The allocation of the AFI RVSM Safety Requirements to the high-level elements of the AFI RVSM System
  - The residual risks (see below)

Hazards that do not achieve their safety objective after mitigation remains safety critical, meaning that the risk associated remains not tolerable. These risks, named as “**residual risks**” will require the attention of the RVSM Program to ensure a proper resolution before the implementation of the AFI RVSM System.

The allocated safety requirements constitute the main results of the AFI RVSM FHA. They constitutes the minimum requirements to be achieved by the AFI RVSM system elements. They will be used as input where appropriate for the PISC and for the National Safety Plans, which aim to provide evidence of satisfaction.

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Annex D: AFI RVSM Severity Classification Scheme

What happens if the hazard occurs?

How strongly the safe provision of RVSM will be affected by the hazard?

This section presents the AFI RVSM Severity Classification Scheme approved by the ARTF/5 (Dakar – November 2005).

D.1 Purpose

The purpose of the AFI RVSM severity classification scheme is to provide a framework for assigning a severity class to a defined hazard. This severity class gives an indication of the impact on the safety of RVSM operations in case the hazard arises.

It is based on the EUROCONTROL Safety Regulatory Requirement (ESARR) 4 "Risk Assessment and Mitigation in ATM" - ref [32] – with minor modifications for communicating and understanding the classification table.

D.2 Assessment of hazard effects on safe RVSM operations

The potential for a hazard to lead to an accident or an incident - considering both the proximity of the accident and the degree of ability to recover from the hazardous situation – depending on many factors, the scope of operational effects assessment should thus include all components and systems involved in RVSM provision, as well as the environment of operations.

Three major headings can be pointed out to support the assessment :

- Safety of RVSM service provision: effects on the ability to provide or maintain safe provision of RVSM, especially, impacts on separation margins,
- Working conditions: effects on the controller(s) and flight crew ability to cope with the reduction in functional capability, especially, impacts on their workload,
- Adverse operational and environmental conditions: effects on the ability for controller and/or flight crew to cope with adverse operational and environmental conditions.

This should be seen as characteristics needed to be considered for a consistent assessment of effects. They are included in the following severity classification scheme.

D.3 Severity classification scheme

The severity classification scheme is a qualitative ranking scheme for the magnitude of the safety consequences of a given hazard.

Severity Class	1 [Most Severe]	2	3	4	5 [Least Severe]
Effect	**Complete loss of safety margins**	**Large reduction in safety margins**	**Major reduction in safety margins**	**Slight reduction in safety margins**	**No effect on safety**
Examples of Effects include:	Accidents, including: ✈ one or more catastrophic accidents, ✈ one or more mid- air collisions _ one or more collisions on the ground between two aircraft ✈ one or more Control Flight Into Terrain ✈ Total loss of flight control. No independent source of recovery mechanism, such as surveillance or ATC and/ or flight crew procedures can reasonably be expected to revent the accident(s).	Serious incidents, including: ✈ large reduction in separation (e. g. higher than half the separation minima), **without** crew or ATC fully controlling the situation or able to recover from the situation. ✈ one or more aircraft deviating from their intended clearance, ***and*** abrupt collision or terrain avoidance manoeuvres are required to avoid an accident (or when an avoidance action would be appropriate).	Major incidents, including: ✈ Large reduction in separation (e. g. higher than half the separation minima) **with** crew or ATC fully controlling the situation and able to recover from the situation. ✈ Major reduction in separation (e. g., lower than half the separation minima) **without** crew or ATC fully controlling the situation, hence jeopardising the ability to recover from the situation (without the use of collision or terrain avoidance manoeuvres).	Significant incidents, incl.: ✈ No direct impact on safety but indirect impact on safety by increasing the workload of the air traffic controller or aircraft flight crew, **or** slightly degrading the functional capability of the enabling CNS system. ✈ Major reduction in separation (e. g. lower than half the separation minima) **with** crew or ATC controlling the situation and fully able to recover from the situation.	No hazardous condition, i. e. no direct or indirect impact on the operations.

Figure 10 : AFI RVSM severity classification scheme

It allows classifying the hazards into 5 severity classes, class 1-5, with severity 1 as the most severe classification with complete loss of safety margins and severity 5 as the least severe classification with no safety consequences. It mainly focuses on the extent of the reduction of separation if the hazard occurs and whether or not the Flight Crew or Controller is fully controlling the situation and able to recover from.

Note: Reference is ESARR4 " Risk assessment and mitigation in ATM" – Eurocontrol – version 1.0
Note': Examples of effects are not exhaustive and the generic qualitative classification approach is not restricted to these criteria.

D.4 Severity class decision matrix

According to experience gained in FHA processes for other RVSM implementations, as in EUROPE, the two most commonly identified safety consequences are “potential loss of separation” and the associated “controller/pilot ability to fully control the situation”. They constitute the high level operational effects, as the ATM service considered in RVSM operation is a separation service.

Hence, in order to enhance communicating and understanding of the severity classification scheme, the following decision matrix has been developed to supporting decision during the FHA sessions.

	Not Controlled by Crew or ATC controllers	**Controlled** by Crew or ATC controller
Total loss of separation	1	
Large Reduction in Separation i.e. >50%	2	3
Major Reduction in Separation i.e. <50%	3	4
No Reduction of Separation	5	

Figure 11 : AFI RVSM decision matrix

This matrix aims to assist operational experts attending brainstorming sessions in severity class assignment, which requires a subjective judgment. As today there is no scheme as an accident/incident causation model, the most probable effect of hazards shall be assessed under the worst case scenario. In others words, the worst credible outcomes are considered. The rationale should be given.

To some extent, when assessing worst credible consequences, the following sets of indicators should also be considered:

- Various types of exposure (e.g. number of aircrafts exposed to the hazard…),
- Environmental types characteristics - which can be used as compensating factors – including recovery indicators (detection and diagnosis, contingencies available…)

Hence, the severity class is subjected to differ from the different environmental types identified within AFI RVSM System.

D.5 Consideration of existing mitigation means

Existing mitigations means can be used to prevent the hazard from occurring or to minimise its operational effects (and consequently to lower its severity class). They can be organisational, procedural (contingencies…) or functional (detection and diagnosis…).

To be taken into consideration when assessing the severity, they shall already exist today in CVSM or shall be RVSM mitigations already known and planned and taken as assumption to the FHA.

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Annex E: AFI RVSM Risk Classification Scheme

How safe shall the AFI RVSM System be?

This section presents the AFI RVSM Classification Scheme as approved by the ARTF/5 (Dakar – November 2005).

E.1 AFI RVSM risk classification scheme

A safety objective is defined as the maximum frequency at which a hazard can be tolerated to occur. It depends on the hazard severity.

To support safety objective specification, the probability scale is divided into 4 probability classes that are gradation, ranging from extremely improbable (more stringent) to probable (less stringent):

- **Extremely improbable :** the occurrence is not expected to happen more than exceptionally and in some specific circumstances throughout the AFI RVSM system.
- **Extremely remote :** the occurrence is expected to happen sometimes throughout the system.
- **Remote:** the occurrence is expected to happen several times throughout the AFI RVSM system.
- **Probable:** the occurrence is expected to happen often throughout the AFI RVSM system.

Probability Class	Per flight hour / per aircraft	AFI RVSM Airspace
Extremely improbable	$P \leq 10^{-9}$	P≤1/100 years
Extremely remote	$10^{-9} < P \leq 10^{-7}$	1/100 years < P ≤ 1/year
Remote	$10^{-7} < P \leq 10^{-5}$	1/year < P ≤ 1/day
Probable	$10^{-5} \leq P$	1/day ≤ P

Table 18: Probability classification

The **AFI RVSM risk classification scheme** provides the coherence between the severity class and the probability classification:

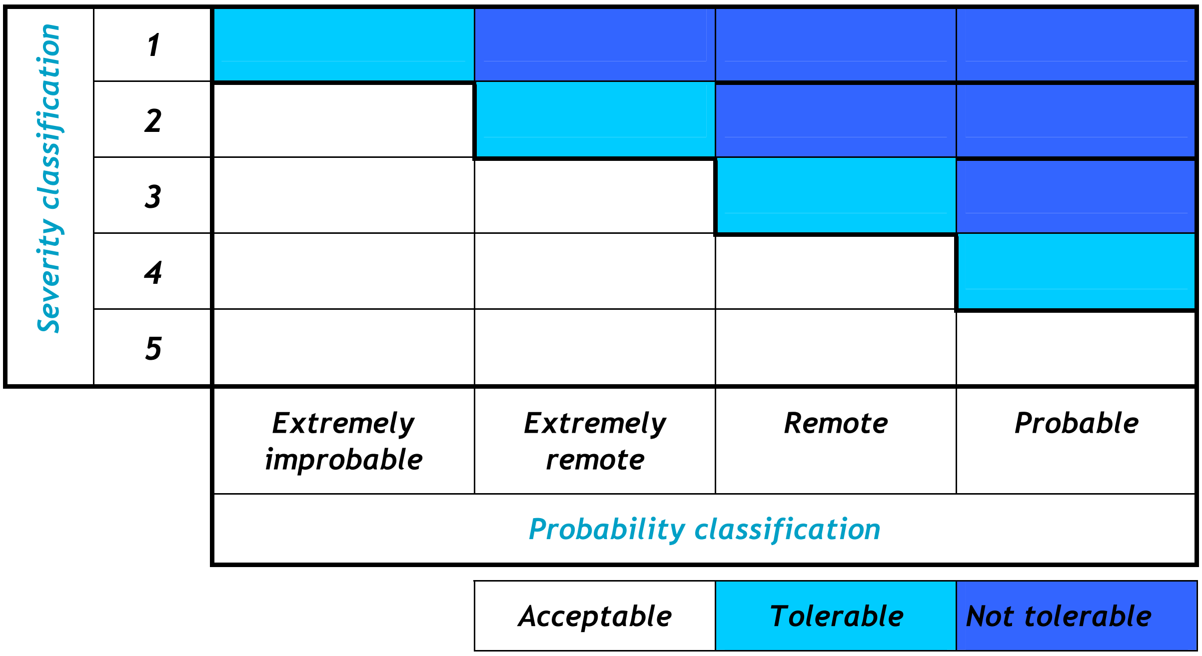

Figure 12 : AFI RVSM risk classification scheme

E.2 Safety objectives

Safety objectives are expressed as follows for severity classes ranked 1 to 3:

Severity class	Safety objective
1	The probability of the hazard occurring shall not be greater than extremely improbable
2	The probability of the hazard occurring shall not be greater than extremely remote
3	The probability of the hazard occurring shall not be greater than remote

Table 19: Safety objectives

Note: severity 4 and 5 classified hazards are not assigned a safety objective, they are considered as not safety critical hazards

Annex F: Traceability Framework

This section presents the traceability framework between the different elements outputted by the AFI RVSM FHA process and describes the forms in which they are presented.

F.1 Environmental types

The Environmental Types specified during the AFI RVSM FHA process are referenced according to the following form:

ENV_[X] with:

- **ENV** = Environmental type
- **[X]** = Number of the environmental type

The environmental conditions applying to the different environmental types are presented in the environmental condition table:

Environnemental type reference	Environmental conditions
ENV_[X]	Description of the environmental conditions

Table 20 : Enviromental conditions table

F.2 Operational scenarios and associated operating methods

AFI RVSM operational scenarios are referenced as follows:

[COMP]_[TYPE]_[XX] with:

- **[COMP]** = Operational area of the AFI RVSM concept in which the scenario is considered:
  - **Core** for the core/mature airspace
  - **Swit** for the switchover period
- **[TYPE]** = Type of scenario:
  - **Nom** for a normal operations scenario
  - **Abn** for an abnormal operations scenario
  - **Mis** for a miscellaneous scenario
- **[XX] =** Number of the scenario:
  - **0X** for a normal operations scenario
  - **1X** for an abnormal operations scenario
  - **2X for** a miscellaneous scenario

Operating methods reflecting how RVSM is operated under the operational conditions of the scenario are presented as follows:

Step	**Actions (by pilot, controller or system)**
Environmental type	**ENV_[X]** concerned by the operating method
1	Action for initial step: - information - required checking - handling of information - source and/or destination of information
2	Action for next step
3	…
…	Final Step

Table 21: Operating method description table

Each row in the table describes a step in the operations for the considered environmental type, as the operating method could differ from the Air Traffic Services provided.

F.3 Hazards classification

Identified hazard (per operational scenarios)

They are the hazards identified per operational scenario . Some of them are related to different operational scenarios (repetitive hazards) and have been grouped in unique ones to be named as approved hazard for the next steps of the process.

They are referenced as follows:

$H_{[COMP]}$_[XX].[Y] with:

- **H** = Identified hazard
- **[COMP]** = Operational area of the AFI RVSM concept in which the hazard is identified
    - **CORE** = Core airspace
    - **TRAN** = Transition airspace
    - **SWIT** = Switch-over period
- **[XX] =** Number of the considered hazard
    - **0X** for a normal operations scenario
    - **1X** for an abnormal operations scenario
    - **2X** for a miscellaneous scenario
- **[Y]** = number of the hazard

Operational hazard

The approved hazards are referenced as follows:

$AH_{[COMP]}$.[XX] with:

- **AH** = Approved hazard
- **[COMP]** = Operational area of the AFI RVSM concept in which the hazard is approved
  - **CORE** = Core airspace
  - **SWIT** = Switch-over period
- **[XX] =** Number of the considered hazard

They correspond to the identified hazards that have been grouped in unique ones when they were relevant for different operational scenarios.

Their classification presented in the **Hazard Classification Table** which takes the following form:

Hazard reference	Hazard Description	Env. Types	Severity class	Severity Rationale	Id. Hazards	Safety objective and criticity
Reference AH_{COMP}_[XX]	Designation of the hazard (wording)	Operational environment where the hazard and associated severities are applicable	Severity class 1-5	Rationale of the severity gradation	Backtrace to the associated identified hazard (in the different operational scenarios) H_{COMP}_[XX].[Y]	- Associated safety objective - Hazard criticality (achievement or not before mitigation) with rationale

Table 22: Hazard classification table form

F.4 Safety requirements and recommendations

The safety requirements are referenced as follows:

Req$_{[COMP]}$.[XX] with:

- **Req** = Safety Requirement
- **[COMP]** = Operational area of the AFI RVSM concept in which the requirement is applicable
    - **CORE** = Core airspace
    - **SWIT** = Switch-over period
- **[XX]** = Number of the considered requirement

The safety recommendations are referenced as follows:

Rco$_{[COMP]}$.[XX] with:

- **Rco** = Safety Recommendations
- **[COMP]** = Operational area of the AFI RVSM concept in which the recommendation is applicable
    - **CORE** = Core airspace
    - **SWIT** = Switch-over period
- **[XX]** = Number of the considered recommendation

The high-level elements of the AFI RVSM System into which the requirements and recommendations are allocated, are referenced as follows:

- AIR_DES : Airspace Design
- AIR_PRO : Air Procedures (Flight crew, operators, maintenance staff)
- AIR_TRA : Air staff Training (Flight crew, operators, maintenance staff)
- AIR_EQU : Aircraft Equipment
- ATC_PRO : ATC Procedures (ATCO, maintenance staff, military controllers)
- ATC_TRA : ATC Training (ATCO, maintenance staff, military controllers)
- ATC_EQU : ATC Equipment
- SYS_MON : System Monitoring
- RVSM_PRO : RVSM Program

Their derivation from the risk mitigation strategy is presented in the Hazard Mitigation Table that takes the following form:

Hazard description	**Env. Type**	**Sev**	**Safety objective Criticity**	**After mitigation**	**Risk elimination (hazard)**	**Risk reduction (causes)**	**Risk control (effects)**
Hazard reference **AH $_{core}$_XX** Hazard description	Operational environment where the hazard and associated severities are applicable	Severity class 1-5	Associated safety objective - Hazard criticality with rationale	Revised severity class after mitigation when applicable or '—' Resulted safety objective when applicable or '—' Hazard criticity after mitigation when relevant or '—'	Elimination factors Derived safety requirements Derived safety recommendations	Hazard causes Reduction factors Derived safety requirements Derived safety recommendations	Hazard generic effects Control factors Derived safety requirements Derived safety recommendations

Table 23: Hazard mitigation table form

Their allocation to the high-level elements of the AFI RVSM System is presented in the Allocation Table that takes the following form:

		Procedures	Training	Equipment	AFI RVSM Programme
Req/Rco$_{[COMP]}$.[XX] Requirement/Recommendation reference Requirement/Recommendation description Backtrace to the hazard applicable to the requirement/recommendation	**AIR**	'☺' = req/rec allocated to the **AIR_PRO** element	'☺' = req/rec allocated to the **AIR_TRA** element	'☺' = req/rec allocated to the **AIR_EQU** element	'☺' = req/rec to be addressed and satisfied by appropriate actions of the **AFI RVSM Programme** (Switch-Over period only)
	ENV X	'☺' = req/rec allocated to the **ATC_PRO e**lement and applicable to the environmental type ENV_X	'☺' = req/rec allocated to the **ATC_TRA** element and applicable to the environmental type ENV_X	'☺' = req/rec allocated to the **ATC_EQU** element and applicable to the environmental type ENV_X	'☺' = req/rec to be addressed and satisfied by appropriate actions of the **AFI RVSM Programme** (Switch-Over period only)

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AFI RVSM FUNCTIONAL HAZARD ASSESSMENT

APPENDICES A-D

innovation & technologie

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Appendix A: AFI RVSM FHA Brainstorming Sessions

This section describes how the three AFI RVSM Brainstorming sessions have been performed.

A.1 History of the meetings

The three Brainstorming Sessions for the AFI RVSM Programme were convened at the Aviation Training Academy (ATA) of Air Traffic Navigation Services (ATNS), Johannesburg, Republic of South Africa.

The schedule was the following:

- Session 1: 1-5 November 2004
- Session 2: 31 January- 4 February 2005
- Session 3: 4-8 April 2005

The sessions were organised by the ARMA in coordination with ICAO and prepared, animated and moderated by the ALTRAN TECHNOLOGIES project team of 4 consultants.

They were conducted in the English language and when appropriate in the French language, ALTRAN TECHNOLOGIES consultants acting as translators.

A.2 Preparation of the session

The sessions were prepared in coordination with ICAO and ARMA. Each participant received prior to the sessions a working pack including the session Guidelines **[15][16][17]** and other relevant material regarding RVSM operations and safety assessment.

The Guidelines describe the sessions scope, objectives and approach and provide the inputs coming from ALTRAN TECHNOLOGIES analysis.

The objective of the material was to allow participants to familiarise themselves with the AFI RVSM FHA methodology and with the work to be completed.

A.3 Attendance

The three sessions were attended by 57 participants from AFI States and International Organisations, namely ICAO, ARMA, IATA and IFALPA . The complete list of participants is provided in **Appendix B.**

The participants have been grouped into five categories:

- Air traffic controllers
- Pilots
- Flight safety inspectors, airworthiness and certification engineers
- ATM experts, National Program Managers (NPM)
- CNS engineers

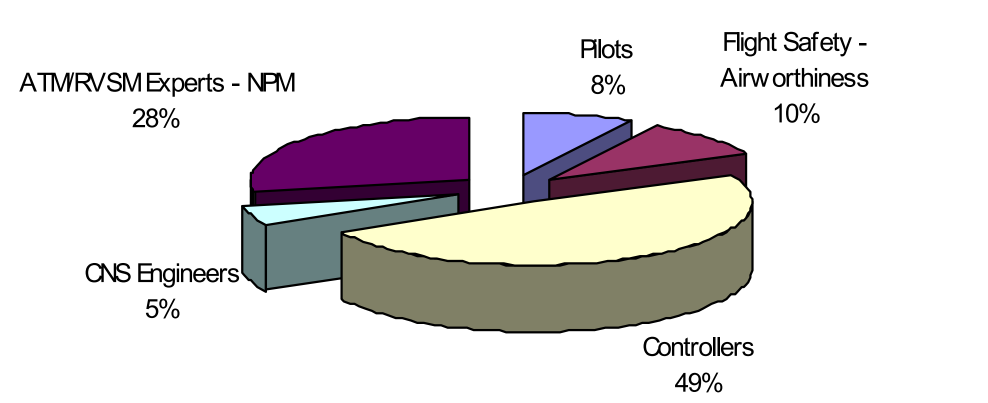

Figure 1: AFI RVSM working group composition

This composition reflects that the sessions were attended by experts representing the various groups of people who will design or develop as well as work with the future AFI RVSM system, ensuring the representative outcome of the sessions.

Moreover, it should be mentioned the great involvement from the attendees and the maturity reached by the group in a very short time, giving further confidence in the relevance and completeness of the results.

A.4 Session process and approach

The sessions were introduced by the presentation to the participants of the session scope and objectives, as described in the related guidelines. An introduction on the safety wording, the AFI RVSM FHA methodology and on the AFI RVSM safety assessment background were also given.

The work sub-sessions were facilitated by a moderator who encouraged the participants to come forward with all concerns and though, and who ensured that the session maintained a structured approach and kept the discussions relevant without restricting new and unexpected views/ideas.

The results were recorded on a database especially tailored for the session purposes and displayed on-line for plenary approval.

Daily debriefings on the work progress status were also given, as well as a final debriefing which summarised the session results. The outputs were included in an outcome material distributed to the participants.

The session reports **[12][13][14]** were circulated with a comment form to the working group members few weeks after the sessions.

A.5 Objectives and work completeness report

As integral part of the AFI RVSM FHA process, the brainstorming sessions objectives **[15][16][17]** were associated to the appropriate methodological tasks as presented in **Annex C.**

These objectives have been completed as follows:

OBJECTIVES	CORE	TRANSITION	SWITCH OVER
Environmental types specification	Session I	Session I	Session II
Operational scenarios identification	Session I	Session I	Session II
Hazard identification	Session I	Session I	Session II
Severity assessment	Session I	Session I	Session II
Hazard approval and classification	Session II	--	Session II
Safety objective specification	Session II	--	Session II
Hazard criticity assessment	Session II	--	Session II
Hazard criticity rationale approval	Session III	--	Session III
Mitigation factors identification	Session III	--	Session III
Safety requirements specification and approval	Session III	--	Session III
Safety recommendations specification and approval	Session III	--	Session III

Table 1: Brainstorming sessions work completeness report

It should be noted that the work related to the AFI RVSM Transition Airspace have been considered as out of scope during the project in accordance with ICAO and ARMA. The reason is that the CAR/SAM Region has implemented RVSM since January 2005.

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Appendix C: AFI RVSM OPERATIONAL SCENARIOS

This section presents the Operational Scenarios identified and assessed during the Brainstorming Sessions in order to support hazard identification and assessment.

C.1 AFI RVSM Core/Mature Airspace scenarios

Nine (9) operational scenarios have been identified and assessed for the AFI RVSM core airspace, six (6) regarding normal RVSM operations and three (3) regarding abnormal operations.

C.1.1 Normal RVSM operations

CORE_NOM_1: Flying according to assigned flight level in RVSM core airspace

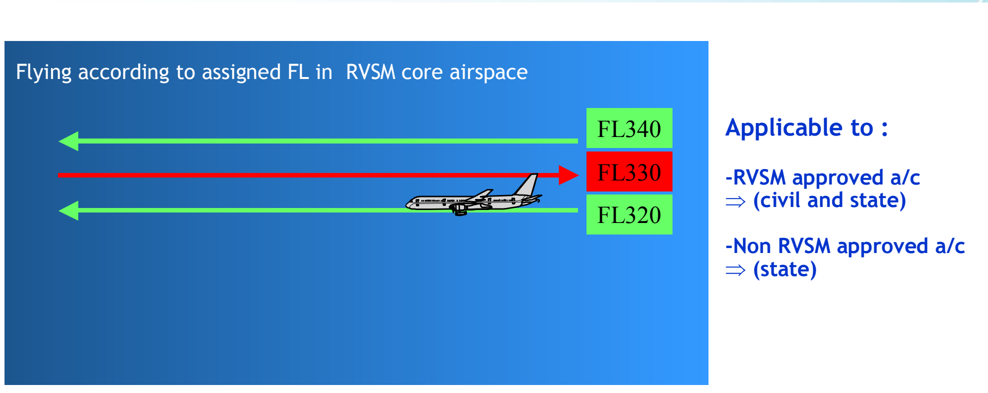

Figure 2: Flying according to assigned level in core airspace (CORE_NOM_1)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	ENV_4 and ENV_3
1	Pilot keeps Height Keeping System in command	
2	Approximatively every hour, Pilot checks the altitude indications. At least two main indicators should be within 200 feet	
3	Pilot reports its position at specific waypoints	

Table 2: CORE_NOM_1 operating method

CORE_NOM_2: Change of flight level (descent/climb) inside RVSM core airspace

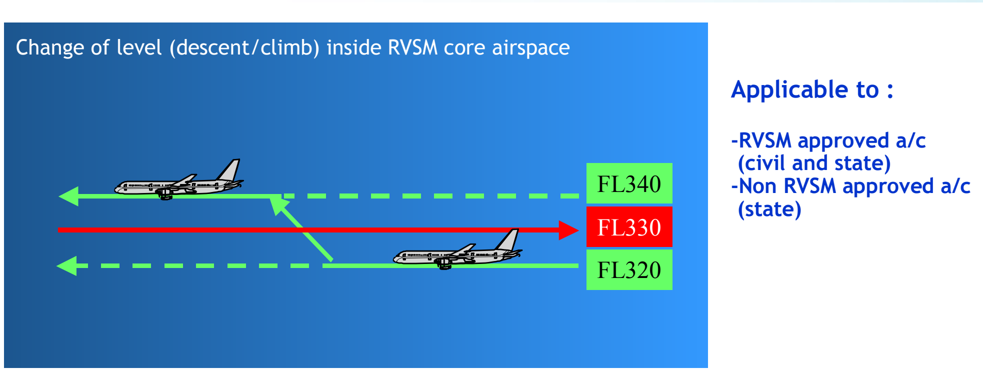

Figure 3: Change of flight level inside core airspace (CORE_NOM_2)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	**ENV_4 and ENV_3**
1	Pilot requests to descend/climb in RVSM airspace (option)	Pilot informs the controller of its intention to descend/climb in RVSM airspace (according to its flight plan)
2	Controller clears pilot to RVSM FL	Controller provides information when needed to the pilot
3	Pilot descends/climbs to cleared FL	Pilot descends/climbs to reach the planned FL
4	Pilot reaches cleared FL	Pilot informs when reaching the FL
5	Pilot reports when cleared FL is reached	

Table 3: CORE_NOM_2 operating method

CORE_NOM_3: Change of ACC/UAC

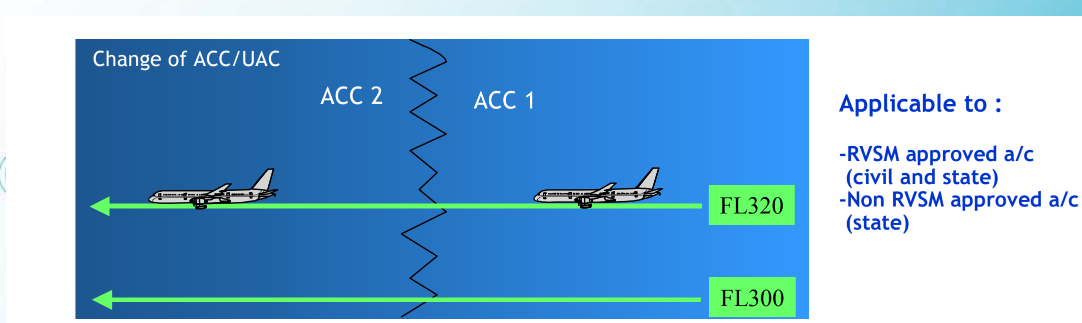

Figure 4: Change of ACC/UAC (CORE_NOM_3)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	**ENV_4 and ENV_3**

1	Flight plan is transmitted to ACC2 in accordance to LoAs	Flight plan is transmitted to ACC2 in accordance to LoAs
2	Controller ACC1 coordinates with controller ACC2 the aircraft transfer conditions (ATS/DS)	Controller ACC1 coordinates with controller ACC2 the aircraft transfer conditions (ATS/DS)
3	Controller ACC1 performs aircraft transfer to ACC2	Controller ACC1 performs aircraft transfer to ACC2

Table 4: CORE_NOM_3 operating method

CORE_NOM_4: Entrance to RVSM core airspace

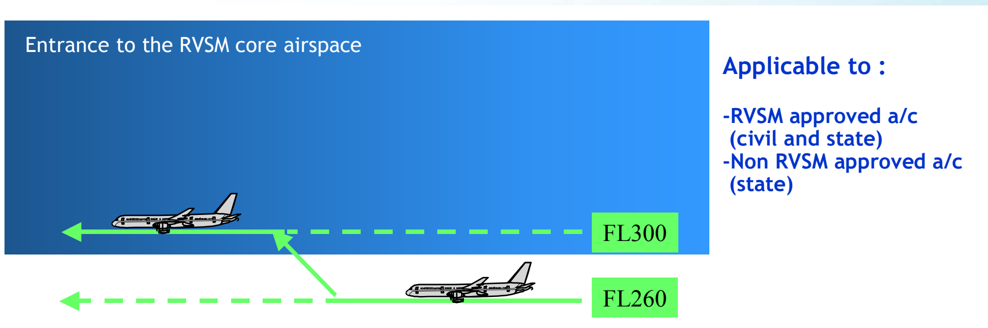

Figure 5: Entrance to core airspace (CORE_NOM_4)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	ENV_4 and ENV_3
1	Pilot requests to descend/climb in RVSM airspace (option)	Pilot informs the controller of its intention to climb in RVSM airspace
2	After checking RVSM Status, Controller clears pilot to RVSM FL	Controller provides information when needed to the pilot
3	Pilot climbs to cleared FL	Pilot climbs at its own discretion
4	Pilot reaches cleared FL	Pilot informs when reaching the FL
5	Pilot reports when cleared FL is reached	

Table 5: CORE_NOM_4 operating method

CORE_NOM_5: Exit RVSM core airpsace

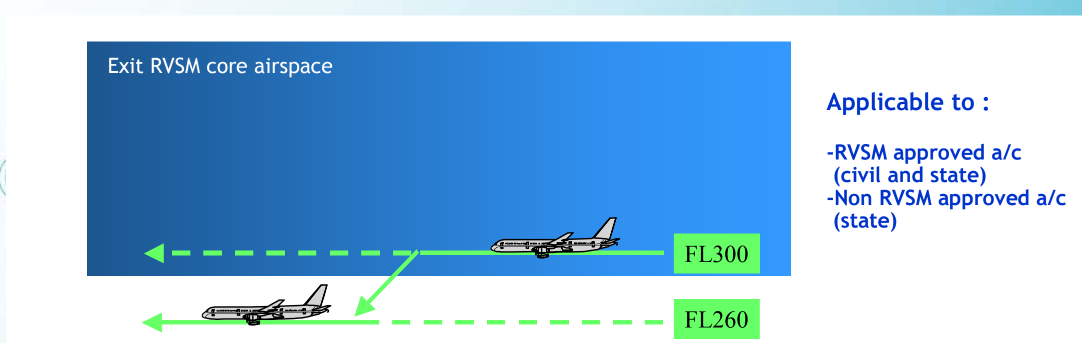

Figure 6: Exit core airspace (CORE_NOM_5)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	ENV_4 and ENV_3

1	Pilot requests to leave the RVSM airspace (option)	Pilot informs the controller of its intention to leave the RVSM airspace
2	Controller clears pilot to leave the RVSM airspace	Controller provides information when needed to the pilot
3	Pilot leaves the RVSM airspace	Pilot leaves the RVSM airspace at its own discretion
4	Pilot reaches cleared FL	Pilot informs when reaching the planned FL
5	Pilot reports when cleared FL is reached	

Table 6: CORE_NOM_5 operating method

CORE_NOM_6 : Crossing RVSM core airspace

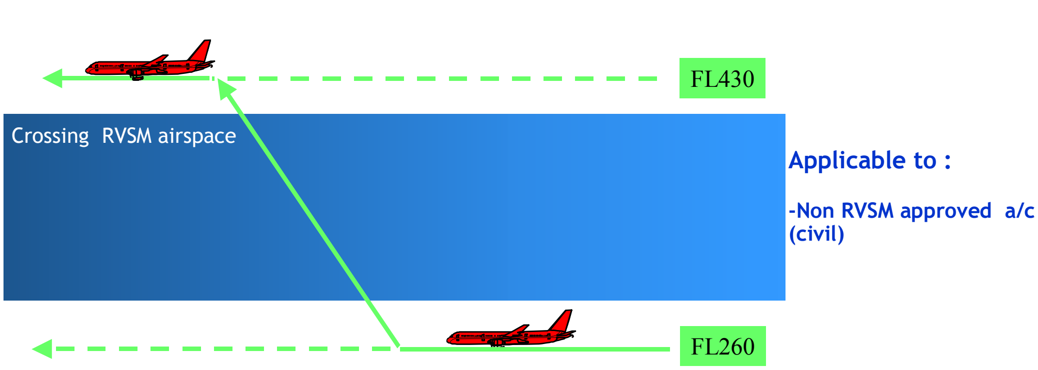

Figure 7: Crossing RVSM core airpsace (CORE_NOM_6)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	**ENV_4 and ENV_3**
1	Pilot requests to climb above the RVSM airspace (option)	Pilot informs the controller of its intention to climb above the RVSM airspace
2	Controller clears pilot to climb above the RVSM airspace	Controller provides information when needed to the pilot
3	Pilot climbs to cleared FL	Pilot climbs at its own discretion
4	Pilot reaches cleared FL	Pilot informs when reaching the planned FL
5	Pilot reports when cleared FL is reached (option dependent on Env Type)	

Table 7: CORE_NOM_6 operating method

C.1.2 Abnormal RVSM operations

CORE_ABN_11: Deviation from assigned flight level due to local weather phenomena

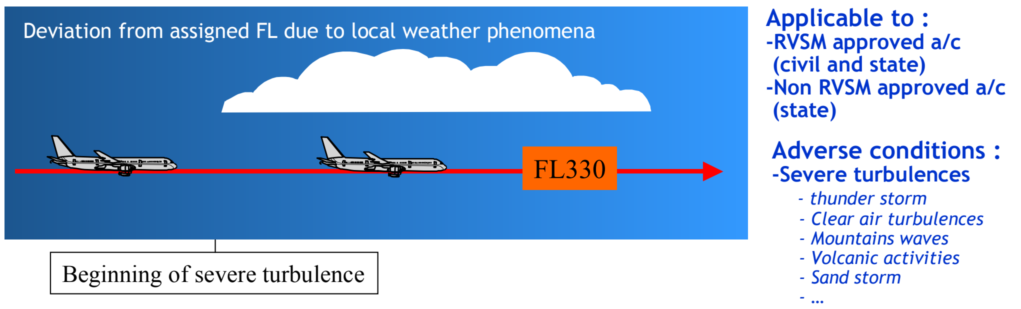

Figure 8: Deviation from assigned FL due to local wheather phenomena (CORE_ABN_11)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	ENV_4 and ENV_3
1	Pilot applies the weather deviation procedures (in flight contingencies)	Pilot applies the weather deviation procedures (in flight contingencies)

Table 8: CORE_ABN_11 operating method

CORE_ABN_12: Deviation from assigned flight level due to adverse traffic conditions

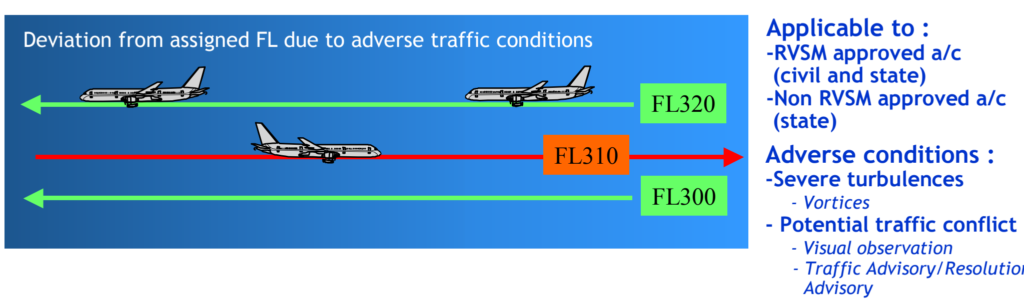

Figure 9: Deviation from assigned FL due to adverse traffic conditions (CORE_ABN_12)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	ENV_4 and ENV_3
1	Pilot applies general procedures (in flight contingencies)	Pilot applies general procedures (in flight contingencies)

Table 9: CORE_ABN_12 operating method

CORE_ABN_13: Emergency descent

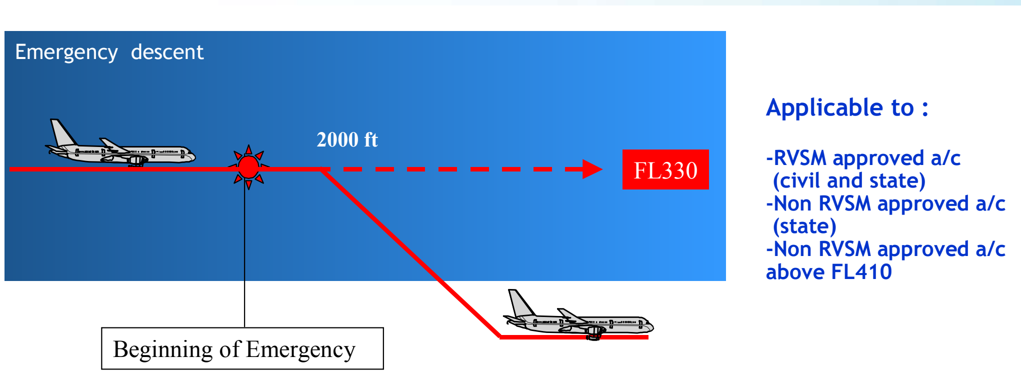

Figure 10: Emergency descent (CORE_ABN_13)

Step	ATC airspace	FIS airspace
	ENV_1 and ENV_2	ENV_4 and ENV_3
1	Pilot applies Emergency procedures (in flight contingencies)	Pilot applies Emergency procedures (in flight contingencies)

Table 10: CORE_ABN_13 operating method

C.2 AFI RVSM Operational Scenarios for the Switch-Over Period

Four (4) operational scenarios have been identified and assessed for the AFI RVSM Switch-over period. Relevance of SWIT_NOM_02b and SWIT_NOM_04b depends in the validity of the assumption (K) regarding the possibility for non RVSM civil approved aircraft to transit through the RVSM airspace.

C.2.1 State or RVSM civil aircraft flying at T0 (SWIT_NOM_01)

SWIT_NOM_01a: RVSM aircraft flying at T0

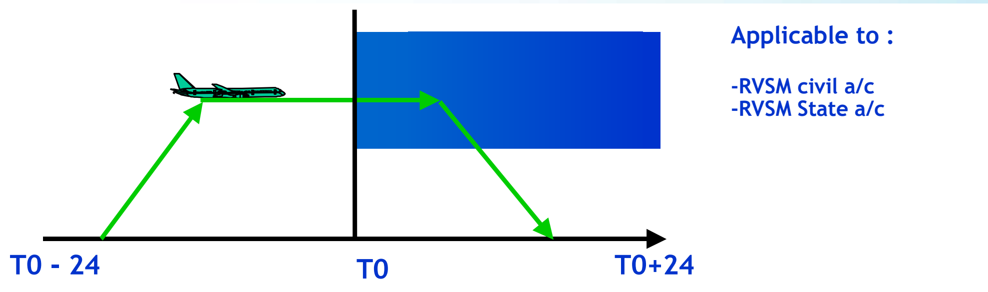

Figure 11: RVSM aircraft flying at T0 (SWIT_NOM_01a)

Step	ATC airspace	FIS airspace
1	At T0, RVSM aircraft pilot shall comply with controller clearance. This clearance is to cruise, climb or descent to RVSM level according to local FLAS and FPL	At T0, RVSM aircraft pilot shall inform controller of his intention. This intention is to cruise, climb or descent to RVSM level according to local FLAS and FPL

Table 11: SWIT_NOM_01a operating method

SWIT_NOM_01b : Non RVSM State aircraft flying at T0

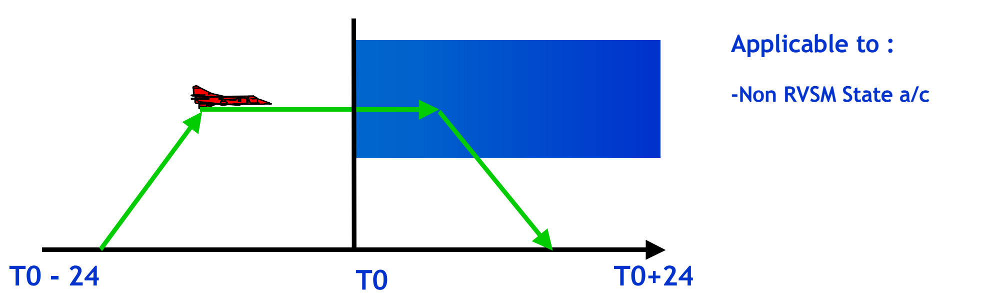

Figure 12: Non RVSM State aircraft flying at T0 (SWIT_NOM_01b)

Step	ATC airspace	FIS airspace

1	At T0, Non RVSM state aircraft pilot shall comply with controller clearance. This clearance is to cruise, climb or descent to RVSM level according to local FLAS and FPL 2000 feet vertical separation is required	At T0, Non RVSM state aircraft pilot shall inform controller of his intention. This intention is to cruise, climb or descent to RVSM level according to local FLAS and FPL 2000 feet vertical separation is required

Table 12: SWIT_NOM_01b operating method

C.2.2 Non RVSM civil aircraft flying at T0 (SWIT_NOM_02)

SWIT_NOM_02a: Non RVSM civil aircraft flying at T0 (a)

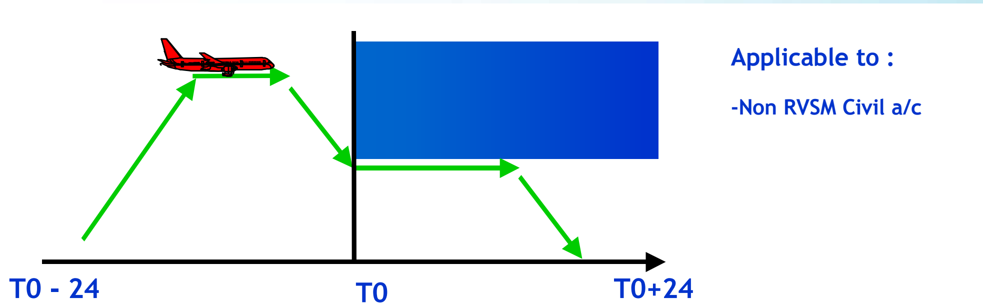

Figure 13: Non RVSM civil aircraft flying at T0 (SWIT_NOM_02a)

Step	ATC airspace	FIS airspace
1	Before T0, Non civil RVSM aircraft pilot shall comply with controller clearance. This clearance is to descent under RVSM Airspace according to FPL 2000 feet vertical separation is required	Before T0, Non civil RVSM aircraft pilot shall inform controller of his intention. This intention is to descent under RVSM airspace according to FPL 2000 feet vertical separation is required

Table 13: SWIT_NOM_02a operating method

SWIT_NOM_02b: Non RVSM civil aircraft flying at T0 (b)

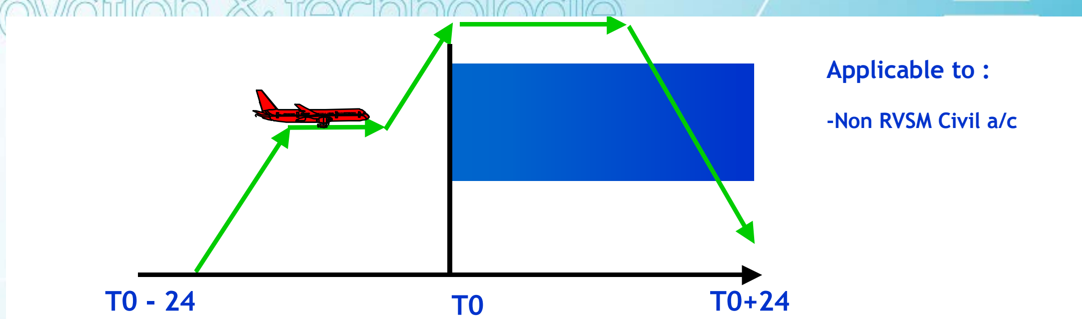

Figure 14: Non RVSM civil aircraft flying at T0 (SWIT_NOM_02b)

Step	ATC airspace	FIS airspace
1	Before T0, Non civil RVSM aircraft pilot shall comply with controller clearance. This clearance is to climb above RVSM Airspace according to FPL 2000 feet vertical separation is required	Before T0, Non civil RVSM aircraft pilot shall inform controller of his intention. This intention is to to climb above RVSM airspace according to FPL 2000 feet vertical separation is required

Table 14: SWIT_NOM_02b operating method

C.2.3 State or RVSM civil aircraft taking off after T0 (SWIT_NOM_03)

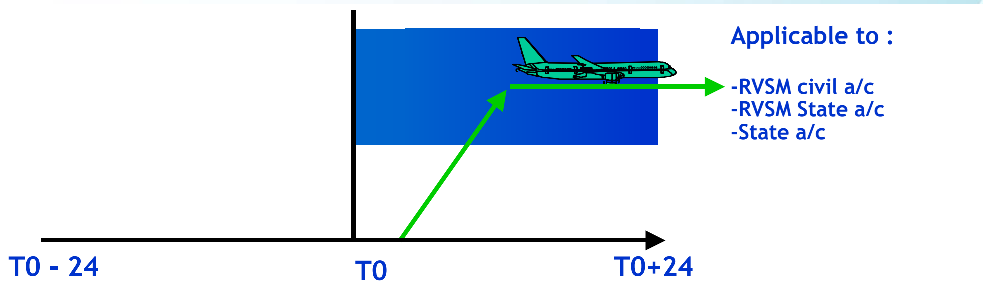

Figure 15: State or RVSM civil aircraft taking off after T0 (SWIT_NOM_03)

Step	ATC airspace	FIS airspace
1	After T0, RVSM aircraft pilot shall comply with controller clearance. This clearance is to climb and after cruise in RVSM Airspace according to FPL 2000 feet vertical separation is required if the aircraft is a State Non RMSM Aircraft	After T0, RVSM aircraft pilot shall inform controller of his intention. This intention is to climb and after cruise in RVSM Airspace according to FPL 2000 feet vertical separation is required if the aircraft is a State Non RMSM Aircraft

Table 15: SWIT_NOM_03 operating method

C.2.4 Non RVSM civil aircraft taking off after T0 (SWIT_NOM_04)

SWIT_NOM_04a: Non RVSM civil aircraft taking off after T0 (a)

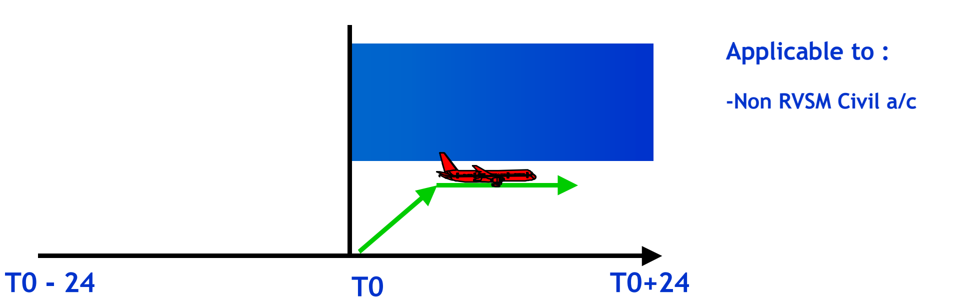

Figure 16: Non RVSM civil aircraft taking off after T0 (SWIT_NOM_04a)

Step	ATC airspace	FIS airspace
1	After T0, Non RVSM civil aircraft pilot shall comply with controller clearance. This clearance is to climb and after cruise below RVSM Airspace according to FPL	After T0, Non RVSM civil aircraft pilot shall inform controller of his intention. This intention is to climb and after cruise below RVSM Airspace according to FPL

Table 16: SWIT_NOM_04a operating method

SWIT_NOM_04b: Non RVSM civil aircraft taking off after T0 (b)

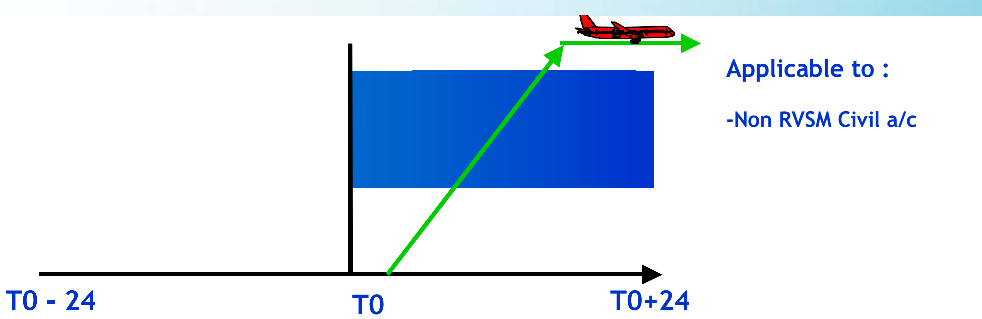

Figure 17: Non RVSM civil aircraft taking off after T0 (SWIT_NOM_04b)

Step	ATC airspace	FIS airspace
1	After T0, Non RVSM civil aircraft pilot shall comply with controller clearance. This clearance is to climb through RVSM Airspace and cruise above FL410 according to FPL	After T0, Non RVSM civil aircraft pilot shall inform controller of his intention. This intention is to climb through RVSM Airspace and cruise above FL410 according to FPL

Table 17: SWIT_NOM_04b operating method

Appendix D: Hazard Classification Tables

This section presents the hazard classification tables for the AFI RVSM Core/Mature Airspace and Switch-Over Period.

The table form is presented in **Annex F** as well as the associated traceability.

D.1 Core/ Mature Airspace

Twenty eight (28) hazards have been identified, assessed and classified for the AFI RVSM Core/Mature Airspace.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_1}$	Height keeping system failure	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**2** **2** **2** **2**	The pilot observes and reports height keeping system failure. The a/c RVSM approval status is downgraded to 'Non RVSM approved' and 2000 feet separation is applied for this a/c. The controller shall normally clear the a/c out of the RVSM airspace and coordinates with adjacent ACCs/UACs as appropriate. The pilot shall apply the appropriate contingency procedure In a worst case situation, this could easily lead to an extensive workload for the flight crew, to a large reduction of vertical separation and, at least initially, without the flight crew to be able to control the situation. Based on these consequences, the hazard was graded to a severity 2.	01-01 02-06	**Safety objective:** Extremely remote **Criticity:** Non Safety Critical **Rationale:** It was estimated that the safety objective is achieved due to a/c RVSM capability approval (MASPS requirements) including: - Airworthiness approval (including continued airworthiness-maintenance procedures) - Operational approval

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core_}$2	Loss of at least one of the two main Altitude Indications (display)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	The pilot observes and reports the display failure. The a/c equipment no longer meets RVSM MASPS (MEL). The a/c RVSM approval status is downgraded to 'Non RVSM approved' and 2000 feet separation is applied for this a/c. The controller shall normally clear the a/c out of the RVSM airspace and coordinates with adjacent ACCs/UACs as appropriate. The pilot shall apply the contingency procedure It might result in a major reduction of vertical separation but the flight crew and ATC fully control the situation. Based on these consequences, the hazard was graded to a severity 4.	01-02 02-07	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical. Moreover, it was estimated that the safety objective is achieved due to a/c RVSM capability approval (MASPS requirements) including: - Airworthiness approval (including continued airworthiness-maintenance procedures) - Operational approval

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_3}$	Loss of transponder capability	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	The pilot/ATC observes and reports the transponder failure. The a/c equipment no longer meets RVSM MASPS (MEL). The a/c RVSM approval status is downgraded to 'Non RVSM approved' and 2000 feet separation is applied for this a/c. The controller shall normally clear the a/c out of the RVSM airspace and coordinates with adjacent ACCs/UACs as appropriate. The pilot shall apply the appropriate contingency procedure Increase of pilot/controller workload It might result in a major reduction of vertical separation but the flight crew and ATC fully control the situation. Based on these consequences, the hazard was graded to a severity 4	01-04 02-08	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical. Moreover, it was estimated that the safety objective is achieved due to a/c RVSM capability approval (MASPS requirements) including: - Airworthiness approval (including continued airworthiness-maintenance procedures) - Operational approval

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_4}$	Loss of altitude alerting system	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	The pilot observes and reports the altitude alerting system failure. The a/c equipment no longer meets RVSM MASPS (MEL). The a/c RVSM approval status is downgraded to 'Non RVSM approved' and 2000 feet separation is applied for this a/c. The controller shall normally clear the a/c out of the RVSM airspace and coordinates with adjacent ACCs/UACs as appropriate. The pilot shall apply the appropriate contingency procedure It might result in a major reduction of vertical separation but the flight crew and ATC fully control the situation. Based on these consequences, the hazard was graded to a severity 4	01-05 02-09	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical. Moreover, it was estimated that the safety objective is achieved due to a/c RVSM capability approval (MASPS requirements) including: - airworthiness approval (including continued airworthiness-maintenance procedures) - operational approval

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core_}$5	Non RVSM civil Aircraft transiting through RVSM airspace with degraded climb performances	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	This hazard is related to non-RVSM civil aircraft transiting through the RVSM airspace to cruise above FL410. The pilot may be unable to reach its assigned level or need additional time to reach it, due to low climbing a/c performances or to a degradation of these performances (a/c operations capabilities reduced). In that case, the non-RVSM civil a/c is flying within the RVSM airspace for an extended period of time. Available flight levels may be reduced, increasing workload of controller and pilot. It may result in a major reduction in separation, the situation being fully control by the pilot and the controller The hazard is thus graded as severity 4.	06-01	**Safety objective:** Probable **Criticity:** Not Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_6}$	Loss of aircraft communications capabilities (voice)	**ENV_1** **ENV_3**	**4** **4**	The controller and flight crew are unable to exchange clearance/information. The pilot shall try to establish contact with other ATC units and if no contact squawk 7600 and follows air-ground communication failure procedures. It may result in a major reduction in separation, but with the flight crew in full control of the situation. In radar (or ADS) environment, the controller is also fully controlling the situation. The hazard was thus graded to a severity 4.	01-03 02-01 04-01 05-01	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical in ENV_1 and ENV_3 (radar or ADS environment). Moreover, it was estimated that the likelihood is probable due to a/c airworthiness
		ENV_2 **ENV_4**	**3** **3**	In non-radar environment, the controller only assumes that the a/c is operating in accordance with contingencies and thus does not fully control the situation. The hazard was thus graded to a severity 3		**Safety objective:** Remote **Criticity:** Non Safety Critical **Rationale:** It was estimated that the safety objective is achieved (in non radar/ADS environment) due to a/c airworthiness

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core_}$7	Loss of ground/air (ATC R/T) communications capabilities	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	The controller is unable to exchange clearances/information with all the aircraft under its responsibility. Pilots shall try to contact other ATC units and apply contingency procedures. It may result in a major reduction in separation, with the controller not controlling the situation. The severity given is thus 3.	02-02 03-02 04-02 05-02	**Safety objective:** Remote **Criticity:** dependent on the communication means: - VHF: Non Safety Critical - HF: Safety Critical **Rationale:** The safety objective is remote, meaning the hazard shall not occur more than once per day in the AFI RVSM airspace. For VHF as communication means, the likelihood was estimated to remote due to equipment robustness and VHF reliability, enabling safety objective meeting. For HF as communication means, it was estimated that the hazard occurs more than once per day in the RVSM airspace due to the following HF specific problems: - Congestion - Reliability dependent on atmospheric conditions. These problems are more relevant for HF than for VHF and the safety objective is not achieved.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_}$ 8	Loss of Point to Point (ATS/DS) communications capabilities	**ENV_1** **ENV_3**	**3** **3**	Adjacent controllers are not able to coordinate the transfer of traffic. The only information a controller has are in the filed flight plan. He is not aware at which FL the a/c will enter. Contingencies procedures are applied according to LoAs (relay via other center or a/c) This hazard could lead in a large reduction in separation, the receiving controller is able to recover from the hazardous situation, by being able to detect potential conflict. The severity assigned is thus 3.	03-01	**Safety objective:** Remote **Criticity:** Non safety critical **Rationale:** The safety objective is remote, meaning the hazard shall not occur more than once per day in the AFI RVSM airspace. The likelihood was estimated to extremely remote for the following means because of equipment robustness and redundancy: - Phone/AFTN/HF - VSAT/Phone The safety objective is thus estimated as achieved

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
		ENV_2 **ENV_4**	**2** **2**	In non-radar environment, the receiving controller does not fully control the situation. The severity given is thus 2.		**Safety objective:** Extremely remote **Criticity:** Non safety critical **Rationale:** The safety objective is extremely remote, meaning the hazard shall not occur more than once per year in the AFI RVSM airspace. The likelihood was estimated to extremely remote for the following means because of equipment robustness and redundancy: Phone/AFTN/HF and VSAT/Phone The safety objective is thus estimated as achieved.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core_}$9	Controller issues incorrect clearance	**ENV_1**	**3**	Various reasons can cause this hazard such as: wrong application of separation standards or human error. This hazard could possibly result in the execution of an incorrect clearance by the pilot, leading to a large reduction in separation. In a radar (or ADS) environment, the controller is able to recover from the hazardous situation. The hazard was thus graded to a severity 3.	02-03 04-03 05-03	**Safety objective:** Remote **Criticity:** Safety critical **Rationale:** The safety objective is remote, meaning the hazard shall not occur more than once per day in the AFI RVSM airspace. The hazard is caused by a human error from the controller and by the wrong application of separation standards Even though the assumption (b) (all required training for pilots and controllers has been completed) is accepted as having been implemented, this will not prevent human error from occurring and therefore the hazard cannot be fully mitigated to meet the safety objective.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
		ENV_2	**2**	In non-radar environment, the controller is not able to recover from the hazardous situation. The severity assigned to the hazard is 2		**Safety objective:** Extremely Remote **Criticity:** Safety critical **Rationale:** The objective of remote is not achieved in ENV_1 and the hazard occurrence is independent from the ATC surveillance capabilities. The objective of extremely remote for ENV_2 is thus obviously not met.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_10}$	Controller provides incorrect traffic information	**ENV_3**	**3**	In a radar (or ADS) environment, the controller becomes aware of a hazardous situation (It could lead to a large reduction of separation) created by the provision of incorrect traffic information and could recover from that situation by informing the pilot. Severity given is 3.	02-04 04-04 05-04	**Safety objective:** Remote **Criticity:** Safety critical **Rationale:** The safety objective is remote, meaning the hazard shall not occur more than once per day in the AFI RVSM airspace. The hazard is caused by a human error from the controller and by the bad knowledge RVSM procedures and rules Even though the assumption (b) (all required training for pilots and controllers has been completed) is accepted as having been implemented, this will not prevent human error from occurring and therefore the hazard cannot be fully mitigated to meet the safety objective.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
		ENV_4	**2**	In that case, the pilot could not be aware of the adverse conditions. It could lead to a large reduction in vertical separation created by the provision of incorrect traffic information In non-radar environment, the controller and the pilot are not able to recover from the hazardous situation. Severity assigned is 2		**Safety objective:** Extremely Remote **Criticity:** Safety critical **Rationale:** The objective of remote is not achieved in ENV_3 and the hazard occurrence is independent from the ATC surveillance capabilities. The objective of extremely remote for ENV_4 is thus obviously not met.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_11}$	Pilot deviates from clearance	**ENV_1**	**3**	Several reasons may cause this hazard: it could be a human error (misreading of clearance), incorrect level input into the Flight Control Unit, or call sign confusion. However, this hazard can only occur if implemented mitigation factors fail (crosscheck between pilots). The consequence is that the pilot deviates from his assigned flight level, thereby makes a level bust. The loss a vertical separation could be large. In radar environment, the controller is able to detect the deviation and to control the situation (resulting in a significant increase of workload). The hazard is thus graded to a severity 3.	02-05 04-05 05-05	**Safety objective:** Remote **Criticity:** Safety critical **Rationale:** The safety objective is remote, meaning that the hazard shall not occur more than once per 10^5 flight hours (once per day in the AFI RVSM airspace). The hazard can be caused by: - Human error - Incorrect level input into Flight Control Unit - Call sign confusion The assumption (b) on pilot training enables to reduce the contribution of these causes to hazard occurrence. However, it has been considered as not sufficient to conclude the objective as met. Note: the mitigation based on cross check between pilots could not be used as some a/c are operated by only one pilot.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
		ENV_2	**2**	In non-radar environment, the controller is not able to detect the deviation. The severity assigned is thus 2		**Safety objective:** Extremely Remote **Criticity:** Safety critical **Rationale:** The objective of remote is not achieved in ENV_1 and the hazard occurrence is independent from the ATC surveillance capabilities. The objective of extremely remote for ENV_2 is thus obviously not met.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_12}$	Lack of ATS Coordination	**ENV_1** **ENV_3**	**3** **3**	This hazard is caused by a human error, from the receiving controller (misreading of information, call sign confusion) or from the transferring controller (incorrect information given, information not transferred). In that case, the coordination fails and the receiving controller accepts aircraft without having the correct information (especially entering FL, RVSM status). This could lead in a large reduction in separation, but the receiving controller is able to recover from the hazardous situation, by being able to detect a/c flight level. The severity assigned is thus 3.	03-06	**Safety objective:** Remote **Criticity:** Safety critical **Rationale:** The safety objective is remote, meaning that the hazard shall not occur more than once per day in the AFI RVSM airspace. The hazard can be caused by: - human error from the transferring controller - human error the receiving controller Even though the assumption (b) (all required training for pilots and controllers has been completed) is accepted as having been implemented, this will not prevent human error from occurring and therefore the hazard cannot be fully mitigated to meet the safety objective.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
		ENV_2 **ENV_4**	2 2	In non-radar environment, the controller is not able to know entering a/c level and does not fully control the situation. Severity 2 is thus given.		**Safety objective:** Extremely remote **Criticity:** Safety critical **Rationale:** The objective of remote is not achieved in ENV_1 and ENV_3 and the hazard occurrence is independent from the ATC surveillance capabilities. The objective of extremely remote for ENV_2 and ENV_ 4 is thus obviously not met.
AH $_{core_}$13	Ground ATC system failure (RDPS/ ADS system)	**ENV_1** **ENV_3**	4 4	This hazard is caused by a technical failure on RDPS/ADS system. In this case, the controller does not have radar/ADS display. He shall revert to procedural control. That results in significant increase in workload. The hazard could also result in major reduction in vertical separation. However, the controller fully controls the situation. Severity assigned is thus 4.	02-10	**Safety objective:** Probable **Criticity:** Non safety critical **Rationale:** The severity is 4 and thus the hazard is not safety critical in these environments. Moreover, it was estimated that the likelihood is not greater than remote, i.e. a such hazard will not occur more than once per day in the RVSM airspace, due to equipment robustness and maintenance procedures.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core_}$14	Ground ATC system failure (FDPS)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	This hazard is caused by a technical failure. In that case, no new strips are available. That results in increase of workload for controller. Severity assigned is thus 4.	02-11	**Safety objective:** Probable **Criticity:** Non safety critical **Rationale:** The severity is 4 and thus the hazard is not safety critical. Moreover, it was estimated that the likelihood is not greater than remote, i.e. a such hazard will not occur more than once per day in the RVSM airspace, due to equipment robustness and maintenance procedures.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH core_15	Ground ATC system failure (HMI and/or FDPS+RDSPS/ ADS system)	**ENV_1** **ENV_3**	4 4	This hazard is caused by a technical failure on RDPS/ ADS system. In this case, the controller does not have radar/ADS display. He shall revert to procedural control. That results in significant increase in workload. The hazard could also result in major reduction in vertical separation. However, the controller fully controls the situation. Severity assigned is thus 4.	02-12	**Safety objective:** Probable **Criticity:** Non safety critical **Rationale:** The severity is 4 and thus the hazard is not safety critical in these environments. Moreover, it was estimated that the likelihood is not greater than remote, i.e. a such hazard will not occur more than once per day in the RVSM airspace, due to equipment robustness and maintenance procedures.
AH core_16	Flight plan not received by accepting ACC	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	The controller does not have flight data. In that case, the controller requests the data from the pilot or from the transferring controller The controller is also not aware of aircraft intentions and this could lead to a reduction of vertical separation. Severity given is thus 4.	03-03	**Safety objective:** Probable **Criticity:** Non safety critical **Rationale:** The severity is 4 and thus the hazard is not safety critical.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH_{core_17}	Incorrect RVSM status on filed and a/c flight plan	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	There are number of causes related to the occurrence of this hazard. There may have been a late change of a/c or flight crew, the aircraft operator may have made typing error on the flight plan. The flight crew and controllers will act according to the information they have received or know of. The a/c, which may not comply with RVSM MASPS, may suddenly deviate from assigned flight level. This could lead to a major reduction in separation, without full control by the controller. Severity 3 is thus assigned.	03-04 04-06	**Safety objective:** Remote **Criticity:** Non safety critical **Rationale:** The safety objective is remote, meaning that the hazard shall not occur more than once per day in the AFI RVSM Airspace. The hazard source related to a late change of a/c or flight crew is reduced in term of likelihood thanks to the systematic use of a message CHG. With that statement, the likelihood was estimated to remote and consequently the safety objective was estimated to be met.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_18}$	Incorrect RVSM status only on filed ATC flight plan	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	There are number of causes related to the occurrence of this hazard. There may have been a late change of a/c or the aircraft operator may have made a typing error on the flight plan.		**Safety objective:** Probable **Criticity:** Non safety critical **Rationale:** The severity is 4 and thus the hazard is not safety critical.
AH $_{core\_19}$	Flight level deviation due to not forecast severe turbulence	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	2 2 2 2	This hazard can be caused by the development of CB, by clear air turbulence (CAT) or mountain waves. If an aircraft encounters such turbulence, the cockpit crew may have difficulty to maintain the assigned flight level. They may request/inform level change and re-routing, which will increase the workload for both the flight crew and the controller. By not being able to maintain the assigned level, it may result in a large reduction in separation. Even if the pilot is able to recover from the situation, the controller does not fully control the situation. The hazard is thus given the severity 2	11-01	**Safety objective:** Extremely remote **Criticity:** Safety critical **Rationale:** The safety objective is extremely remote, meaning that the hazard shall not occur more than once per year in the AFI RVSM Airspace. The hazard contributor is the meteorological element, which is difficult to manage. The likelihood was estimated to remote (a such hazard could occur once per day) and consequently, the safety objective is not achieved.

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Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH_{core_20}	Flight level / route deviation due to weather conditions	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	The pilot may request or inform of a level change due to adverse weather conditions (e.g. thunderstorm ,sand storm, volcanic activity), which will increase the workload for both pilot and controller. It will increase the workload for both the flight crew and the controller which may result in a large reduction in separation. The severity assigned is thus 3.	11-02	**Safety objective:** Remote **Criticity:** Safety critical **Rationale:** The safety objective is remote, meaning that the hazard shall not occur more than once per day in the AFI RVSM Airspace. The hazard contributor is the meteorological element which is difficult to manage. It was estimated that adverse conditions, such as thunderstorm, sandstorm or volcanic activity, could be encountered more than once per day in the RVSM airspace. As a consequence, the safety objective is not met.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_21}$	Unexpected severe vortices	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	Severe vortices are generated from aircraft flying above or by aircraft crossing the level of the affected aircraft. This is especially considered to be a problem if the separation is only 1000 feet and/or when a smaller aircraft is following a heavier. However, with reference to the Flight Level Allocation Scheme, aircraft flying behind and below will normally be separated by 2000 feet. It is estimated that such an encounter may result in a large reduction in separation (the pilot is unable to maintain assigned FL) with the pilot fully able to recover from the situation, giving a severity class of 3.	12-01	**Safety objective:** Remote **Criticity:** Non safety critical **Rationale:** The safety objective is remote, meaning that the hazard shall not occur more than once per day in the AFI RVSM Airspace. It was estimated, under the condition that separation standards with regards to wake turbulence are applied as appropriate, that a such hazard will not occur more than once per day and, as a consequence, that the objective is achieved

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core_}$22	Specific situation requires an emergency descent (pressurisation)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**2** **2** **2** **2**	This hazard is related to an emergency situation. In that case, the pilot performs an emergency descent, in accordance with contingency procedures. In worst-case conditions (high traffic density), it may result in a large reduction in vertical separation, with the controller/Pilot not fully controlling the situation. The severity given is thus 2.	13-01	**Safety objective:** Extremely remote **Criticity:** Non safety critical **Rationale:** The safety objective is extremely remote meaning that the hazard shall not occur more than once per year in the AFI RVSM Airspace (once per 10^5 flight hours). It was estimated, based on working group operational experience, that this objective is met.
AH $_{core_}$23	Altitude deviation due to degraded aircraft performances	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**4** **4** **4** **4**	This hazard is related to the degradation of aircraft performances, requiring a descent (drift down). In that case, the pilot and controller apply contingencies. It may result in a major reduction in separation but with the full control of the pilot and the controller. The severity given is thus 4.	13-02	**Safety objective:** Probable **Criticity:** Non safety critical **Rationale:** The severity is 4 and thus the hazard is not safety critical.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core_}$24	ACAS TA	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**5** **5** **5** **5**	No safety effects on RVSM operations.	12-02	**Safety objective:** - **Criticity:** Non safety critical **Rationale:** No safety effects
AH $_{core_}$25	ACAS RA (nuisance)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	This hazard is normally caused by close proximity of traffic with high rate of climb and descent resulting in a generation of a RA. In this case, the pilot follows the resolution advisory. This could lead in large reduction of separation, but the pilot fully controls the situation. Severity given is thus 3.	12-03	**Safety objective:** Remote **Criticity:** Safety critical **Rationale:** The safety objective is remote meaning that the hazard shall not occur more than once per day in the AFI RVSM Airspace. It was estimated, based on working group operational experience, that such a hazard could occur more than once per day and thus that this objective is not achieved.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_26}$	Wrong visual perception of other traffic position in relation to vertical separation	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	A pilot may lose the visual perspective due to a lack of outside reference. If he observes an aircraft 1000 feet above or below, he may deviate intentionally. It may result in a major reduction of separation, with the controller not being in full control of the situation due to pilot action. The hazard is thus graded to a severity 3	12-04	**Safety objective:** Remote **Criticity:** Safety critical **Rationale:** The safety objective is remote, meaning that the hazard shall not occur more than once per 10^5 flight hours (once per day in the AFI RVSM airspace). The hazard contributor is thus the human element. The assumption (b) on pilot training enables to reduce the contribution of these causes to hazard occurrence. However, it has been considered as not sufficient to conclude the objective as met.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH core_27	Uncoordinated activation of a military reserved airspace (Temporary segregated area)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	This hazard is caused by the activation of a military airspace without coordination between civil / military. In worst case, military aircraft may conflict with aircraft in RVSM. It may result in a major reduction of separation, without the controller fully controlling the situation. The hazard is thus graded to a severity 3	03-05	**Safety objective:** Remote **Criticity:** Non safety critical **Rationale:** The safety objective is remote, meaning that the hazard shall not occur more than once per day in the AFI RVSM airspace. It has been estimated that such a hazard will not occur more than once per day, due to the assumption (e) (CIV/MIL coordination is in place) which enables to consider only the human contribution to this hazard (no procedural causes). As a consequence, the safety objective is met.

Ref.	Hazard description	Env. Type	Sev	Severity rationale	Id. Haz.	Safety objective Hazard criticity and rationale
AH $_{core\_28}$	Non-RVSM civil aircraft which is experiencing severe icing or turbulences requiring a climb into RVSM airspace	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	An aircraft experiencing such a situation affecting the safety of flight may have to climb into the RVSM Airspace. It results in an increase of the controller workload to manage the vertical separation. The situation is fully controlled by the controller and the pilot.	04_08	**Safety objective:** Probable **Criticity:** Non safety critical **Rationale:** The severity is 4 and thus the hazard is not safety critical.

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D.2 Switch-Over Period

Twenty (20) hazards (and their severity class per environmental type) have been identified, assessed and classified for the AFI RVSM Switch-over Period.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_01	Incorrect RVSM status in Flight Plan at T0	**ENV_1** **ENV_3**	4 4	The controller does not know the RVSM status of the aircraft but obtained it from the pilot at T0 (assumption (3) on a RVSM check between aircraft and ATCO at ToS) The controller can: - Exit a RVSM civil aircraft from the RVSM Airspace - Decrease the vertical separation for Non RVSM State a/c - Clear Non RVSM Civil a/c into the RVSM airspace Even if the controller workload increases, the situation is fully controlled. The hazard was thus graded to a severity 4	01-01 02-01	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical in these environments.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
		ENV_2 **ENV_4**	3 3	Even if the controller obtained the RVSM status from the pilot at T0 (assumption (e)), his/her workload increases significantly leading to a potential reduction in separation not fully controlled. Based on these consequences, the hazard was graded to a severity 3		**Safety objective:** Remote **Criticity:** Non Safety Critical **Rationale:** It was estimated that the likelihood would be Remote, achieving the safety objective, due to: - The awareness campaign that will focus on the new flight planning requirements. - The upgrade of ground systems, before Switch-Over period, to manage RVSM
AH_{swit_02}	Controller issues incorrect clearance with regards to RVSM procedure	**ENV_1** **ENV_2**	3 3	The controller issues incorrect clearance with respect to the application of RVSM FLAS. The pilot may execute the incorrect clearance. The worst scenario occurs when aircraft is in flight during ToS. It may be cleared to CVSM FL which change of direction in RVSM (e.g. FL350) That could result in a large reduction in separation. The assumption (4) on the reinforcement of ATC and technical Teams for the switch-over period allows to fully control the situation. Therefore, the hazard was graded to a severity 3 (instead of 2)	01-02 03-01 04-01	**Safety objective:** Remote **Criticity:** Non Safety Critical **Rationale:** It was estimated that the likelihood would be Remote, achieving the safety objective, due to the reinforcement of ATC team for the switch-over period

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_03	Controller provides incorrect information with regards to RVSM procedure (wrong RVSM FL)	**ENV_3** **ENV_4**	3 3	The controller provides incorrect information with respect to the application of RVSM FLAS. The pilot reacts to the incorrect information provided by the controller. The worst scenario occurs when aircraft is in flight during ToS. That could result in a large reduction in separation. The assumption (4) on the reinforcement of ATC and technical Teams for the switch-over period allows to fully control the situation. Therefore, the hazard was graded to a severity 3 (instead of 2)	01-03 03-02 04-02	**Safety objective:** Remote **Criticity:** Non Safety Critical **Rationale:** It was estimated that the likelihood would be Remote, achieving the safety objective, due to the reinforcement of ATC team for the switchover period.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_04	Pilot deviates from clearance with regards to new RVSM procedures (wrong RVSM FL)	**ENV_1**	**3**	The pilot executes maneuver not expected by ATC due to new RVSM procedures. The worst scenario occurs when aircraft is in flight during ToS. However, this hazard can only occur if implemented mitigation factors fail (crosscheck between pilots). That could result in a large reduction in separation, but the situation is fully controlled by the controller. The hazard was graded to a severity 3 Note : the assumption (4) on the reinforcement of the ATC and technical team for the switch-over period does not mitigate the hazard.	01-04 03-03 04-03	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Remote, meaning that the safety objective is not achieved.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
		ENV_2	**2**	The detection of the problem is longer in Non Radar environment. The hazard was graded to a severity 2, as the situation is not in full control.		**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Remote, meaning that the safety objective is not achieved.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit_05}	Flight Level not in accordance with FLAS	**ENV_3**	**3**	In FIS environment, the pilot wants to follow his/her flight plan and does not comply with the RVSM FLAS. The different scenarios are: -An aircraft operates within the RVSM airspace at a non RVSM level -An Non RVSM civil aircraft which was supposed to cruise below FL290 and which enters into the RVSM airspace -An Non RVSM civil aircraft which was supposed to climb and cruise above FL410 and which stops its climb before the exit of the RVSM airspace - An Non RVSM civil aircraft which was supposed to descent below FL290 and which stops its descent before the exit of the RVSM airspace That could result in a large reduction in separation. The assumption (4) on the reinforcement of ATC and technical Teams for the switch-over period allows a full control the situation. The hazard was graded to a severity 3 (instead of 2)	01-05 03_04 04-04	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Remote, meaning that the safety objective is not achieved.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
		ENV_4	1	The controller may not detect the altitude deviation. The collision is possible. The hazard was graded to a severity 1 Note : the assumption (4) on the reinforcement of the ATC and technical team for the switch-over period does not mitigate the hazard.		**Safety objective:** Extremely Improbable **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Improbable, meaning that the safety objective is not achieved
$AH_{swit\_}06$	Flight Level in the filed Flight Plan is not in accordance with FLAS	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	The filed Flight Plan is not in accordance with FLAS. The hazard is detected in all environments by the controller. The hazard was graded to a severity 4	01-06 03-05 04-05	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_07	Pilot changes to RVSM level before T0 (RVSM approved aircraft and state aircraft)	**ENV_3**	**2**	The Aircraft cruises at RVSM flight level before T0. The worst case occurs when this Flight Level is intended to change direction after the ToS (e.g. FL 350). There is the possibility of head on. In radar environment, there is a monitoring of the aircraft. Large reduction of vertical separation is possible, but with the ability for the controller to recover from the situation. The hazard was graded to a severity 2	01-07	**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Remote, meaning that the safety objective is not achieved
		ENV_4	**1**	The altitude deviation may not be detected by the controller (detection is based on pilot reports). The collision is possible. The hazard was graded to a severity 1		**Safety objective:** Extremely improbable **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Improbable, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_08	Controller does not instruct the non RVSM civil aircraft to leave the RVSM FL before T0	**ENV_1**	**3**	The worst case occurs when this Flight Level is intended to change direction (e.g. FL 350) after ToS. There is the possibility of head on. The assumption (4) on the reinforcement of the ATC and technical team for the switch-over period decreases the possibility of the reduction in vertical separation (from large to major). The hazard was graded to a severity 3 (instead of 2)	02-02	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Remote, meaning that the safety objective is not achieved
		ENV_2	**2**	The detection of problem is longer in Non Radar environment (detection is based on pilot reports). the assumption (4) on the reinforcement of the ATC and technical team for the switch-over period decreases the possibility of the reduction in vertical separation and therefore the risk of collision. The hazard was graded to a severity 2 (instead of 1)		**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Remote, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_09	Pilot does not leave the FL band 290-410 before T0 (Non RVSM civil approved aircraft)	**ENV_3**	**2**	The worst case occurs when this Flight Level is intended to change direction (e.g. FL 350). There is the possibility of head on. In radar environment, there is a monitoring of the aircraft. Large reduction of vertical separation is possible, but with the ability for the controller to recover from the situation. The hazard was graded to a severity 2	02-03	**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Remote, meaning that the safety objective is not achieved
		ENV_4	**1**	The detection of problem is longer in Non Radar environment (detection is based on pilot reports). The collision is possible. The hazard was graded to a severity 1		**Safety objective:** Extremely improbable **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Improbable, meaning that the safety objective is not achieved

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Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_10	Controller issues incorrect clearance to a non-RVSM civil a/c intended to transit(climb/descent) through the RVSM airspace (error due to new RVSM procedures)	**ENV_1**	**4**	The controller levels off the aircraft inside the RVSM airspace. The controller workload increases to ensure a vertical separation of 2000 ft. The hazard was graded to a severity 4	02-04 04-06	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical in that environment
		ENV_2	**3**	The increase of the workload is greater due to the application of the procedural control. The hazard was graded to a severity 3		**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Remote, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_11	Non-RVSM approved civil aircraft does not apply new RVSM procedures to transit through the RVSM airspace	**ENV_3**	4	Non-RVSM approved civil aircraft levels off during its transition within the RVSM airspace. The workload of the controller increases and there is a reduction of the vertical separation (control by the controller). The hazard was graded to a severity 4	02-05 04-07	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical in that environment.
		ENV_4	2	Non-Radar environment, the detection of the reduction of separation relies on the pilot altitude report. Therefore, the reduction of the separation could be large without full control by ATC. The hazard was graded to a severity 2		**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Remote, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_12	High Traffic Density during the Switch Over period	**ENV_1** **ENV_3**	**3** **3**	If the traffic density is high during the Switch Over Period, it may result in a major increase of controllers workload. There is a potential reduction of separation. The workload of the pilots is also increased The hazard was graded to a severity 3	00-01	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood of a loss of vertical separation, due to significant increase of ATCO workload while adapting RVSM, could be greater than Remote, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
		ENV_2 **ENV_4**	2 2	Without surveillance capabilities the impact on the controller workload is higher. The reduction of the separation could be large. The hazard was graded to a severity 2		**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood of a loss of vertical separation, due to significant increase of ATCO workload while adapting RVSM, could be greater than Extremely Remote, meaning that the safety objective is not achieved
AH_{swit}_13	Loss of Point to Point (ATS/DS) communications capabilities during switch over period	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	3 3 3 3	If point to point communications are lost during the switch over period it will result in an increase of workload for the controllers. It could result in a large reduction of the vertical separation. The controller is able to recover from the situation. Due the assumption (4) on the reinforcement of the ATC and technical team for the switch-over period, the hazard was graded to a severity 3	00-02	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Remote, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_14	Ground system failure during switch over period (HMI or RDPS/ADS)	**ENV_1** **ENV_3**	3 3	Controllers lose their radar display, they must revert to procedural control. It results in a large increase of controllers workload. Controllers are fully controlling the situation. The assumption (4) on the reinforcement of the ATC and technical team for the switch-over period allows to fix the system quicker. The hazard was graded to a severity 3	00-03	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Remote, meaning that the safety objective is not achieved
AH_{swit}_15	Ground system failure during switch over period (FDPS)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Controllers have no information concerning flights. Information may be obtained from the relevant ACCs or directly from the aircraft. The assumption (4) on the reinforcement of the ATC and technical team for the switch-over period allows to help controllers in collecting information and to fix the system quicker. The hazard was graded to a severity 4	00-04	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_16	Weather phenomena during switch over period	**ENV_1** **ENV_3**	3 3	Weather phenomena could have impact on the flight operations during the switch over period (deviation to CB, sandstorm, rain…) The hazard was graded to a severity 3	00-05	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood of a loss of vertical separation due to weather conditions could be greater than Remote, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
		ENV_2 **ENV_4**	2 2	Without surveillance capability, the workload of controllers and pilots increase and large reduction of vertical separation could occur. The hazard was graded to a severity 2		**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood of a loss of vertical separation due to weather conditions could be greater than Extremely Remote, meaning that the safety objective is not achieved
AH_{swit}_17	Non compliance with LoAs	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	1 1 1 1	The non-compliance with the LoAs related to RVSM implementation may result in a potential collision. Aircraft may not be transferred with regard to the agreed conditions (LoAs) and could lead to a traffic conflict. The hazard was graded to a severity 1	00-06	**Safety objective:** Extremely improbable **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Improbable, meaning that the safety objective is not achieved

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_18	Non compliance with Civil/Military coordination procedures related to RVSM during switch over period	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	3 3 3 3	Non-compliance with Civil/Military coordination procedures related to RVSM during ToS period. Non-compliance with coordination procedures may result in an increase in controllers workload. Potential reduction in separation. The hazard was graded to a severity 3	00-07	**Safety objective:** Remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Remote, meaning that the safety objective is not achieved
AH_{swit}_19	Defense exercise during switch over period	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Defense exercises are planned, coordination is ensured between civil and military but it could increase controllers workload. The hazard was graded to a severity 4	00-08	**Safety objective:** Probable **Criticity:** Non Safety Critical **Rationale:** The hazard severity is 4 and thus the hazard is not safety critical.

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
AH_{swit}_20	Pilot does not leave the FL band 410 and above before T0 (Non RVSM civil approved aircraft) Note: Hazard resulting from the risk mitigation strategy	**ENV_3**	**2**	The worst case occurs when this Flight Level is intended to change direction (e.g. FL 350). There is the possibility of head on. In radar environment, there is a monitoring of the aircraft. Large reduction of vertical separation is possible, but with the ability for the controller to recover from the situation. The hazard was graded to a severity 2	02-03	**Safety objective:** Extremely remote **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Remote, meaning that the safety objective is not achieved
		ENV_4	**1**	The detection of problem is longer in Non Radar environment (detection is based on pilot reports). The collision is possible. The hazard was graded to a severity 1		**Safety objective:** Extremely improbable **Criticity:** Safety Critical **Rationale:** It was estimated that the likelihood could be greater than Extremely Improbable, meaning that the safety objective is not achieved

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AFI RVSM FUNCTIONAL HAZARD ASSESSMENT

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Appendix E: Hazard Mitigation Tables

This section presents the hazard mitigation tables for the AFI RVSM Core/Mature Airspace and Switch-Over Period.

The table form is presented in **Annex D** as well as the associated traceability.

E.1 AFI RVSM Core Airspace

The elements in yellow background need to be confirmed and validated during the ARTF/6.

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$**_1** Height keeping system failure	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	2 2 2 2	Objective: Extremely remote Non Safety Critical	-- --	**Elimination** not possible	**Causes:** Technical failure **Reduction factors:** Limited by a/c certification approval and operator maintenance capabilities **Safety requirement:** **Req** $_{Core}$**_1** The aircraft shall meet MASPS requirements	**Effects:** Loss of vertical separation (due to vertical deviation) limited by the application of the appropriate contingency **Control factors:** - Contingency application - ATC and flight crew training (contingency) **Safety Requirements :** **Req** $_{Core}$**_2** Contingency Procedures shall be defined to provide 2000 feet separation

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
							for non RVSM civil aircraft **Req** $_{Core}$**_3** Contingency Procedures shall be defined to execute lateral/level deviation from RVSM level **Req** $_{Core}$**_4** Contingency Procedures shall be defined to exit non RVSM civil aircraft from RVSM Airspace **Req** $_{Core}$**_5** Controllers shall be trained appropriately with regards to contingency procedures in case of MASPS requirements failure **Req** $_{Core}$**_6** Flight crew shall be trained appropriately with regards to contingency procedures (RVSM status degradation)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_2 Loss of at least one of the two main Altitude Indications (display)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**4** **4** **4** **4**	Objective: Probable Non Safety Critical	-- **--**	**Elimination** not possible	**Causes:** Technical failure **Reduction factors:** Limited by a/c certification approval and operator maintenance capabilities **Safety requirement:** **Req $_{Core}$_1** The aircraft shall meet MASPS requirements	**Control factors:** See AH$_{core}$_1 **Safety requirements:** **Req $_{Core}$_2** Contingency Procedures shall be defined to provide 2000 feet separation for non RVSM civil aircraft **Req $_{Core}$_3** Contingency Procedures shall be defined to execute lateral/level deviation from RVSM level **Req $_{Core}$_4** Contingency Procedures shall be defined to exit non RVSM civil aircraft from RVSM Airspace **Req $_{Core}$_5** Controllers shall be trained appropriately with regards to contingency procedures in case of MASPS requirements failure **Req $_{Core}$_6** Flight crew shall be trained appropriately with regards to contingency procedures (RVSM status degradation)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core_}$3 Loss of transponder capability	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**4** **4** **4** **4**	Objective: Probable Non Safety Critical	**--** **--**	**Elimination** not possible	**Causes:** Technical failure **Reduction factors:** Limited by a/c certification approval and flight operator maintenance capabilities **Safety requirement:** **Req $_{Core_}$1** The aircraft shall meet MASPS requirements	**Control factors:** See AH$_{core_}$1 **Safety requirements:** **Req $_{Core_}$2** Contingency Procedures shall be defined to provide 2000 feet separation for non RVSM civil aircraft **Req $_{Core_}$3** Contingency Procedures shall be defined to execute lateral/level deviation from RVSM level **Req $_{Core_}$4** Contingency Procedures shall be defined to exit non RVSM civil aircraft from RVSM Airspace **Req $_{Core_}$5** Controllers shall be trained appropriately with regards to contingency procedures in case of MASPS requirements failure **Req $_{Core_}$6** Flight crew shall be trained appropriately with regards to contingency procedures (RVSM status degradation)

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Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core\_}$**4** Loss of altitude alerting system	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**4** **4** **4** **4**	Objective: Probable Non Safety Critical	**--** **--**	**Elimination** not possible	**Causes:** Technical failure **Reduction factors:** Limited by a/c certification approval and flight operator maintenance capabilities **Safety requirement:** **Req** $_{Core\_}$**1** The aircraft shall meet MASPS requirements	**Control factors:** See $AH_{core\_}1$ **Safety requirements:** **Req** $_{Core\_}$**2** Contingency Procedures shall be defined to provide 2000 feet separation for non RVSM civil aircraft **Req** $_{Core\_}$**3** Contingency Procedures shall be defined to execute lateral/level deviation from RVSM level **Req** $_{Core\_}$**4** Contingency Procedures shall be defined to exit non RVSM civil aircraft from RVSM Airspace **Req** $_{Core\_}$**5** Controllers shall be trained appropriately with regards to contingency procedures in case of MASPS requirements failure **Req** $_{Core\_}$**6** Flight crew shall be trained appropriately with regards to contingency procedures (RVSM status degradation)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_5 Non-RVSM civil Aircraft transiting through RVSM airspace with degraded climb performances	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective: Probable Non Safety Critical	-- --	**Elimination:** - subjected to ICAO/RVSM TF decision - degradation of performances : elimination not possible	**Causes:** - Degradation of climbing performances (operations capabilities reduced) -Low climbing performances **Reduction factors:** - Degradation: no reduction factor - Low performances: ▪ When the situation warrants, minimum performances should be requested by ATCO before transit clearance is issued (only applicable for ATC environment) ▪ When the situation warrants minimum performances required to transit FIS airspace ▪ Degradation of performances are to be reported by the pilot to the controller	**Effects:** - Long time to transit - Level off => airspace reorganization for ATC (application of 2000 feet separation) **Control factors:** - Application of 2000 feet separation and exit of the RVSM airspace - ATC training - Flight Crew Training (FLAS and procedures knowledge) **Safety requirements:** **Req $_{Core}$_2** Contingency Procedures shall be defined to provide 2000 feet separation for non RVSM civil aircraft **Req $_{Core}$_4** Contingency Procedures shall be defined to exit non RVSM civil aircraft from RVSM Airspace **Req $_{Core}$_7** Controllers shall be trained appropriately with regards to Non-RVSM aircraft transiting procedures (including contingencies)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Safety recommendations: **Rco $_{Core}$_1** When the situation warrants Minimum performances should be requested by ATCO before transit clearance is issued (ATC environment only) **Rco $_{Core}$_2** When the situation warrants Minimum performances should be requested to transit FIS airspace **Rco $_{Core}$_3** Degradation of performances should be reported by the pilot to the controller	**Req $_{Core}$_8** Flight crew shall be trained appropriately with regards to Non-RVSM civil aircraft transiting procedures (including contingencies)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_6 Loss of aircraft communications capabilities (voice)	**ENV_1** **ENV_3**	4 4	Objective: Probable Non Safety Critical	-- --	**Elimination** not possible	**Causes:** Technical failure **Reduction factors:** Limited by a/c airworthiness and flight operator maintenance capabilities	**Effects:** Loss of vertical separation limited by application of Radio Communication Failure contingency (7 min rules) **Control factors:** - Radio Communications Failure contingency application - ATC and flight crew training (Radio Communications Failure contingency) **Safety requirements:** **Req $_{Core}$_9** Radio Communications Failure procedures shall be defined. **Req $_{Core}$_10** Controllers shall be trained appropriately with regards to Radio Communications Failure procedures. **Req $_{Core}$_11** Flight crew shall be trained appropriately with regards to Radio Communications Failure procedures.

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2 **ENV_4**	3 3	Objective: Remote Non Safety Critical	-- --	**Elimination** not possible	**Causes:** Technical failure **Reduction factors:** Limited by a/c airworthiness and flight operator maintenance capabilities	**Effects:** Loss of vertical separation limited by application of Radio Communications Failure contingency (7 min rules) **Control factors:** - Radio Communications Failure procedure application - ATC and flight crew training (Radio Communications Failure procedure) **Safety requirements:** **Req $_{Core}$_9** Radio Communications Failure procedures shall be defined. **Req $_{Core}$_10** Controllers shall be trained appropriately with regards to Radio Communications Failure procedures. **Req $_{Core}$_11** Flight crew shall be trained appropriately with regards to Radio Communications Failure procedures.

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core_}$7 Loss of ground/air (ATC R/T) communications capabilities	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	Objective: Remote VHF : Non Safety Critical HF : Safety Critical	**--** **--** HF: Non safety critical (HF not recom-mended)	**Elimination:** two <u>independent</u> communication means	**Causes:** -Technical failure -Congestion (HF) -Atmospheric conditions (HF) **Reduction factors:** - Technical failure: equipment redundancy + maintenance (procedures and staff) + equipment failure contingencies (Mean Time Between Failure) - Congestion HF: increase number of frequencies used for ATC or use of another communications means (different from HF) - Atmospheric conditions: use of another communications means (different from HF) - Reliability/availability improvement for example : VSAT ,datalink (CPDLC)	**Effects:** Loss of vertical separation limited by application of Radio Communications Failure contingency as defined Annex 10 Volume 2 chapter 5.2.2.7 and Doc 4444 Chapter 15.5.1 (ground failure) for the ground and Radio Communications Failure Contingency procedures in 7030 for the Air. **Control factors:** - Equipment failure contingencies (Mean Time To Repair) - IFBP application - Application of Radio Communications Failure procedures - Flight Crew and controllers Training

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Safety requirements: **Req Core_12** Air/Ground Communication system shall be designed to ensure a total coverage of the RVSM Airspace with a minimum MTBF of 2 months for a given FIR **Req Core_14** Air/Ground Communications Maintenance team shall be trained appropriately with regards to Air/Ground Communication system maintenance procedures **Safety recommendation:** **Rco Core_4** Efficient means of communications should be implemented (e.g. VSAT, datalink-CPDLC, …)	**Safety requirements:** **Req Core_9** Radio Communications Failure procedures shall be defined. **Req Core_10** Controllers shall be trained appropriately with regards to Radio Communications Failure procedures. **Req Core_11** Flight crew shall be trained appropriately with regards to Radio Communications Failure procedures. **Req Core_13** Air/Ground Communications system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement **Req Core_14** Air/Ground Communications Maintenance team shall be trained appropriately with regards to Air/Ground Communication system maintenance procedures

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core_8 Loss of Point to Point (ATS/DS) communications capabilities	**ENV_1** **ENV_3**	**3** **3**	Objective: Remote Phone/ AFTN/HF: Non Safety Critical VSAT/ Phone: Non safety critical	-- -- --	**Elimination:** two <u>independent</u> communication means	**Causes:** - Technical failure - Atmospheric conditions (HF) **Reduction factors:** - Technical failure : equipment redundancy + maintenance (procedures and staff) + equipment failure contingencies (MTBF) - Atmospheric conditions: use of another communications means (different from HF) - Suitable and reliable communications **Safety requirements:** **Req Core_15** ATS/DS Communications system shall be designed to ensure point-to-point communications between all adjacent ACCs with a minimum MTBF of 2 months for a given Radar / ADS FIR **Req Core_16** Transfer procedures shall be defined in the LoA (including communications failure contingencies) **Req Core_17** Controller shall be trained appropriately with	**Effects:** Loss of vertical separation limited by application contingency consisting in relaying via another ACC or a/c included in the LoA (referring to Doc 4444 chapter 15.5.1) **Control factors:** - Equipments failure contingencies (MTTR) - Application of Ground/Ground procedures (defined in LoAs) - ATC Training (contingency)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Safety Recommendations: **Rco** $_{Core}$**_5** Silent transfer procedures should be defined in the LoA between ATS units equipped with Radar systems, which are capable of communicating with each other.	**Safety requirements** **Req** $_{Core}$**_18** Transfer of communications failure Contingency procedures shall be defined in LoA **Req** $_{Core}$**_19** Controllers shall be trained appropriately with regards to ATS/DS failure contingency procedures **Req** $_{Core}$**_20** Flight crew shall be trained appropriately with regards to ATS/DS failure (awareness training). **Req** $_{Core}$**_21** Ground/Ground Communication system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. **Req** $_{Core}$**_22** Maintenance team shall be trained appropriately with regards to Ground/Ground Communications systems maintenance procedures

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2 **ENV_4**	**2** **2**	Objective: Extremely Remote Phone/ AFTN/HF: Non Safety Critical VSAT/ Phone: Non safety critical	-- -- --	**Elimination:** two independent communication means	**Causes:** - Technical failure - Atmospheric conditions (HF) **Reduction factors:** - Technical failure : equipment redundancy + maintenance (procedures and staff) + equipment failure contingencies (MTBF) - Atmospheric conditions : use of another communications means (different from HF)	**Effects:** Loss of vertical separation limited by application contingency consisting in relaying via another ACC or a/c included in the LoA (referring to Doc 4444 chapter 15.5.1) **Control factors:** - Equipment failure contingencies (MTTR) - Application of Radio Communications Failure contingencies (LoA) - ATC and Flight Crew Training (contingency)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Safety requirements: **Req $_{Core}$_23** ATS/DS Communication system shall be designed to ensure point-point communications between all adjacent ACCs with a minimum MTBF of 60 years for a given non Radar / ADS FIR **Req $_{Core}$_16** Transfer procedures shall be defined in the LoA **Req $_{Core}$_17** Controller shall be trained appropriately with regards to LoA transfer procedures	**Safety requirements:** **Req $_{Core}$_18** Transfer of communications failure Contingency procedures shall be defined in LoA **Req $_{Core}$_19** Controllers shall be trained appropriately with regards to ATS/DS failure contingency procedures **Req $_{Core}$_20** Flight crew shall be trained appropriately with regards to ATS/DS failure (awareness training). **Req $_{Core}$_21** Ground/Ground Communication system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. **Req $_{Core}$_22** Maintenance team shall be trained appropriately with regards to Ground/Ground Communications systems maintenance procedures

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core_9 Controller issues incorrect clearance	**ENV_1**	**3**	Objective : Remote Safety Critical	**--** Non Safety Critical	**Elimination** not possible (human error)	**Causes:** - Application of incorrect separation standards (inadequate knowledge of procedures) - Human error - Incorrect RVSM status for a/c **Reduction factors:** - Inadequate knowledge of procedures : ATC Training - Human error : ATC Training, crosscheck between controllers where appropriate **Safety requirements:** **Req Core_24** Controllers shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req Core_25** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req Core_26** RVSM Status shall be included in the strip **Req Core_27** RVSM/Non RVSM Status shall be displayed on radar or ADS HMI **Req Core_28** Crosscheck between controllers shall be	**Effects:** Loss of vertical separation limited by detection capability **Control factors:** - STCA capabilities - Reinforce the requirement to obtain read back - Crosscheck between controllers where appropriate **Safety requirements:** **Req Core_29** Procedures for read back shall be reinforced **Req Core_30** Controllers shall be trained appropriately with regards to RVSM Procedures (including read back for clearance) **Req Core_31** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including read back for clearance) **Req Core_32** Existing STCA capabilities shall be updated to be compliant with RVSM **Req Core_28** Crosscheck between controllers shall be performed **Safety recommendation:** **Rco Core_6** STCA capabilities

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2	**2**	Objective: Extremely Remote Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** - Application of incorrect separation standards (inadequate knowledge of procedures) - Human error - Incorrect RVSM status for the a/c **Reduction factors:** - Inadequate knowledge of procedures : ATC Training - Human error : ATC Training, crosscheck between controllers where appropriate **Safety requirements:** **Req** Core**_24** Controllers shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req** Core**_25** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req** Core**_26** RVSM Status shall be included in the strip **Req** Core**_33** Pilots awareness on reporting accuracy shall be reinforced by training	**Effects:** Loss of vertical separation **Control factors:** - Reinforce the awareness of read back for level clearance - Reinforce pilot awareness of the requirement to report leaving/reaching the requested level **Safety requirements:** **Req** Core**_29** Procedures for read back shall be reinforced **Req** Core**_34** Controllers shall be trained appropriately with regards to RVSM Procedures (including read back for clearance+ leaving/reaching level) **Req** Core**_35** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including read back for clearance+ leaving/reaching level) **Req** Core**_28** Crosscheck between controllers shall be performed

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core**_10** Controller provides incorrect traffic information	**ENV_3**	**3**	Objective : Remote Safety Critical	**--** Non Safety Critical	**Elimination** not possible (human error)	**Cause:** - Inadequate knowledge of procedures - Human error - Wrong RVSM status for the a/c **Reduction factors:** - Inadequate knowledge of procedures : ATC Training - Human error : ATC Training, crosscheck between controllers where appropriate **Safety requirements:** **Req** Core**_24** Controllers shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req** Core**_25** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req** Core**_26** RVSM Status shall be included in the strip **Req** Core**_27** RVSM/Non RVSM Status shall be displayed on radar or ADS HMI **Req** Core**_28** Crosscheck between controllers shall be	**Effect:** Loss of vertical separation limited by detection capability **Control factors:** - STCA capabilities - Reinforce the requirement to obtain read back - Crosscheck between controllers where appropriate **Safety requirements:** **Req** Core**_29** Procedures for read back shall be reinforced **Req** Core**_30** Controllers shall be trained appropriately with regards to RVSM Procedures (including read back for clearance) **Req** Core**_31** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including read back for clearance) **Req** Core**_32** Existing STCA capabilities shall be updated to be compliant with RVSM **Req** Core**_28** Crosscheck between controllers shall be performed **Safety recommendation:** **Rco** Core**_6** STCA capabilities

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_4	**2**	Objective : Extremely remote Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Cause:** - Inadequate knowledge of procedures - Human error - Wrong RVSM status for the a/c - Incorrect pilot reporting **Reduction factors:** - Inadequate knowledge of procedures : ATC Training - Human error : ATC Training, crosscheck between controllers where appropriate **Safety requirements:** **Req** Core**_24** Controllers shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req** Core**_25** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Req** Core**_26** RVSM Status shall be included in the strip **Req** Core**_33** Pilots awareness on reporting accuracy shall be reinforced by training	**Effect:** Loss of vertical separation **Control factors:** - Reinforce the requirement to obtain read back - Reinforce pilot awareness of the requirement to report leaving/reaching the requested level **Safety requirements:** **Req** Core**_29** Procedures for read back shall be reinforced **Req** Core**_34** Controllers shall be trained appropriately with regards to RVSM Procedures (including read back for clearance+ leaving/reaching level) **Req** Core**_35** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including read back for clearance+ leaving/reaching level) **Req** Core**_28** Crosscheck between controllers shall be performed

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core_11 Pilot deviates from clearance	**ENV_1**	**3**	Objective : Remote Safety Critical	**--** Non Safety Critical	**Elimination** not possible (human error)	**Cause:** Human error (misreading of clearance, call sign confusion, incorrect level input into the Flight Control Unit) **Reduction factors:** - Cross check between pilots - Accuracy of the read back - Flight Crew Training - Suitable and reliable communications (e.g. VHF, Datalink,…) **Safety requirements:** **Req Core_29** Procedures for read back shall be reinforced **Req Core_25** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Safety recommendation:** **Rco Core_7** Suitable and reliable communication should be in place (e.g. VHF, Datalink,…)	**Effect:** Loss of vertical separation limited by detection capabilities **Control factors:** - STCA capabilities where available **Safety requirements:** **Req Core_31** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including read back for clearance) **Req Core_32** Existing STCA capabilities shall be updated to be compliant with RVSM **Safety recommendation:** **Rco Core_6** STCA capabilities should be implemented

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2	**2**	Objective : Extremely Remote Safety Critical	**--** Safety Critical	**Elimination** not possible (human error)	**Cause:** - Human error (misreading of clearance, call sign confusion, incorrect level input into the Flight Control Unit) **Reduction factors:** - Cross check between pilots - Accuracy of the read back - Flight Crew Training - Suitable and reliable communications (e.g. VHF, Datalink,…) **Safety requirements:** **Req $_{Core}$_29** Procedures for read back shall be reinforced **Req $_{Core}$_25** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) **Safety recommendation:** **Rco $_{Core}$_7** Suitable and reliable communication should be in place (e.g. VHF, Datalink,…)	**Effect:** Loss of vertical separation **Control factors:** - Reinforce the requirement to obtain read back - Reinforce pilot awareness of the requirement to report leaving/reaching the requested level **Safety requirements:** **Req $_{Core}$_29** Procedures for read back shall be reinforced **Req $_{Core}$_35** Flight Crew shall be trained appropriately with regards to RVSM Procedures (including read back for clearance+ leaving/reaching level)

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core_12 Lack of ATS Coordination	**ENV_1** **ENV_3**	**3** **3**	Objective : Remote Safety critical	**--** Non Safety Critical	**Elimination** not possible (human error)	**Cause:** human error during coordination - From the receiving controller (misreading of information, call sign confusion) - From the transferring controller (incorrect information given, information not transferred) **Reduction factors:** - Read back between controllers - ATC Training (emphasis on correct use of Phraseology) - Suitable and reliable communications : VSAT **Safety requirement:** **Req Core_36** Controllers shall be trained appropriately with regards to RVSM Coordination Procedures **Req Core_37** RVSM/Non RVSM Status shall be provided by transferring controller (including when status is downgraded) **Req Core_38** Suitable and reliable ground communications means shall be implemented	**Effect:** Loss of vertical separation limited by detection capability **Control factors:** - STCA Capabilities - Read back for coordination information - Pilots report before entering the next FIR(e.g State Level/RVSM Status before FIR entry) **Safety requirement:** **Req Core_32** Existing STCA capabilities shall be updated to be compliant with RVSM **Req Core_39** Transfer procedures shall be defined in LoA (including read back) **Req Core_40** Controllers shall be trained appropriately with regards to transfer procedures **Req Core_41** Transferring Procedure for Flight crew shall be defined (e.g State Level/RVSM Status before FIR entry) **Req Core_42** Flight crew shall be trained appropriately with regards to the transfer

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Safety Recommendation: **Rco $_{Core}$_8** Silent transfer procedures should be defined	**Safety Recommendation:** **Rco $_{Core}$_6** STCA capabilities should be implemented

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2 ENV_4	2 2	Objective : Extremely Remote Safety Critical	-- Non Safety Critical	**Elimination** not possible (human error)	**Cause:** human error - from the receiving controller (misreading of information, call sign confusion) - from the transferring controller (incorrect information given, information not transferred) **Reduction factors:** - Read back between controllers - ATC Training (emphasis on correct use of Phraseology) - Suitable and reliable communications : VSAT **Safety requirements** **Req** $_{\text{Core}}$**_36** Controllers shall be trained appropriately with regards to RVSM Coordination Procedures **Req** $_{\text{Core}}$**_37** RVSM/Non RVSM Status shall be provided by transferring controller (including when status is downgraded) **Req** $_{\text{Core}}$**_38** Suitable and reliable ground communications means shall be implemented **Safety Recommendation:** **Rco** $_{\text{Core}}$**_8** Silent transfer	**Effect:** Loss of vertical separation **Control factors:** - Read back for coordination information - Pilots report before entering the next FIR(e.g State Level/RVSM Status before FIR entry) **Safety requirements** **Req** $_{\text{Core}}$**_39** Transfer procedures shall be defined in LoA (including read back) **Req** $_{\text{Core}}$**_40** Controllers shall be trained appropriately with regards to transfer procedures **Req** $_{\text{Core}}$**_41** Transferring Procedure for Flight crew shall be defined (e.g State Level/RVSM Status before FIR entry) **Req** $_{\text{Core}}$**_42** Flight crew shall be trained appropriately with regards to the transfer procedures

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_13 Ground ATC system failure (RDPS/ ADS system)	**ENV_1** **ENV_3**	**4** **4**	Objective : Probable Non Safety Critical	**--** **--**	**Elimination:** two <u>independent</u> surveillance means	**Cause:** Technical failure **Reduction factors:** - Equipments redundancy - Maintenance capabilities (procedures and staff) - Equipment failure contingencies (MTBF) **Safety recommendation:** **Rco $_{Core}$_9** RDPS / ADS system should be designed to ensure a relevant MTBF for a given Radar / ADS FIR	**Effects:** Reduction in vertical separation (reverting to procedural control) **Control factors:** - Equipment failure contingencies (MTTR) - ATC Training (reverting to procedural control) **Safety requirements:** **Req $_{Core}$_43** Procedures to revert to procedural control shall be specified (due to RDPS/ADS system failure) **Req $_{Core}$_44** Controllers shall be trained appropriately to revert to procedural control (in case of RDPS/ADS system failure) **Req $_{Core}$_45** RDPS/ ADS system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. **Req $_{Core}$_46** Maintenance team shall be trained appropriately with regards to RDPS / ADS systems maintenance

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_14 Ground ATC system failure (FDPS)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective : Probable Non Safety Critical	-- --	**Elimination:** two <u>independent</u> FDPS	**Cause:** Technical failure **Reduction factors:** - Equipments redundancy - Maintenance capabilities (procedures and staff) - Equipments failure contingencies (MTBF) **Safety recommendation:** **Rco $_{Core}$_10** FDPS system should be designed to ensure a relevant MTBF for a given FIR	**Effects:** Increase of workload **Control factors:** - Availability of blank strip - Equipments failure contingencies (MTTR) -Service level agreement - ATC Training (operate without FDPS) **Safety requirements :** **Req $_{Core}$_47** Controller shall be trained appropriately to operate without FDPS system (blank strip,…) **Req $_{Core}$_48** FDPS maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. **Req $_{Core}$_49** Maintenance team shall be trained appropriately with regards to FDPS systems maintenance procedures

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Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_15 Ground ATC system failure (HMI and/or FDPS+RDPS/ ADS system)	**ENV_1** **ENV_3**	**4** **4**	Objective : Probable Non Safety Critical	-- --	**Elimination:** two <u>independent</u> surveillance means	**Cause:** Technical failure **Reduction factors:** - Equipments redundancy - Maintenance capabilities (procedures and staff) - Equipment failure contingencies (MTBF) **Safety recommendation:** **Rco $_{Core}$_11** FDPS / RDPS / ADS system should be designed to ensure a relevant MTBF for a given Radar / ADS FIR	**Effects:** Reduction in vertical separation (revert to procedural control) **Control factors:** - Availability of blank strip - Equipment failure contingencies (MTTR) - ATC Training (reverting to procedural control/flight crew information…) **Safety requirements:** **Req $_{Core}$_50** Procedures to revert to procedural control shall be specified (due to FDPS / RDPS/ADS system failure) **Req $_{Core}$_51** Controllers shall be trained appropriately to revert to procedural control (in case of FDPS/RDPS/ADS system failure) **Req $_{Core}$_52** FDPS / RDPS/ ADS system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. **Req $_{Core}$_53** Maintenance team shall be trained appropriately with regards to FDPS/RDPS/ADS systems maintenance

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_16 Flight plan not received by accepting ACC	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective : Probable Non Safety Critical	-- --	**Elimination** not possible	**Causes:** - FPL not sent by flight operator - FPL not sent by point of departure - FPL incorrectly addressed - Late FPL reception - Communications System failure **Reduction factors:** - Procedures and training for Operators (flight plan filling) - Procedures and training for staff responsible for FPL processing - AFTN communications availability/reliability and transmission rate improvement	**Effect:** - Reduction in vertical separation limited by information obtained from the pilot and the transferring ACC - Increase of controller workload **Control factors:** - Non-receipt of flight plan procedures - ATC training regarding Non-receipt of flight plan procedures - RVSM/Non RVSM Status in coordination information

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Safety recommendations: **Rco Core_12** AFTN communications availability/reliability and data rate transmission should meet the Regional requirements **Req Core_58** Procedures for operators regarding flight plan filling shall be reinforced **Req Core_59** Operators staff shall be appropriately trained with regards to flight plan filling **Rco Core_13** Procedures for staff responsible for the flight plan processing should be defined **Rco Core_14** Staff responsible for the flight plan processing should be trained appropriately regarding flight plan filling	**Safety requirements:** **Req Core_54** ATC Procedures regarding Non-receipt of flight plan shall be defined **Req Core_55** Controllers shall be trained appropriately regarding Non-receipt of flight plan procedures **Req Core_56** Transfer procedures shall be defined in LoA (including RVSM/Non RVSM Status) **Req Core_40** Controllers shall be trained appropriately with regards to transfer procedures

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core_17 Incorrect RVSM status on filed and a/c flight plan	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	Objective: Remote Non Safety Critical	-- --	**Elimination** not possible	**Causes:** - Late change of a/c or flight crew - Typing error from flight oper. - Lack of training for Flight Ops staff **Reduction factors :** - Use of CHG message - Procedures and training for Operators (flight plan filling) - Check by flight crew of RVSM Status before departure **Safety requirements:** **Req Core_57** Operator shall send CHG message when appropriate **Req Core_58** Procedures for operators regarding flight plan filling shall be reinforced **Req Core_59** Operators staff shall be appropriately trained with regards to flight plan filling **Req Core_60** Procedures to check RVSM Status by flight crew before departure shall be specified **Req Core_61** Flight crew shall be trained appropriately regarding RVSM Status	**Effect:** Reduction in vertical separation due incorrect knowledge (from controller and flight crew) of the RVSM Status of the a/c **Control factors:** - Check by flight crew of RVSM Status before departure - Check by ATC of a/c RVSM Status before entry into the RVSM airspace (if any doubt) **Safety requirements:** **Req Core_62** ATC Procedures regarding knowledge of RVSM status shall be defined **Req Core_63** Controllers shall be trained appropriately regarding knowledge of RVSM status procedures

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$**_18** Incorrect RVSM status only on filed ATC flight plan	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective : Probable Non Safety Critical	-- --	**Elimination** not possible	**Causes:** - Late change of a/c - Typing error from flight operator - Corruption during transmission **Reduction factors :** - Use of message CHG - Procedures and training for Operators (flight plan filling) - AFTN communications availability/reliability improvement - RVSM Status validity checking by FDPS **Safety recommendations:** **Req** $_{Core}$**_57** Operator shall send CHG message when appropriate **Req** $_{Core}$**_58** Procedures for operators regarding flight plan filling shall be reinforced **Rco** $_{Core}$**_15** FPDS should check validity of RVSM status	**Effect:** Reduction in vertical separation limited by report of negative RVSM Status on the initial call on any frequency within the AFI RVSM airspace **Control factors:** - Report of negative RVSM Status on the initial call on any frequency within the AFI RVSM airspace **Safety requirement:** **Req** $_{Core}$**_64** Flight Crew shall be trained to report negative RVSM Status on the initial call on any frequency within the AFI RVSM airspace

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core_19 Flight level deviation due to not forecast severe turbulence	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	2 2 2 2	Objective : Extremely Remote Safety Critical	-- Non Safety Critical	**Elimination** by temporary suspension of RVSM **Safety requirements:** **Req Core_101** Procedures to suspend RVSM shall be defined **Req Core_102** Procedures to coordinate RVSM suspension with adjacent ACCs shall be defined **Req Core_103** ATC shall be trained appropriately regarding suspension of RVSM (including coordination with adjacent ACCs) **Req Core_104** Flight Crew shall be trained appropriately regarding suspension of RVSM	**Causes:** - CB Development - Clear Air Turbulence (CAT) - Mountain waves **Reduction factors:** - Weather forecast - Flight Planning - In-flight met report **Safety requirements:** **Req Core_65** Weather forecast shall be in place to inform ATC, flight crew and operators about areas with potential severe turbulence **Req Core_66** Flight planning procedures shall take into account weather forecast **Req Core_67** Operators staff shall be trained appropriately with regards to flight planning (consideration of forecast turbulence) **Req Core_68** Flight crew shall be trained to report significant weather encountered en-route	**Effect:** Reduction in vertical separation limited by contingencies (as defined in ICAO Doc 7030) **Control factors:** - Application of contingency - Flight Crew and ATC Training (contingency) **Safety requirement:** **Req Core_69** Contingency procedures regarding not forecast severe turbulence shall be defined **Req Core_70** Controllers shall be trained appropriately regarding contingency procedures related to not forecast turbulence **Req Core_71** Flight crew shall be trained appropriately regarding contingency procedures related to not forecast turbulence

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core**_20** Flight level / route deviation due to weather conditions	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	3 3 3 3	Objective : Remote Safety Critical	**--** Non Safety Critical	**Elimination** by temporary suspension of RVSM **Safety requirements:** **Req** Core**_101** Procedures to suspend RVSM shall be defined **Req** Core**_102** Procedures to coordinate RVSM suspension with adjacent ACCs shall be defined **Req** Core**_103** ATC shall be trained appropriately regarding suspension of RVSM (including coordination with adjacent ACCs) **Req** Core**_104** Flight Crew shall be trained appropriately regarding suspension of RVSM	**Causes:** - Thunderstorm - Sandstorm - Volcanic activity… **Reduction factors:** - Weather forecast - Flight Planning - In flight MET report **Safety requirements:** **Req** Core**_72** Weather forecast shall be in place to inform ATC, flight crew and operators about bad weather conditions **Req** Core**_73** Flight planning procedures shall take into account bad weather conditions forecast **Req** Core**_74** Operators staff shall be trained appropriately with regards to flight planning (consideration of forecast bad weather considerations) **Req** Core**_68** Flight crew shall be trained to report significant weather encountered en-route	**Effect:** Reduction in vertical separation limited by contingencies (as defined in ICAO Doc 7030) **Control factors:** - Application of contingency - Flight Crew and ATC Training (contingency) **Safety requirement:** **Req** Core**_75** Contingency procedures regarding not forecast severe turbulence shall be defined **Req** Core**_76** Controllers shall be trained appropriately regarding contingency procedures related to not forecast turbulence **Req** Core**_77** Flight crew shall be trained appropriately regarding contingency procedures related to not forecast turbulence

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_21 Unexpected severe vortices	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	Objective : Remote Non Safety Critical	-- --	**Elimination** not possible	**Causes:** Severe vortices generated from aircraft flying above or by aircraft crossing at the same level **Reduction factors:** - Route network structure: parallel, unidirectional track - Appropriate separation standards with regards to wake turbulence - Offset track **Safety requirements:** **Req $_{Core}$_78** Appropriate separation standards shall be specified with regards to wake turbulences **Req $_{Core}$_79** Controllers shall be trained appropriately regarding Appropriate separation standards related to wake turbulence **Safety recommendations:** **Rco $_{Core}$_16** Unidirectional and/or parallel tracks should be implemented where appropriate **Rco $_{Core}$_17** Offset from track should be allowed	**Effects:** - Inability to maintain flight level - Reduction in vertical separation limited by contingencies (as defined in ICAO Doc 7030) **Control factors:** - Application of contingency - Flight Crew and ATC Training (contingency) - Flight crew report vortices encountered **Safety requirements:** **Req $_{Core}$_80** Contingency procedures regarding wake turbulence shall be defined **Req $_{Core}$_81** Controllers shall be trained appropriately regarding contingency procedures related to wake turbulence **Req $_{Core}$_82** Flight crew shall be trained appropriately regarding contingency procedures related to wake turbulence **Req $_{Core}$_83** Flight crew shall report encountered vortices

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_22 Specific situation requires an emergency descent (pressurisation)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**2** **2** **2** **2**	Objective : Extremely Remote Non Safety Critical	**--** **--**	**Elimination** not possible	**Cause :** Emergency situation including pressurisation No **reduction factors**	**Effect :** - Emergency descent required - Reduction in vertical separation limited by emergency contingencies (as defined in ICAO Doc 7030) **Control factors:** - Application of emergency contingencies - ATC and flight crew training (emergency contingencies) **Safety requirements:** **Req $_{Core}$_84** Emergency contingencies shall be specified **Req $_{Core}$_85** Flight crew shall be trained appropriately with regards to emergency contingencies **Req $_{Core}$_86** Controllers shall be trained appropriately with regards to emergency contingencies

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_23 Altitude deviation due to degraded aircraft performances	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective : Probable Non Safety Critical	-- --	**Elimination** not possible	**Cause:** Degradation of aircraft performances requiring a descent (drift down). No **reduction factors**	**Effect:** - Descent required (drift down) - Reduction in vertical separation limited by contingency (ICAO Doc 7030) **Control factors:** - Application of emergency contingencies - ATC and flight crew training (emergency contingencies) **Safety requirements:** **Req $_{Core}$_84** Emergency contingencies shall be specified **Req $_{Core}$_85** Flight crew shall be trained appropriately with regards to emergency contingencies **Req $_{Core}$_86** Controllers shall be trained appropriately with regards to emergency contingencies

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_24 ACAS TA	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**5** **5** **5** **5**	Non Safety Critical			**Cause:** Proximity of traffic	No **safety effects**

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_25 ACAS RA (nuisance)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	3 3 3 3	Objective : Remote Safety Critical	-- Non Safety Critical	**Elimination** not possible	**Cause:** Close proximity of passing traffic or traffic with high rate of climb or descent **Reduction factors:** - Limitation of climbing/descent rate during the level change - Use of ACAS II (TCAS 2 version 7.0) - Flight Crew Training **Safety requirements:** **Req $_{Core}$_87** Climbing/descent rate shall be limited during the level change to avoid nuisance RA (e.g.500ft/min to 1000ft/min) **Req $_{Core}$_88** Aircraft shall be equipped with ACAS II (TCAS version 7.0) **Req $_{Core}$_89** Pilots shall be trained appropriately to TCAS operation (initial and continuous training)	**Effect:** Reduction in vertical separation **Control factors:** - STCA where available **Safety recommendation:** **Rco $_{Core}$_6** STCA capabilities should be implemented

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$**_26** Wrong visual perception of other traffic position in relation to vertical separation	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	Objective : Remote Safety Critical	-- Non Safety Critical	**Elimination** not possible (human error)	**Cause:** Human error from flight crew (depending on air traffic complexity) **Reduction factors:** - Check TCAS indication before deviating - Flight Crew Training **Safety requirements:** **Req** $_{Core}$**_90** Specific procedures to avoid deviation due to incorrect visual perspective shall be defined **Req** $_{Core}$**_89** Pilots shall be trained appropriately to TCAS operation (initial and continuous)	**Effect:** Reduction in vertical separation **Control factors:** - STCA where available **Safety recommendation :** **Rco** $_{Core}$**_6** STCA capabilities should be implemented

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH core_27 Uncoordinated activation of a military reserved airspace (Temporary segregated area)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**3** **3** **3** **3**	Objective : Remote Not Safety Critical	**--** **--**	**Elimination** not possible (human error)	**Causes:** Human error (bad coordination or no coordination) **Reduction factors:** - Cross check between civil/military controllers - Civil and Military ATC Training (coordination) - Suitable and reliable communications **Safety requirements:** **Req Core_91** Coordination procedures shall be defined in the Civil – Military LoA **Req Core_92** Controllers shall be trained appropriately with regards to RVSM Coordination Procedures (including military coordination) **Req Core_93** Military controllers shall be trained appropriately with regards to RVSM Coordination Procedures	**Effect:** Reduction in vertical separation **Control factors:** - Civil and Military ATC Training (coordination) **Safety requirements:** **Req Core_94** Military – Civil coordination Contingency procedures shall be defined in LoA **Req Core_95** Controllers shall be trained appropriately with regards to coordination Contingency procedures (including Military coordination) **Req Core_96** Military Controllers shall be trained appropriately with regards to coordination Contingency procedures

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH $_{core}$_28 Non-RVSM civil aircraft which is experiencing severe icing or turbulences requiring entry into RVSM airspace	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective : Probable Not Safety Critical	-- --	**Elimination** not possible	**Causes:** - Severe icing - Severe turbulences **Reduction factors:** - Weather forecast - Flight planning - In flight MET report **Safety requirements:** **Req $_{Core}$_72** Weather forecast shall be in place to inform ATC, flight crew and operators about bad weather conditions **Req $_{Core}$_73** Flight planning procedures shall take into account bad weather conditions forecast **Req $_{Core}$_74** Operators staff shall be trained appropriately with regards to flight planning (consideration of forecast bad weather considerations) **Req $_{Core}$_97** Flight crew of Non-RVSM aircraft shall be trained to report significant weather encountered en-route	**Effect:** Reduction in vertical separation limited by contingencies **Control factors:** - Application of contingency - Flight Crew and ATC Training (contingency) **Safety requirements:** **Req $_{Core}$_98** Contingency procedures for Non-RVSM aircraft facing severe icing or turbulence shall be defined **Req $_{Core}$_99** ATC controller shall be trained appropriately regarding contingency procedures related to Non-RVSM aircraft facing severe icing or turbulence **Req $_{Core}$_100** Flight crew operating Non-RVSM aircraft shall be trained appropriately to contingency procedures related to Non-RVSM aircraft facing severe icing or turbulence

E.2 AFI RVSM Switch-over Period

The elements in yellow background need to be confirmed and validated during the ARTF/6.

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_01 Incorrect RVSM status in Flight Plan at T0	**ENV_1** **ENV_3**	**4** **4**	Objective : Probable Non safety critical	-- --	**Elimination:** Not possible	**Causes:** - Late change of a/c - Typing error from flight operator - Corruption during transmission **Reduction factors:** - Use of CHG message - Procedures and training for Operators (flight plan filling) - AFTN communications availability/reliability improvement - RVSM Status validity checking by FDPS - Awareness campaigns - RVSM status management capabilities are available in all ATC systems **Safety requirements:** **Req $_{Swit}$_1** Awareness campaigns about RVSM Status shall be organized before the switch-over period **Req $_{Swit}$_2** Upgraded ground system shall be in place to manage the RVSM status information before the switch-	**Effect:** Reduction in vertical separation limited by report of RVSM Status by flight crew before ToS **Control factors:** - Check of RVSM Status by flight crew before the ToS **Safety requirement:** **Req $_{Swit}$_3** ATC shall verify the RVSM status of each aircraft within its area of responsibility before the ToS

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2 **ENV_4**	**3** **3**	Objective: Remote Non safety critical	-- --	**Elimination:** Not possible	**Causes:** - Late change of a/c - Typing error from flight operator - Corruption during transmission **Reduction factors:** - Use of CHG message - Procedures and training for Operators (flight plan filling) - AFTN communications availability/reliability improvement - RVSM Status validity checking by FDPS - Awareness campaigns - RVSM status management capabilities are available in all ATC systems **Safety requirements:** **Req $_{Swit}$_1** Awareness campaigns about RVSM Status shall be organized before the switch-over period **Req $_{Swit}$_2** Upgraded ground system shall be in place to manage the RVSM status information before the switch-	**Effect:** Reduction in vertical separation limited by report of RVSM Status by flight crew before ToS **Control factors:** - Check of RVSM Status by flight crew before the ToS **Safety requirement:** **Req $_{Swit}$_3** ATC shall verify the RVSM status of each aircraft within its area of responsibility before the ToS

Functional Hazard Analysis Report
Appendices E - F of FHA Report

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_02 Controller issues incorrect clearance with regards to RVSM procedure	**ENV_1** **ENV_2**	**3** **3**	Objective: Remote Non safety critical	-- --	**Elimination** not possible (human error)	**Causes:** - Incorrect application of separation standards (bad knowledge of procedures) - Human error due to new RVSM procedures **Reduction factors:** - ATC Training to avoid wrong knowledge of procedures: - Crosscheck between controllers to avoid incorrect clearance with regards to RVSM procedures **Safety requirements:** **Req $_{Swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period	**Effects:** Loss of vertical separation limited by detection capabilities **Control factors:** - STCA where available - Reinforce the awareness of read back for level clearance - Detection of incorrect flight level by flight crew **Safety requirement:** **Req $_{Swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{Swit}$_11** Switch-over Procedures shall be in place to impose the read back for level clearance during the switch-over period **Req $_{Swit}$_12** Controller shall be trained appropriately with regards to switch-over procedures (read back for level clearance)

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{\text{Swit}}$**_8** Switch-over Procedures shall be in place to impose the surveillance of the execution of the level clearance during the switch-over period **Req** $_{\text{Swit}}$**_9** Controller shall be trained appropriately with regards to switch-over procedures (surveillance of the execution of the level clearance) **Req** $_{\text{Swit}}$**_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period	**Req** $_{\text{Swit}}$**_13** Flight crew shall be trained appropriately with regards to switch-over procedures(read back for level clearance) **Req** $_{\text{Swit}}$**_14** Switch-over Procedures shall be in place to recover from incorrect clearance issue **Req** $_{\text{Swit}}$**_15** Controller shall be trained appropriately with regards to switch-over procedures (recovering from incorrect clearance issue)

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_03 Controller provides incorrect information with regards to RVSM procedure (wrong RVSM FL)	**ENV_3** **ENV_4**	**3** **3**	Objective: Remote Non safety critical	**--** **--**	**Elimination** not possible (human error)	**Causes:** - Incorrect application of separation standards - Human error due to new RVSM procedures **Reduction factors:** - ATC Training to avoid wrong knowledge of procedures: - Crosscheck between controllers to avoid incorrect information with regards to RVSM procedures **Safety requirements:** **Req $_{Swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{Swit}$_8** Switch-over Procedures shall be in place to impose the surveillance of the execution of the level information during the switch-	**Effects:** Loss of vertical separation limited by detection capability **Control factors:** - STCA where available - Reinforce the awareness of read back for level information **Safety requirements:** **Req $_{Swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{Swit}$_18** Switch-over Procedures shall be in place to impose the surveillance of the level change during the switch-over period **Req $_{Swit}$_19** Controller shall be trained appropriately with regards to switch-over procedures related to the level change **Req $_{Swit}$_20** Flight crew shall be trained appropriately with regards to switch-over procedures related Report

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{Swit}$_9 Controller shall be trained appropriately with regards to switch-over procedures (surveillance of the execution of the level information) **Req $_{Swit}$_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period	**Req $_{Swit}$_21** Switch-over Procedures shall be in place to recover from incorrect information issue **Req $_{Swit}$_22** Controller shall be trained appropriately with regards to switch-over procedures (recovering from incorrect information issue)

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_04 Pilot deviates from clearance with regards to new RVSM procedures (wrong RVSM FL)	**ENV_1**	**3**	Objective: Remote Safety Critical	-- Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error due to new RVSM procedures (misreading of clearance, incorrect flight level input into the flight control unit, call sign confusion) **Reduction factors:** - Cross check between pilots - Reinforce Accuracy of read back - Flight Crew training - Reinforce the Awareness of the level changes during the switch-over period - Suitable and reliable communications **Safety requirements:** **Req $_{swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS	**Effect:** Loss of vertical separation limited by detection capabilities **Control factors:** - STCA where available - Controller surveillance of aircraft level movements **Safety requirements:** **Req $_{swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{swit}$_8** Switch-over Procedures shall be in place to impose the surveillance of the execution of the level clearance during the switch-over period **Req $_{swit}$_9** Controller shall be trained appropriately with regards to switch-over procedures (surveillance of the execution of the level clearance)

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{\text{Swit}}$**_10** An NOTAM shall be issued for Level changes during the switch-over period **Req** $_{\text{Swit}}$**_11** Switch-over Procedures shall be in place to impose the read back for level clearance during the switch-over period **Req** $_{\text{Swit}}$**_12** Controller shall be trained appropriately with regards to switch-over procedures (read back for level clearance) **Req** $_{\text{Swit}}$**_13** Flight crew shall be trained appropriately with regards to switch-over procedures(read back for level clearance)	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2	**2**	Objective: Extremely remote Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error due to new RVSM procedures (misreading of clearance, incorrect flight level input into the flight control unit, call sign confusion) **Reduction factors:** - Cross check between pilots - Reinforce Accuracy of read back - Flight Crew training - Reinforce the Awareness of the level changes during the switch-over period - Suitable and reliable communications **Safety requirements:** **Req $_{Swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS	**Effect:** Loss of vertical separation **Control factor:** - Controller monitoring of aircraft level movements **Safety requirement:** **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{Swit}$_8** Switch-over Procedures shall be in place to impose the surveillance of the execution of the level clearance during the switch-over period **Req $_{Swit}$_9** Controller shall be trained appropriately with regards to switch-over procedures (surveillance of the execution of the level clearance)

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{Swit}$_10 A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req $_{Swit}$_11** Switch-over Procedures shall be in place to impose the read back for level clearance during the switch-over period **Req $_{Swit}$_12** Controller shall be trained appropriately with regards to switch-over procedures (read back for level clearance) **Req $_{Swit}$_13** Flight crew shall be trained appropriately with regards to switch-over procedures(read back for level clearance)	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_05 Flight Level not in accordance with FLAS	**ENV_3**	**3**	Objective: remote Safety Critical	**--** Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error from the pilot due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - Cross check between pilots - Reinforce read back procedure - Flight planning (checking of a/c flight plan before departure) - Flight Crew Training (compliance to FLAS) **Safety requirements:** **Req $_{Swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of	**Effect:** Loss of vertical separation limited by detection capabilities **Control factors:** - STCA where available - Reinforce the awareness of Report reaching level - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. **Safety requirements:** **Req $_{Swit}$_18** Switch-over Procedures shall be in place to impose the surveillance of the level change during the switch-over period **Req $_{Swit}$_19** Controller shall be trained appropriately with regards to switch-over procedures related to the level change **Req $_{Swit}$_20** Flight crew shall be trained appropriately with regards to switch-over procedures related Report reaching level

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{Swit}$_10 A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req $_{Swit}$_23** Awareness campaigns shall be organized before the switch-over period to reinforce the importance of read back	**Req $_{Swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{Swit}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_4	**1**	Objective : Extremely improbable Safety Critical	Severity 3 -> Remote Non safety critical	**Elimination** not possible (human error)	**Causes:** Human error from the pilot due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - Cross check between pilots - Reinforce read back procedure - Flight planning (checking of a/c flight plan before departure) - Flight Crew Training (compliance to FLAS) **Safety requirements:** **Req $_{swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS	**Effect:** Loss of vertical separation **Control factors:** - Reinforce the awareness of Report reaching level - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. **Safety requirements:** **Req $_{swit}$_18** Switch-over Procedures shall be in place to impose the surveillance of the level change during the switch-over period **Req $_{swit}$_19** Controller shall be trained appropriately with regards to switch-over procedures related to the level change **Req $_{swit}$_20** Flight crew shall be trained appropriately with regards to switch-over procedures related Report reaching level **Req $_{swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{\text{Swit}}$**_8** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req** $_{\text{Swit}}$**_21** Awareness campaigns shall be organized before the switch-over period to reinforce the importance of read back	**Req** $_{\text{Swit}}$**_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_06 Flight Level in the filed ATC Flight Plan is not in accordance with FLAS	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**4** **4** **4** **4**	Objective : Probable Not Safety Critical	-- --	**Elimination** not possible (human error)	**Causes:** - Typing error from flight operator - Lack of training for Flight Ops staff **Safety requirements:** **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS **Req $_{Swit}$_26** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS for operators	**Effects:** Loss of vertical separation **Control factors:** - Check Flight Plan **Safety requirement:** **Req $_{Swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS

Functional Hazard Analysis Report
Appendices E - F of FHA Report

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_07 Pilot changes to RVSM level before T0 (RVSM approved aircraft and state aircraft)	**ENV_3**	**2**	Objective : Extremely remote Safety Critical	Severity 3 -> Remote Non safety Critical	**Elimination** not possible (human error)	**Causes:** Human error from the pilot due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - Cross check between pilots - Reinforce read back procedure - Flight planning (checking of a/c flight plan before departure) - Flight Crew Training (compliance to FLAS) - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Controller checks in flight plan that Fl310, FL350 and FL390 are not intended to be used after ToS for a period of XX hours - Countdown broadcast **Safety requirements:** **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of	**Effect:** Loss of vertical separation limited by restriction of RVSM Level **Control factors:** - STCA where available - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Reinforce the awareness of Report reaching level **Safety requirements:** **Req $_{Swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{Swit}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours **Req $_{Swit}$_18** Switch-over Procedures shall be in place to impose the surveillance of the level change during the

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{swit}$**_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req** $_{swit}$**_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours **Req** $_{swit}$**_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req** $_{swit}$**_27** Controller shall be trained appropriately with regards to check in flight plan that Fl310, FL350 and FL390 are not intended to be used after ToS **Req** $_{swit}$**_28** The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS - 60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS **Req** $_{swit}$**_23** Awareness campaigns shall be organized before the switch-over period to reinforce the importance of	**Req** $_{swit}$**_19** Controller shall be trained appropriately with regards to switch-over procedures related to the level change **Req** $_{swit}$**_20** Flight crew shall be trained appropriately with regards to switch-over procedures related Report reaching level

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_4	**1**	Objective : Extremely improbable Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error from the pilot due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - Cross check between pilots - Reinforce read back procedure - Flight planning (checking of a/c flight plan before departure) - Flight Crew Training (compliance to FLAS) - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Controller checks in flight plan that Fl310, FL350 and FL390 are not intended to be used after ToS for a period of XX hours - Countdown broadcast **Safety requirement:** **Req $_{\text{Swit}}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of	**Effect:** Loss of vertical separation limited by restriction of RVSM Level **Control factors:** - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Reinforce the awareness of Report reaching level **Safety requirements:** **Req $_{\text{Swit}}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{\text{Swit}}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours **Req $_{\text{Swit}}$_18** Switch-over Procedures shall be in place to impose the surveillance of the level change during the switch-over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{\text{Swit}}$**_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req** $_{\text{Swit}}$**_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours **Req** $_{\text{Swit}}$**_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req** $_{\text{Swit}}$**_27** Controller shall be trained appropriately with regards to check in flight plan that Fl310, FL350 and FL390 are not intended to be used after ToS **Req** $_{\text{Swit}}$**_28** The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS - 60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS **Req** $_{\text{Swit}}$**_23** Awareness campaigns shall be organized before the switch-over period to reinforce the importance of	**Req** $_{\text{Swit}}$**_19** Controller shall be trained appropriately with regards to switch-over procedures related to the level change **Req** $_{\text{Swit}}$**_20** Flight crew shall be trained appropriately with regards to switch-over procedures related Report reaching level

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_08 Controller does not instruct the non RVSM civil aircraft to leave the FL band 290-410 before T0	**ENV_1**	**3**	Objective : Remote Safety Critical	-- Non safety critical	**Elimination** not possible (human error)	**Causes:** Human error from the controller due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - Appropriate ATC Training - Reinforce ATC team - Flight crew awareness to new FLAS - Cross check between controllers to prevent omission of clearances to be issued to the affected aircraft **Safety requirements:** **Req $_{swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS **Req $_{swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{swit}$_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period	**Effect:** Loss of vertical separation limited by restriction of RVSM Level **Control factors:** - STCA where available - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Flight crew awareness to new FLAS **Safety requirements:** **Req $_{swit}$_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req $_{swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{swit}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{Swit}$_28 The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS -60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS **Req $_{Swit}$_29** Switch-over Procedures shall be in place to ensure the delivery of relevant level clearance for non RVSM civil aircraft to leave the FL band 290-410 before ToS **Req $_{Swit}$_30** Controllers shall be trained appropriately with regards to deliver relevant level clearance for non RVSM civil aircraft to leave the FL band 290-410 before ToS	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2	**2**	Objective : Extremely remote Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error from the controller due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - Appropriate ATC Training - Reinforce ATC team - Flight crew awareness to new FLAS - Cross check between controllers to prevent omission of clearances to be issued to the affected aircraft **Safety requirements:** **Req $_{\text{Swit}}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS **Req $_{\text{Swit}}$_7** ATC team shall be reinforced during the switch-over period **Req $_{\text{Swit}}$_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period	**Effect:** Loss of vertical separation limited by restriction of RVSM Level **Control factors:** - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Flight crew awareness to new FLAS **Safety requirements:** **Req $_{\text{Swit}}$_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req $_{\text{Swit}}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{\text{Swit}}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{Swit}$_28 The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS - 60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS **Req $_{Swit}$_29** Switch-over Procedures shall be in place to ensure the delivery of relevant level clearance for non RVSM civil aircraft to leave the FL band 290-410 before ToS **Req $_{Swit}$_30** Controllers shall be trained appropriately with regards to deliver relevant level clearance for non RVSM civil aircraft to leave the FL band 290-410 before ToS	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AHswit_09 Pilot does not leave the FL band 290-410 before T0 (Non RVSM civil a/c)	**ENV_3**	**2**	Objective : Extremely remote Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error from the pilot due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - RVSM status check before T0 - Appropriate ATC Training - Reinforce ATC team - Flight crew awareness to new FLAS - Read back procedures - Check of a/c flight plan before departure - Countdown broadcast - Indication of change level point/time in the FPL **Safety requirements:** **Req swit_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS **Req swit_7** ATC team shall be reinforced during the switch-over period **Req swit_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-	**Effect:** Loss of vertical separation limited by restriction of RVSM Level - Non RVSM civil a/c flying between FL290-410 after T0 **Control factors:** - STCA where available - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Flight crew awareness to new FLAS **Safety requirements:** **Req swit_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req swit_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req swit_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{\text{Swit}}$**_28** The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS - 60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS **Req** $_{\text{Swit}}$**_31** Switch-over Procedures shall be in place to ensure the delivery of relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS **Req** $_{\text{Swit}}$**_32** Controllers shall be trained appropriately with regards to deliver relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS **Req** $_{\text{Swit}}$**_33** Level change and time/point for non RVSM civil aircraft to leave the FL band 290-410 before ToS shall be indicated in the flight plan **Req** $_{\text{Swit}}$**_34** Flight plan shall be checked for non RVSM civil aircraft to leave the FL band 290-410 before ToS (Level change and time/point)	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_4	1	Objective : Extremely improbable Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error from the pilot due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - RVSM status check before T0 - Appropriate ATC Training - Reinforce ATC team - Flight crew awareness to new FLAS - Read back procedures - Check of a/c flight plan before departure - Countdown broadcast - Indication of change level point/time in the FPL **Safety requirements:** **Req $_{Swit}$_6** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{Swit}$_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period	**Effect:** Loss of vertical separation limited by restriction of RVSM Level - Non RVSM civil a/c flying between FL290-410 after T0 **Control factors:** - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Flight crew awareness to new FLAS **Safety requirements:** **Req $_{Swit}$_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req $_{Swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{Swit}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{\text{Swit}}$_28 The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS - 60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS **Req $_{\text{Swit}}$_31** Switch-over Procedures shall be in place to ensure the delivery of relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS **Req $_{\text{Swit}}$_32** Controllers shall be trained appropriately with regards to deliver relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS **Req $_{\text{Swit}}$_33** Level change and time/point for non RVSM civil aircraft to leave the FL band 290-410 before ToS shall be indicated in the flight plan **Req $_{\text{Swit}}$_34** Flight plan shall be checked for non RVSM civil aircraft to leave the FL band 290-410 before ToS (Level change and time/point)	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_10 Controller issues incorrect clearance to a non-RVSM civil a/c intended to transit (climb/descent) through the RVSM airspace	**ENV_1**	**4**	Objective: Probable Not Safety Critical	**--** **--**	**Elimination** possible **Elimination factors:** - Transit of non-RVSM a/c not allowed for a period of XX hours after T0 - Operation above FL410 suspended for non-RVSM a/c for a period of XX hours after T0 **Safety requirements:** **Req $_{swit}$_35** Transit of non-RVSM a/c shall be suspended for a period of XX hours after T0 **Req $_{swit}$_36** Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0		

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2	**3**	Objective: Remote Safety Critical	-- Non Safety Critical (elimina-tion)	**Elimination** possible **Elimination factors:** - Transit of non-RVSM a/c not allowed for a period of XX hours after T0 - Operation above FL410 suspended for non-RVSM a/c for a period of XX hours after T0 **Safety requirements:** **Req $_{Swit}$_35** Transit of non-RVSM civil a/c shall be suspended for a period of XX hours after T0 **Req $_{Swit}$_36** Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0		

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH_{swit}_11 Non-RVSM approved civil aircraft does not apply new RVSM procedures to transit through the RVSM airspace	**ENV_3**	**4**	Objective: Probable Not Safety Critical	-- Non Safety Critical (elimination)	**Elimination** possible **Elimination factors:** - Transit of non-RVSM a/c not allowed for a period of XX hours after T0 - Operation above FL410 suspended for non-RVSM a/c for a period of XX hours after T0 **Safety requirements:** **Req $_{swit}$_35** Transit of non-RVSM civil a/c shall be suspended for a period of XX hours after T0 **Req $_{swit}$_36** Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0		

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_4	2	Objective : Extremely remote Safety Critical	-- Non Safety Critical (elimina-tion)	**Elimination** possible **Elimination factors:** - Transit of non-RVSM a/c not allowed for a period of XX hours after T0 - Operation above FL410 suspended for non-RVSM a/c for a period of XX hours after T0 **Safety requirements:** **Req $_{Swit}$_35** Transit of non-RVSM a/c shall be suspended for a period of XX hours after T0 **Req $_{Swit}$_36** Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0		

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_12 High Traffic Density during the Switch Over period	**ENV_1** **ENV_3**	3 3	Objective : Remote Safety Critical	-- Non Safety Critical	**Elimination** possible **Elimination factors :** - To perform the switch-over during an appropriate low traffic density period **Safety requirements :** **Req $_{Swit}$_37** The switch-over period shall be performed during an appropriate low traffic density period	**Causes :** Poor management of traffic flow **Reduction factors:** - Reinforce the accuracy of traffic flow management **Safety requirement:** **Req $_{Swit}$_38** The traffic flow management capabilities shall be available before the switch-over period **Req $_{Swit}$_39** The switch-over period shall be determine out of Hadj period	**Effects:** - Significant increase of controller workload - Potential loss of vertical separation **Control factors:** - Limitation of traffic density during switchover period - FIR airspace management optimisation - Reinforce ATC team **Safety requirement:** **Req $_{Swit}$_40** Traffic density shall be limited during switch-over period as appropriate **Req $_{Swit}$_41** The FIR airspace shall be optimised to reduce controller workload **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2 ENV_4	2 2	Objective : Extremely Remote Safety Critical	-- Non Safety Critical	**Elimination** possible **Elimination factors :** - To perform the switch-over during an appropriate low traffic density period **Safety requirements :** **Req $_{Swit}$_37** The switch-over period shall be performed during an appropriate low traffic density period	**Causes :** Poor management of traffic flow **Reduction factors:** - Reinforce the accuracy of traffic flow management **Safety requirement:** **Req $_{Swit}$_38** The traffic flow management capabilities shall be available before the switch-over period **Req $_{Swit}$_39** The switch-over period shall be determine out of Hadj period	**Effects:** - Significant increase of controller workload - Potential loss of vertical separation **Control factors:** - Limitation of traffic density during switchover period - FIR airspace management optimisation - Reinforce ATC team **Safety requirement:** **Req $_{Swit}$_40** Traffic density shall be limited during switch-over period as appropriate **Req $_{Swit}$_41** The FIR airspace shall be optimised to reduce controller workload **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_13 Loss of Point to Point (ATS/DS) communications capabilities during switch over period	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	3 3 3 3	Objective : Remote Safety Critical	-- Non Safety Critical	**Elimination:** two <u>independent</u> communication means	**Causes:** - Technical failure - Atmospheric conditions (HF) **Reduction factors:** - Technical failure : equipments redundancy + maintenance (procedures and staff) + equipments failure contingencies (MTBF) - Atmospheric conditions: use of another communications means (different from HF) - Reliability/availability improvement: VSAT, SAT Phone/PSTN… - No modification of existing reliable communications systems before the switch over *Note : Safety requirements identified in the core airspace for Hcore_ 8 are applicable*	**Effects:** - Loss of vertical separation limited by application contingency consisting in relaying via another ACC or a/c included in the LoA (referring to Doc 4444 chapter 15.5.1) **Control factors:** - Equipments failure contingencies (MTTR) - Application of Ground/Ground procedures (defined in LoAs) - ATC Training (contingency) - No modification of point to point (ATS/DS) communications system before an time before the switch over (to ensure systems maturity) - Reinforce the maintenance staff - Use of other communication means (e.g SAT phone, PSTN) *Note : Safety requirements identified in the core airspace for Hcore_ 8 are applicable*

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Safety Requirements: **Req $_{Swit}$_42** SAT Phone and/or PSTN shall be available for point to point communications during the switch over period **Req $_{Swit}$_43** Modification to existing reliable communication systems (and related procedures) which compromise reliability prior to switch over and during switch over period shall not be performed	**Safety requirement:** **Req $_{Swit}$_42** SAT Phone and/or PSTN shall be available for point to point communications during the switch over period **Req $_{Swit}$_44** Maintenance staff shall be trained appropriately with regards to modified systems before Switch-over period **Req $_{Swit}$_45** Maintenance staff shall be reinforced during switch over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_14 Ground system failure during switch over period (HMI or RDPS)	**ENV_1** **ENV_3**	**3** **3**	Objective : Remote Safety Critical	-- Non Safety Critical	**Elimination:** two independent HMI or RDPS	**Cause:** Technical failure **Reduction factors:** - Equipments redundancy - Maintenance capabilities - Equipment failure contingencies (MTBF) - No modification of existing reliable systems before the switch over **Safety requirements:** **Req $_{Swit}$_46** HMI failure contingencies shall be defined before the switch over period **Req $_{Swit}$_47** RDPS/ADS system failure contingencies shall be defined before the switch over period **Req $_{Swit}$_48** Modification to existing reliable HMI (and related procedures) which compromise reliability prior to switch over and during switch over period shall not be performed **Req $_{Swit}$_49** Modification to existing reliable RDPS/ADS system (and related procedures) which compromise reliability prior to switch over and during switch over period	**Effects:** - Reduction in vertical separation (reverting to procedural control) **Control factors:** - Availability of blank strip - Equipment failure contingencies (MTTR) - ATC Training (reverting to procedural control/flight crew information...) - Equipments failure contingencies (MTTR) -Service level agreement **Safety requirements:** **Req $_{Swit}$_44** Maintenance staff shall be trained appropriately with regards to modified systems before Switch-over period **Req $_{Swit}$_45** Maintenance staff shall be reinforced during switch over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_15 Ground system failure during switch over period (FDPS)	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective : Remote Non Safety Critical	-- --	**Elimination:** two <u>independent</u> FDPS	**Cause:** - Technical failure **Reduction factors:** - Equipments redundancy - Maintenance capabilities (procedures and staff) - Equipment failure contingencies (MTBF) - No modification of existing reliable systems before the switch over **Safety requirements:** **Req $_{Swit}$_50** FDPS failure contingencies shall be defined before the switch over period **Req $_{Swit}$_51** Modification to existing reliable FDPS (and related procedures) which compromise reliability prior to switch over and during switch over period shall not be performed	**Effects:** - Reduction in vertical separation (reverting to procedural control) **Control factors:** - Availability of blank strip - Equipment failure contingencies (MTTR) - ATC Training (reverting to procedural control/flight crew information…) - Equipments failure contingencies (MTTR) -Service level agreement **Safety requirements:** **Req $_{Swit}$_44** Maintenance staff shall be trained appropriately with regards to modified systems before Switch-over period **Req $_{Swit}$_45** Maintenance staff shall be reinforced during switch over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)

AH$_{swit}$_16
 	
Weather phenomena during switch over period
	ENV_1
	ENV_3
		3
		3
			Objective : Remote
			
			Safety Critical
				--
				
				Non Safety Critical
					Elimination not possible	**Causes:**
						- Bad weather conditions:
						  ○ Thunderstorm
						  ○ Sandstorm
						  ○ Volcanic activity….
						- Turbulences:
						  ○ CB development
						  ○ CAT
						  ○ Mountain waves
						
						Reduction factors :
						- Avoid sandstorm period for the Switch over
						- Avoid thunderstorm period for the Switch over
						
						Safety requirements:
						Req $_{swit}$_52 The date of switchover shall take into account the effect of adverse weather (thunderstorm, sandstorm, …) to minimize the effect on switch over operations
							Effect:
							Reduction in vertical separation limited by contingencies (as defined in ICAO Doc. 7030)
							
							Control factors:
							- Application of contingencies
							- Flight Crew and ATC Training (contingency)
							
							Safety requirements:
							Req $_{swit}$_4 Controller shall be trained appropriately with regards to RVSM procedures
							
							Req $_{swit}$_5 Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
	ENV_2 **ENV_4**	2 2	Objective : Extremely Remote Safety Critical	-- Non Safety Critical	**Elimination** not possible	**Causes:** - Bad weather conditions: o Thunderstorm o Sandstorm o Volcanic activity…. - Turbulences: o CB development o CAT o Mountain waves **Reduction factors :** - Avoid sandstorm period for the Switch over - Avoid thunderstorm period for the Switch over **Safety requirements:** **Req $_{Swit}$_52** The date of switchover shall take into account the effect of adverse weather (thunderstorm, sandstorm, …) to minimize the effect on switch over operations	**Effect:** Reduction in vertical separation limited by contingencies (as defined in ICAO Doc. 7030) **Control factors:** - Application of contingencies - Flight Crew and ATC Training (contingency) **Safety requirements:** **Req $_{Swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures **Req $_{Swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_17 Non compliance with LOAs	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	**1** **1** **1** **1**	Objective : Extremely Improbable Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** Human error: ○ From the transferring ATCO ○ From the accepting ATCO **Reduction factors:** - ATC Training to avoid wrong knowledge of transfer procedures - Crosscheck between controllers to avoid incorrect clearance with regards to RVSM procedures **Safety requirements:** **Req $_{Swit}$_7** ATC team shall be reinforced during the switch-over period **Req $_{Swit}$_53** LoAs and Procedures shall be in place before Switch-over period **Req $_{Swit}$_54** Controller shall be trained appropriately with regards to LoAs and procedures before Switch-over period **Req $_{Swit}$_55** Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of	**Effects:** - Potential loss of vertical separation - Potential risk of collision **Control factors:** - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. **Safety requirements:** **Req $_{swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{swit}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_18 Non compliance with Civil/Military coordination procedures related to RVSM during switch over period	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	3 3 3 3	Objective : Remote Safety Critical	**--** Non Safety Critical	**Elimination** of risk by possible restriction of military operations between FL290-410 during switchover period Application of Flexible Use Airspace (FUA)	**Causes:** - Human error from civil controller - Human error from military controller **Reduction factors:** - Reinforce civil/military coordination for RVSM including switch over - Civil/Military coordination committee **Safety requirements :** **Req $_{Swit}$_56** Civil/Military coordination procedures shall be in place before Switch-over period **Req $_{Swit}$_57** Controller shall be trained appropriately with regards Civil/Military coordination procedures before Switch-over period **Req $_{Swit}$_58** Military Controller shall be trained appropriately with regards Civil/Military coordination procedures before Switch-over period	**Effects:** - Potential loss of vertical separation - Increase of ATCO workload **Control factors:** - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. **Safety requirements:** **Req $_{Swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{Swit}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req Swit_59 Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new Civil/Military coordination procedures **Req Swit_60** Civil/Military coordination committee shall be in place	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_19 Defence exercise during switch over period	**ENV_1** **ENV_2** **ENV_3** **ENV_4**	4 4 4 4	Objective: Probable Non Safety Critical	-- --	**Elimination** of risk by possible postponement of military exercise during switchover period **Safety Recommendation:** **Rco Swit_01** Military exercise should be postponed during switch over period	**Causes:** Planned military exercise **Reductions factors:** - Restriction of military exercise **Safety recommendation:** **Rco Swit_02** Military exercise during switchover period should be restricted	**Effects:** Increase of ATCO workload due to military exercise **Control factors:** - Coordination with civil units of the military exercise with regards to the specific operational situation of the switchover period **Safety Recommendation:** **Rco Swit_03** Military exercise during switchover should be coordinated and planned with civil units in order not to interfere with RVSM operations

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
AH$_{swit}$_20 Pilot does not leave the FL band 410 and above before T0 (Non RVSM civil a/c) *Note : hazard resulting from the mitigation strategy*	**ENV_3**	**2**	Objective : Extremely remote Safety Critical	Severity 3 -> Remote Non Safety Critical	**Elimination** not possible (human error)	**Causes:** - Human error from the pilot due to new RVSM procedures (non compliance with FLAS) **Reduction factors:** - RVSM status check before T0 - Appropriate ATC Training - Reinforce ATC team - Flight crew awareness to new FLAS - Read back procedures - Check of a/c flight plan before departure - Countdown broadcast - Indication of change level point/time in the FPL **Safety requirements:** **Req $_{swit}$_4** Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{swit}$_5** Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period **Req $_{swit}$_6** Awareness campaigns shall be organized before the switch-over period	**Effect:** - Loss of vertical separation limited by restriction of RVSM Level - Non RVSM civil a/c flying between FL290-410 after T0 **Control factors:** - STCA capabilities - Use of Eastbound RVSM FL (Fl310, FL350 and FL390) suspended for a period of XX hours after the T0. - Flight crew awareness to new FLAS **Safety requirements:** **Req $_{swit}$_24** Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. **Req $_{swit}$_25** A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req Swit_7 ATC team shall be reinforced during the switch-over period **Req Swit_10** An NOTAM shall be issued for Level changes during the switch-over period **Req Swit_61** Switch-over Procedures shall be in place to ensure the delivery of relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS **Req Swit_28** The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS - 60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS **Req Swit_62** Level change and time/point for non RVSM civil aircraft to leave the FL band 410 and above-410 before ToS shall be indicated in the flight plan **Req Swit_63** Flight plan shall be	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						checked for non RVSM civil aircraft to leave the FL band 410 and above before ToS (Level change and time/point)	

Appendix F : Allocation Tables

This section presents the allocation tables for the specified safety requirements (AFI RVSM Core Airspace and Switch-over Period).

The table form is presented in **Annex D** as well as the associated traceability.

F.1 Allocated safety requirements for AFI RVSM Core Airspace

One hundred and four (104) safety requirements have been specified for the AFI RVSM core/mature airspace. They have been allocated to the high-level elements of the AFI RVSM System as follows:

		Procedures	Training	Equipment
Req Core_1 The aircraft shall meet MASPS requirements *AH Core 1, AH Core 2, AH Core 3, AH Core 4*	AIR	☺	☺	☺
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_2 Contingency Procedures shall be defined to provide 2000 feet separation for non RVSM civil aircraft *AH Core 1, AH Core 2, AH Core 3, AH Core 4, AH Core 5*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_3 Contingency Procedures shall be defined to execute lateral/level deviation from RVSM level *AH Core 1, AH Core 2, AH Core 3, AH Core 4*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_4 Contingency Procedures shall be defined to exit non RVSM civil aircraft from RVSM Airspace	AIR	☺		
	ENV 1	☺		

		Procedures	Training	Equipment
aircraft from RVSM Airspace *AH $_{Core}$ 1, AH $_{Core}$ 2, AH $_{Core}$ 3, AH $_{Core}$ 4, AH $_{Core}$ 5*	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_5 Controllers shall be trained appropriately with regards to contingency procedures in case of MASPS requirements failure *AH $_{Core}$ 1, AH $_{Core}$ 2, AH $_{Core}$ 3, AH $_{Core}$ 4*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_6 Flight crew shall be trained appropriately with regards to contingency procedures (RVSM Status degradation) *AH $_{Core}$ 1, AH $_{Core}$ 2, AH $_{Core}$ 3, AH $_{Core}$ 4*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_7 Controllers shall be trained appropriately with regards to Non-RVSM aircraft transiting procedures (including contingencies) *AH $_{Core}$ 5*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_8 Flight crew shall be trained appropriately with regards to Non-RVSM civil aircraft transiting procedures (including contingencies) *AH $_{Core}$ 5*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_9 Radio Communications Failure procedures shall be defined. *AH $_{Core}$ 6, AH $_{Core}$ 7*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_10 Controllers shall be trained appropriately with regards to	AIR			

		Procedures	Training	Equipment
Radio Communications Failure procedures. *AH Core 6, AH Core 7*	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_11 Flight crew shall be trained appropriately with regards to Radio Communications Failure procedures *AH Core 6, AH Core 7*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_12 Air/Ground Communication system shall be designed to ensure a total coverage of the RVSM airspace with a minimum MTBF of 2 months for a given FIR *AH Core 7*	AIR			
	ENV 1			☺
	ENV 2			
	ENV 3			☺
	ENV 4			
Req Core_13 Air/Ground Communications system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement *AH Core 7*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_14 Air/Ground Communications Maintenance team shall be trained appropriately with regards to Air/Ground Communication system maintenance procedures *AH Core 7*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_15 ATS/DS Communications system shall be designed to ensure point-to-point between all adjacent ACCs with a minimum MTBF of 2 months for a given Radar / ADS FIR *AH Core 8*	AIR			
	ENV 1			☺
	ENV 2			
	ENV 3			☺
	ENV 4			

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		Procedures	Training	Equipment
Req Core_16 Transfer procedures shall be defined in the LoA (including communication failure contingencies) *AH Core 8*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_17 Controller shall be trained appropriately with regards to LoA transfer procedures *AH Core 8*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_18 Transfer of communications failure Contingency procedures shall be defined in LoA *AH Core 8*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_19 Controllers shall be trained appropriately with regards to ATS/DS failure contingency procedures *AH Core 8*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_20 Flight crew shall be trained appropriately with regards to ATS/DS failure (awareness training). *AH Core 8*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_21 Ground/Ground Communication system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement.	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		

		Procedures	Training	Equipment
AH $_{Core}$ 8	ENV 4	☺		
Req $_{Core}$_22 Maintenance team shall be trained appropriately with regards to Ground/Ground Communications systems maintenance procedures *AH $_{Core}$ 8*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_23 ATS/DS Communication system shall be designed to ensure point-to-point communications between all adjacent ACCs with a minimum MTBF of 60 years for a given non Radar / ADS FIR *AH $_{Core}$ 8*	AIR			
	ENV 1			
	ENV 2			☺
	ENV 3			
	ENV 4			☺
Req $_{Core}$_24 Controllers shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) *AH $_{Core}$ 9, AH $_{Core}$ 10*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_25 Flight Crew shall be trained appropriately with regards to RVSM Procedures (including correct use of FLAS) *AH $_{Core}$ 9, AH $_{Core}$ 10, AH $_{Core}$ 11*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_26 RVSM Status shall be included in the strip *AH $_{Core}$ 9, AH $_{Core}$ 10*	AIR			
	ENV 1			☺
	ENV 2			☺
	ENV 3			☺
	ENV 4			☺
Req $_{Core}$_27 RVSM/Non RVSM Status shall be displayed on radar or ADS HMI *AH $_{Core}$ 9, AH $_{Core}$ 10*	AIR			
	ENV 1			☺
	ENV 2			

		Procedures	Training	Equipment
	ENV 3			☺
	ENV 4			
Req $_{Core}$_28 Crosscheck between controllers shall be performed *AH $_{Core}$ 9, AH $_{Core}$ 10*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_29 Procedures for read back shall be reinforced *AH $_{Core}$ 9, AH $_{Core}$ 10, AH $_{Core}$ 11*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_30 Controllers shall be trained appropriately with regards to RVSM Procedures (including read back for clearance) *AH $_{Core}$ 9*	AIR			
	ENV 1		☺	
	ENV 2			
	ENV 3		☺	
	ENV 4			
Req $_{Core}$_31 Flight Crew shall be trained appropriately with regards to RVSM Procedures (including read back for clearance) *AH $_{Core}$ 9, AH $_{Core}$ 11*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_32 Existing STCA capabilities shall be updated to be compliant with RVSM *AH $_{Core}$ 9, AH $_{Core}$ 10, AH $_{Core}$ 11, AH $_{Core}$ 12*	AIR			
	ENV 1			☺
	ENV 2			
	ENV 3			☺
	ENV 4			
Req $_{Core}$_33 Pilots awareness on reporting accuracy shall be reinforced by training	AIR		☺	
	ENV 1			

		Procedures	Training	Equipment
training *AH $_{Core}$ 9, AH $_{Core}$ 10*	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_34 Controllers shall be trained with regards to RVSM Procedures (including read back + report leaving/reaching) *AH $_{Core}$ 9, AH $_{Core}$ 10*	AIR			
	ENV 1			
	ENV 2		☺	
	ENV 3			
	ENV 4		☺	
Req $_{Core}$_35 Flight Crew shall be trained with regards to RVSM Procedures (including read back + leaving/reaching level) *AH $_{Core}$ 9, AH $_{Core}$ 10, AH $_{Core}$ 11*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_36 Controllers shall be trained appropriately with regards to RVSM Coordination Procedures *AH $_{Core}$ 12*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_37 RVSM/Non RVSM Status shall be provided by transferring controller (including when status is downgraded) *AH $_{Core}$ 12*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_38 Suitable and reliable ground communications means shall be implemented *AH $_{Core}$ 12*	AIR			
	ENV 1			☺
	ENV 2			☺
	ENV 3			☺
	ENV 4			☺
Req $_{Core}$_39 Transfer procedures shall be defined in LoA (including read	AIR			

		Procedures	Training	Equipment
back) *AH Core 12*	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_40 Controllers shall be trained appropriately with regards to transfer procedures *AH Core 12, AH Core 16*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_41 Transferring Procedure for Flight crew shall be defined (e.g State Level/RVSM Status before FIR entry) *AH Core 12*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_42 Flight crew shall be trained appropriately with regards to the transfer procedures *AH Core 12*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_43 Procedures to revert to procedural control shall be specified (due to RDPS/ADS system failure) *AH Core 13*	AIR			
	ENV 1	☺		
	ENV 2			
	ENV 3	☺		
	ENV 4			
Req Core_44 Controllers shall be trained appropriately to revert to procedural control (in case of RDPS/ADS system failure) *AH Core 13*	AIR			
	ENV 1		☺	
	ENV 2			
	ENV 3		☺	
	ENV 4			

		Procedures	Training	Equipment
Req Core_45 RDPS/ ADS system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. *AH Core 13*	AIR			
	ENV 1	☺		
	ENV 2			
	ENV 3	☺		
	ENV 4			
Req Core_46 Maintenance team shall be trained appropriately with regards to RDPS / ADS systems maintenance procedures *AH Core 13*	AIR			
	ENV 1		☺	
	ENV 2			
	ENV 3		☺	
	ENV 4			
Req Core_47 Controller shall be trained appropriately to operate without FDPS system (blank strip,…) *AH Core 14*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_48 FDPS maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. *AH Core 14*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_49 Maintenance team shall be trained appropriately with regards to FDPS systems maintenance procedures *AH Core 14*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_50 Procedures to revert to procedural control shall be specified (due to FDPS / RDPS/ADS system failure) *AH Core 15*	AIR			
	ENV 1	☺		
	ENV 2			
	ENV 3	☺		

		Procedures	Training	Equipment
	ENV 4			
Req $_{Core}$_51 Controllers shall be trained appropriately to revert to procedural control (in case of FDPS / RDPS/ADS system failure) *AH $_{Core}$ 15*	AIR			
	ENV 1		☺	
	ENV 2			
	ENV 3		☺	
	ENV 4			
Req $_{Core}$_52 FDPS / RDPS/ ADS system maintenance procedures shall be defined to ensure a communication system recovery in MTTR defined in Service Level Agreement. *AH $_{Core}$ 15*	AIR			
	ENV 1	☺		
	ENV 2			
	ENV 3	☺		
	ENV 4			
Req $_{Core}$_53 Maintenance team shall be trained appropriately with regards to FDPS / RDPS / ADS systems maintenance procedures *AH $_{Core}$ 15*	AIR			
	ENV 1		☺	
	ENV 2			
	ENV 3		☺	
	ENV 4			
Req $_{Core}$_54 ATC Procedures regarding Non-receipt of flight plan shall be defined *AH $_{Core}$ 16*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_55 Controllers shall be trained appropriately regarding Non-receipt of flight plan procedures *AH $_{Core}$ 16*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_56 Transfer procedures shall be defined in LoA (including RVSM/Non RVSM Status)	AIR			
	ENV 1	☺		
	ENV 2	☺		

		Procedures	Training	Equipment
AH $_{Core}$ 16	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_57 Operator shall send CHG message when appropriate *AH $_{Core}$ 17, AH $_{Core}$ 18*	AIR	☺	☺	☺
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_58 Procedures for operators regarding flight plan filling shall be reinforced *AH$_{Core}$ 17, AH $_{Core}$ 18*	AIR	☺		☺
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_59 Operators staff shall be appropriately trained with regards to flight plan filling *AH $_{Core}$ 17*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_60 Procedures to check RVSM Status by flight crew before departure shall be specified *AH $_{Core}$ 17*	AIR	☺		
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_61 Flight crew shall be trained appropriately regarding RVSM Status checking before departure *AH $_{Core}$ 17*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_62 ATC Procedures regarding knowledge of RVSM status shall be defined	AIR			
	ENV 1	☺		

		Procedures	Training	Equipment
defined *AH Core 17*	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_63 Controllers shall be trained appropriately regarding knowledge of RVSM status procedures *AH Core 17*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_64 Flight Crew shall be trained to report negative RVSM Status on the initial call on any frequency within the AFI RVSM airspace *AH Core 18*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_65 Weather forecast shall be in place to inform ATC, flight crew and operators about areas with potential severe turbulence *AH Core 19*	AIR	☺		☺
	ENV 1	☺		☺
	ENV 2	☺		☺
	ENV 3	☺		☺
	ENV 4	☺		☺
Req Core_66 Flight planning procedures shall take into account weather forecast *AH Core 19*	AIR	☺		
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_67 Operators staff shall be trained appropriately with regards to flight planning (consideration of forecast turbulence) *AH Core 19*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_68 Flight crew shall be trained to report significant weather	AIR		☺	

		Procedures	Training	Equipment
encountered en-route *AH $_{Core}$ 19, AH $_{Core}$ 20*	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_69 Contingency procedures regarding not forecast severe turbulence shall be defined *AH $_{Core}$ 19*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_70 Controllers shall be trained appropriately regarding contingency procedures related to not forecast turbulence *AH $_{Core}$ 19*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_71 Flight crew shall be trained appropriately regarding contingency procedures related to not forecast turbulence *AH $_{Core}$ 19*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_72 Weather forecast shall be in place to inform ATC, flight crew and operators about bad weather conditions *AH $_{Core}$ 20, AH $_{Core}$ 28*	AIR	☺		☺
	ENV 1	☺		☺
	ENV 2	☺		☺
	ENV 3	☺		☺
	ENV 4	☺		☺
Req $_{Core}$_73Flight planning procedures shall take into account bad weather conditions forecast *AH $_{Core}$ 20, AH $_{Core}$ 28*	AIR	☺		
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			

		Procedures	Training	Equipment
Req $_{Core}$_74 Operators staff shall be trained appropriately with regards to flight planning (consideration of forecast bad weather considerations) *AH $_{Core}$ 20, AH $_{Core}$ 28*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_75 Contingency procedures regarding not forecast severe turbulence shall be defined *AH $_{Core}$ 20*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_76 Controllers shall be trained appropriately regarding contingency procedures related to not forecast turbulence *AH $_{Core}$ 20*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_77 Flight crew shall be trained appropriately regarding contingency procedures related to not forecast turbulence *AH $_{Core}$ 20*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{Core}$_78 Appropriate separation standards shall be specified with regards to wake turbulences *AH $_{Core}$ 21*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req $_{Core}$_79 Controllers shall be trained appropriately regarding Appropriate separation standards related to wake turbulence *AH $_{Core}$ 21*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	

		Procedures	Training	Equipment
	ENV 4		☺	
Req Core_80 Contingency procedures regarding wake turbulence shall be defined *AH Core 21*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_81 Controllers shall be trained appropriately regarding contingency procedures related to wake turbulence *AH Core 21*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_82 Flight crew shall be trained appropriately regarding contingency procedures related to wake turbulence *AH Core 21*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_83 Flight crew shall report encountered vortices *AH Core 21*	AIR	☺		
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_84 Emergency contingencies shall be specified *AH Core 22, AH Core 23*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_85 Flight crew shall be trained appropriately with regards to emergency contingencies	AIR		☺	
	ENV 1			
	ENV 2			

Functional Hazard Analysis Report
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		Procedures	Training	Equipment
AH $_{\text{Core}}$ 22, AH $_{\text{Core}}$ 23	ENV 3			
	ENV 4			
Req $_{\text{Core}}$_86 Controllers shall be trained appropriately with regards to emergency contingencies *AH $_{\text{Core}}$ 22, AH $_{\text{Core}}$ 23*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{\text{Core}}$_87 Climbing/descent rate shall be limited during the level change to avoid nuisance RA (e.g.500ft/min to 1000ft/min) *AH $_{\text{Core}}$ 25*	AIR	☺	☺	
	ENV 1	☺	☺	
	ENV 2	☺	☺	
	ENV 3	☺	☺	
	ENV 4	☺	☺	
Req $_{\text{Core}}$_88 Aircraft shall be equipped with ACAS II (TCAS version 7.0) *AH $_{\text{Core}}$ 25*	AIR			☺
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{\text{Core}}$_89 Pilots shall be trained appropriately to TCAS operation (initial and continuous training) *AH $_{\text{Core}}$ 25, AH $_{\text{Core}}$ 26*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{\text{Core}}$_90 Specific procedures to avoid deviation due to incorrect visual perspective shall be defined *AH $_{\text{Core}}$ 26*	AIR	☺		
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req $_{\text{Core}}$_91 Coordination procedures shall be defined in the Civil - Military LoA	AIR			
	ENV 1	☺		

		Procedures	Training	Equipment
Military LoA	ENV 2	☺		
	ENV 3	☺		
AH Core 27	ENV 4	☺		
Req Core_92 Controllers shall be trained appropriately with regards to RVSM Coordination Procedures (including military coordination)	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
AH Core 27	ENV 4		☺	
Req Core_93 Military controllers shall be trained appropriately with regards to RVSM Coordination Procedures	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
AH Core 27	ENV 4		☺	
Req Core_94 Military – Civil coordination Contingency procedures shall be defined in LoA	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
AH Core 27	ENV 4	☺		
Req Core_95 Controllers shall be trained appropriately with regards to coordination Contingency procedures (including Military coordination)	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
AH Core 27	ENV 4		☺	
Req Core_96 Military Controllers shall be trained appropriately with regards to coordination Contingency procedures	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
AH Core 27	ENV 4		☺	
Req Core_97 Flight crew of Non-RVSM aircraft shall be trained to report	AIR		☺	

		Procedures	Training	Equipment
significant weather encountered en-route *AH Core 28*	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_98 Contingency procedures for Non-RVSM aircraft facing severe icing or turbulence shall be defined *AH Core 28*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_99 ATC controller shall be trained appropriately regarding contingency procedures related to Non-RVSM aircraft facing severe icing or turbulence *AH Core 28*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_100 Flight crew operating Non-RVSM aircraft shall be trained appropriately to contingency procedures related to Non-RVSM aircraft facing severe icing or turbulence *AH Core 28*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_101 Procedures to suspend RVSM shall be defined *AH Core 19, AH Core 20*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_102 Procedures to coordinate RVSM suspension with adjacent ACCs shall be defined *AH Core 19, AH Core 20*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		

		Procedures	Training	Equipment
Req $_{Core}$_103 ATC shall be trained appropriately regarding suspension of RVSM (including coordination with adjacent ACCs) *AH $_{Core}$ 19, AH $_{Core}$ 20*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_104 Flight Crew shall be trained appropriately regarding suspension of RVSM *AH $_{Core}$ 19, AH $_{Core}$ 20*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			

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F.2 Allocated safety requirements for AFI RVSM Switch-Over Period

Sixty-six (66) safety requirements have been specified for the AFI RVSM core/mature airspace. They have been allocated to the high-level elements of the AFI RVSM System as follows:

		Procedure	Training	Equipment	RVSM Program
Req Swit_1 Awareness campaigns about RVSM Status shall be organized before the switch-over period *AH Swit 1*	AIR		☺		
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req Swit_2 Upgraded ground system shall be in place to manage the RVSM status information before the switch-over period *AH Swit 1*	AIR				
	ENV 1			☺	
	ENV 2			☺	
	ENV 3			☺	
	ENV 4			☺	
Req Swit_3 ATC shall verify the RVSM status of each aircraft within its area of responsibility before the ToS *AH Swit 1*	AIR				
	ENV 1	☺	☺		
	ENV 2	☺	☺		
	ENV 3	☺	☺		
	ENV 4	☺	☺		
Req Swit_4 Controller shall be trained appropriately with regards to RVSM procedures before Switch-over period *AH Swit 2, AH Swit 3, AH Swit 4, AH Swit 5, AH Swit 16, AH Swit 20*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req Swit_5 Flight crew shall be trained appropriately with regards to RVSM procedures before Switch-over period	AIR		☺		
	ENV 1				
	ENV 2				

		Procedure	Training	Equipment	RVSM Program
over period	ENV 3				
AH_{Swit} 2, AH_{Swit} 3, AH_{Swit} 4, AH_{Swit} 5, AH_{Swit} 6, AH_{Swit} 16, AH_{Swit} 20	ENV 4				
Req $_{Swit}$_6 Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS (after completion of training for all staff)	AIR		☺		
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
AH_{Swit} 2, AH_{Swit} 3, AH_{Swit} 4, AH_{Swit} 5, AH_{Swit} 6, AH_{Swit} 7, AH_{Swit} 8, AH_{Swit} 9, AH_{Swit} 20	ENV 4		☺		
Req $_{Swit}$_7 ATC team shall be reinforced during the switch-over period	AIR				
	ENV 1	☺			
	ENV 2	☺			
AH_{Swit} 2, AH_{Swit} 3, AH_{Swit} 4, AH_{Swit} 8, AH_{Swit} 9, AH_{Swit} 12, AH_{Swit} 17, AH_{Swit} 20	ENV 3	☺			
	ENV 4	☺			
Req $_{Swit}$_8 Switch-over Procedures shall be in place to impose the surveillance of the execution of the level clearance during the switch-over period	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3				
AH_{Swit} 2, AH_{Swit} 4	ENV 4				
Req $_{Swit}$_9 Controller shall be trained appropriately with regards to switch-over procedures (surveillance of the execution of the level clearance)	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3				
AH_{Swit} 2, AH_{Swit} 4	ENV 4				
Req $_{Swit}$_10 A NOTAM shall be issued for the activation of the new FLAS during the switch-over period	AIR	☺			
	ENV 1	☺			
	ENV 2	☺			

		Procedure	Training	Equipment	RVSM Program
period	ENV 3	☺			
AH Swit 2, AH Swit 3, AH Swit 4, AH Swit 5, AH Swit 7, , AH Swit 8, AH Swit 9, AH Swit 20	ENV 4	☺			
Req swit_11 Switch-over Procedures shall be in place to impose the read back for level clearance during the switch-over period	AIR	☺			
	ENV 1	☺			
	ENV 2	☺			
	ENV 3				
AH Swit 2, AH Swit 4	ENV 4				
Req swit_12 Controller shall be trained appropriately with regards to switch-over procedures (read back for level clearance)	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3				
AH Swit 2, AH Swit 4	ENV 4				
Req swit_13 Flight crew shall be trained appropriately with regards to switch-over procedures(read back for level clearance)	AIR		☺		
	ENV 1				
	ENV 2				
	ENV 3				
AH Swit 2, AH Swit 4	ENV 4				
Req swit_14 Switch-over Procedures shall be in place to recover from incorrect clearance issue	AIR				
	ENV 1	☺			
	ENV 2	☺			
AH Swit 2	ENV 3				
	ENV 4				
Req swit_15 Controller shall be trained appropriately with regards to switch-over procedures (recovering from incorrect clearance issue)	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3				
AH Swit 2	ENV 4				

		Procedure	Training	Equipment	RVSM Program
Req $_{Swit}$_16 Switch-over Procedures shall be in place to impose the surveillance of the execution of the level information during the switch-over period *AH $_{Swit}$ 3*	AIR				
	ENV 1				
	ENV 2				
	ENV 3	☺			
	ENV 4	☺			
Req $_{Swit}$_17 Controller shall be trained appropriately with regards to switch-over procedures (surveillance of the execution of the level information) *AH $_{Swit}$ 3*	AIR				
	ENV 1				
	ENV 2				
	ENV 3		☺		
	ENV 4		☺		
Req $_{Swit}$_18 Switch-over Procedures shall be in place to impose the surveillance of the level change during the switch-over period *AH $_{Swit}$ 3, AH $_{Swit}$ 5, AH $_{Swit}$ 7*	AIR	☺			
	ENV 1				
	ENV 2				
	ENV 3	☺			
	ENV 4	☺			
Req $_{Swit}$_19 Controller shall be trained appropriately with regards to switch-over procedures related to the level change *AH $_{Swit}$ 3, AH $_{Swit}$ 5, AH $_{Swit}$ 7*	AIR				
	ENV 1				
	ENV 2				
	ENV 3		☺		
	ENV 4		☺		
Req $_{Swit}$_20Flight crew shall be trained appropriately with regards to switch-over procedures related Report reaching level *AH $_{Swit}$ 3, AH $_{Swit}$ 5, AH $_{Swit}$ 7*	AIR		☺		
	ENV 1				
	ENV 2				
	ENV 3				
	ENV 4				
Req $_{Swit}$_21 Switch-over Procedures shall be in place to recover from incorrect information issue	AIR				
	ENV 1				
	ENV 2				

		Procedure	Training	Equipment	RVSM Program
AH Swit 3	ENV 3	☺			
	ENV 4	☺			
Req Swit_22 Controller shall be trained appropriately with regards to switch-over procedures (recovering from incorrect information issue) *AH Swit 3*	AIR				
	ENV 1				
	ENV 2				
	ENV 3		☺		
	ENV 4		☺		
Req Swit_23 Awareness campaigns shall be organized before the switch-over period to reinforce the importance of read back *AH Swit 5, AH Swit 7*	AIR		☺		
	ENV 1				
	ENV 2				
	ENV 3				
	ENV 4				
Req Swit_24 Use of Eastbound RVSM FL (Fl310, FL350 and FL390) shall be suspended for a period of XX hours after the T0. *AH Swit 5, AH Swit 7, AH Swit 8, AH Swit 9, AH Swit 17, AH Swit 18, AH Swit 20*	AIR	☺	☺		
	ENV 1	☺	☺		
	ENV 2	☺	☺		
	ENV 3	☺	☺		
	ENV 4	☺	☺		
Req Swit_25 A NOTAM shall be produced to suspend FL310, FL350 and FL390 for RVSM operations after ToS during a period of XX hours *AH Swit 5, AH Swit 7, AH Swit 8, AH Swit 9, AH Swit 17, AH Swit 18, AH Swit 20*	AIR	☺			
	ENV 1	☺			
	ENV 2	☺			
	ENV 3	☺			
	ENV 4	☺			
Req Swit_26 Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new FLAS for operators *AH Swit 6*	AIR		☺		
	ENV 1				
	ENV 2				
	ENV 3				
	ENV 4				
Req Swit_27 Controller shall be trained appropriately	AIR				

		Procedure	Training	Equipment	RVSM Program
with regards to check in flight plan that Fl310, FL350 and FL390 are not intended to be used after ToS *AH Swit 7*	ENV 1				
	ENV 2				
	ENV 3		☺		
	ENV 4		☺		
Req Swit_28 The controller shall be trained appropriately with regards to broadcast the switch-over countdown : ToS - 60mn, 45mn, 30mn,15 mn , ToS-5 mn and ToS *AH Swit 7, AH Swit 8, AH Swit 9, AH Swit 20*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req Swit_29 Switch-over Procedures shall be in place to ensure the delivery of relevant level clearance for non RVSM civil aircraft to leave the FL band 290-410 before ToS *AH Swit 8*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3				
	ENV 4				
Req Swit_30 Controllers shall be trained appropriately with regards to deliver relevant level clearance for non RVSM civil aircraft to leave the FL band 290-410 before ToS *AH Swit 8*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3				
	ENV 4				
Req Swit_31 Switch-over Procedures shall be in place to ensure the delivery of relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS *AH Swit 9*	AIR				
	ENV 1				
	ENV 2				
	ENV 3	☺			
	ENV 4	☺			
Req Swit_32 Controllers shall be trained	AIR				

		Procedure	Training	Equipment	RVSM Program
appropriately with regards to deliver relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS	ENV 1				
	ENV 2				
	ENV 3		☺		
AH Swit 9	ENV 4		☺		
Req Swit_33 Level change and time/point for non RVSM civil aircraft to leave the FL band 290-410 before ToS shall be indicated in the flight plan	AIR	☺			
	ENV 1				
	ENV 2				
	ENV 3				
AH Swit 9	ENV 4				
Req Swit_34 Flight plan shall be checked for non RVSM civil aircraft to leave the FL band 290-410 before ToS (Level change and time/point)	AIR				
	ENV 1				
	ENV 2				
	ENV 3	☺	☺	☺	
AH Swit 9	ENV 4	☺	☺	☺	
Req Swit_35 Transit of non-RVSM civil a/c shall be suspended for a period of XX hours after T0	AIR	☺	☺		
	ENV 1	☺	☺		
	ENV 2	☺	☺		
AH Swit 10, AH Swit 11	ENV 3	☺	☺		
	ENV 4	☺	☺		
Req Swit_36 Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0	AIR	☺	☺		
	ENV 1	☺	☺		
	ENV 2	☺	☺		
	ENV 3	☺	☺		
AH Swit 10, AH Swit 11	ENV 4	☺	☺		
Req Swit_37 The switch-over period shall be performed during an appropriate low traffic density period	AIR				
	ENV 1				☺
	ENV 2				☺
	ENV 3				☺

		Procedure	Training	Equipment	RVSM Program
AH Swit 12	ENV 4				☺
Req Swit_38 The traffic flow management capabilities shall be available before the switch-over period *AH Swit 12*	AIR	☺		☺	
	ENV 1	☺		☺	
	ENV 2	☺		☺	
	ENV 3	☺		☺	
	ENV 4	☺		☺	
Req Swit_39 The switch-over period shall be determine out of Hadj period *AH Swit 12*	AIR				
	ENV 1				☺
	ENV 2				☺
	ENV 3				☺
	ENV 4				☺
Req Swit_40 Traffic density shall be limited during switch-over period as appropriate *AH Swit 12*	AIR				
	ENV 1				☺
	ENV 2				☺
	ENV 3				☺
	ENV 4				☺
Req Swit_41 The FIR airspace shall be optimized to reduce controller workload *AH Swit 12*	AIR				
	ENV 1				☺
	ENV 2				☺
	ENV 3				☺
	ENV 4				☺
Req Swit_42 SAT Phone and/or PSTN shall be available for point to point communications during the switch over period *AH Swit 13*	AIR				
	ENV 1			☺	
	ENV 2			☺	
	ENV 3			☺	
	ENV 4			☺	
Req Swit_43 Modification to existing reliable communication systems (and related procedures) which compromise reliability prior to switch over	AIR				
	ENV 1	☺		☺	
	ENV 2	☺		☺	

		Procedure	Training	Equipment	RVSM Program
which compromise reliability prior to switch over and during switch over period shall not be performed *AH Swit 13*	ENV 3	☺		☺	
	ENV 4	☺		☺	
Req Swit_44 Maintenance staff shall be trained appropriately with regards to modified systems before Switch-over period *AH Swit 13, AH Swit 14, AH Swit 15*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req Swit_45 Maintenance staff shall be reinforced during switch over period *AH Swit 13, AH Swit 14, AH Swit 15*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3	☺			
	ENV 4	☺			
Req Swit_46 HMI failure contingencies shall be defined before the switch over period *AH Swit 14*	AIR				
	ENV 1	☺	☺		
	ENV 2				
	ENV 3	☺	☺		
	ENV 4				
Req Swit_47 RDPS/ADS system failure contingencies shall be defined before the switch over period *AH Swit 14*	AIR				
	ENV 1	☺	☺		
	ENV 2				
	ENV 3	☺	☺		
	ENV 4				
Req Swit_48 Modification to existing reliable HMI (and related procedures) which compromise reliability prior to switch over and during switch over period shall not be performed	AIR				
	ENV 1		☺	☺	
	ENV 2				
	ENV 3		☺	☺	

		Procedure	Training	Equipment	RVSM Program
over period shall not be performed *AH $_{Swit}$ 14*	ENV 4				
Req $_{Swit}$_49 Modification to existing reliable RDPS/ADS system (and related procedures) which compromise reliability prior to switch over and during switch over period shall not be performed *AH $_{Swit}$ 14*	AIR				
	ENV 1		☺	☺	
	ENV 2				
	ENV 3		☺	☺	
	ENV 4				
Req $_{Swit}$_50 FDPS failure contingencies shall be defined before the switch over period *AH $_{Swit}$ 15*	AIR				
	ENV 1	☺	☺		
	ENV 2	☺	☺		
	ENV 3	☺	☺		
	ENV 4	☺	☺		
Req $_{Swit}$_51 Modification to existing reliable FDPS (and related procedures) which compromise reliability prior to switch over and during switch over period shall not be performed *AH $_{Swit}$ 15*	AIR				
	ENV 1		☺	☺	
	ENV 2		☺	☺	
	ENV 3		☺	☺	
	ENV 4		☺	☺	
Req $_{Swit}$_52 The date of switchover shall take into account the effect of adverse weather (thunderstorm, sandstorm, …) to minimize the effect on switch over operations *AH $_{Swit}$ 16*	AIR				
	ENV 1				☺
	ENV 2				☺
	ENV 3				☺
	ENV 4				☺
Req $_{Swit}$_53 LoAs and Procedures shall be in place before Switch-over period *AH $_{Swit}$ 17*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3	☺			

		Procedure	Training	Equipment	RVSM Program
	ENV 4	☺			
Req $_{Swit}$_54 Controller shall be trained appropriately with regards to LoAs and procedures before Switch-over period *AH $_{Swit}$ 17*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req $_{Swit}$_55 Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new LOA *AH $_{Swit}$ 17*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req $_{Swit}$_56 Civil/Military coordination procedures shall be in place before Switch-over period *AH $_{Swit}$ 18*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3	☺			
	ENV 4	☺			
Req $_{Swit}$_57 Controller shall be trained appropriately with regards Civil/Military coordination procedures before Switch-over period *AH $_{Swit}$ 18*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req $_{Swit}$_58 Military Controller shall be trained appropriately with regards Civil/Military coordination procedures before Switch-over period	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req Swit_59 Awareness campaigns shall be organized before the switch-over period to reinforce the knowledge of the new Civil/Military	AIR				
	ENV 1		☺		
	ENV 2		☺		

		Procedure	Training	Equipment	RVSM Program
coordination procedures	ENV 3		☺		
AH $_{Swit}$ 18	ENV 4		☺		
Req Swit_60 Civil/Military coordination committee shall be in place *AH $_{Swit}$ 18*	AIR				
	ENV 1				☺
	ENV 2				☺
	ENV 3				☺
	ENV 4				☺
Req $_{Swit}$_61 Switch-over Procedures shall be in place to ensure the delivery of relevant level information for non RVSM civil aircraft to leave the FL band 290-410 before ToS *AH $_{Swit}$ 20*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3	☺			
	ENV 4	☺			
Req $_{Swit}$_62 Level change and time/point for non RVSM civil aircraft to leave the FL band 410 and above-410 before ToS shall be indicated in the flight plan *AH $_{Swit}$ 20*	AIR	☺			
	ENV 1				
	ENV 2				
	ENV 3				
	ENV 4				
Req $_{Swit}$_63 Flight plan shall be checked for non RVSM civil aircraft to leave the FL band 410 and above before ToS (Level change and time/point) *AH $_{Swit}$ 20*	AIR				
	ENV 1	☺	☺	☺	
	ENV 2	☺	☺	☺	
	ENV 3	☺	☺	☺	
	ENV 4	☺	☺	☺	

END OF THE DOCUMENT

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ALTRAN TECHNOLOGIES

ATTACHMENT

PROPOSAL FOR AMENDMENT TO THE REGIONAL SUPPLEMENTARY PROCEDURES – DOC.7030/4 AFRICAN INDIAN OCEAN (AFI) REGION

(Serial No. ESAF-S 04/1 – AFI RAC/1)

a) Proposed by:

AFI Planning and Implementation Regional Group (APIRG)

b) Proposed amendment: *(cf. Regional Supplementary Procedures,* Doc.7030/4 – AFI, Part 1, Rules of the Air, Air Traffic Services and Search and Rescue, incorporating Amendment No.206). Editorial note**:** Amendments are arranged to show deleted text using strikeout (~~text to be deleted~~), and added text with grey shading (text to be inserted).

Amend the SUPPs in the AFI Region as follows:

AFI REGIONAL SUPPLEMENTARY PROCEDURES

PART 1 – RULES OF THE AIR, AIR TRAFFIC SERVICES AND SEARCH AND RESCUE

These procedures are supplementary to the provisions contained in Annex 2, Annex 6 (Part II), Annex 11, PANS-ATM (Doc 4444) and PANS-OPS (Doc 8168).

1.0 FLIGHT RULES

1.1 Visual flight rules (VFR)
(A2 – 4.7 and 4.8)

1.1.1 At selected aerodromes, only VFR flights to be operated within a control zone established at an aerodrome serving international flights and in specified portions of the associated terminal control area shall:

a) have two-way radio communications;

b) obtain clearance from the appropriate ATC unit; and

c) report positions, as required.

Note. - The phrase "specified portions of the associated terminal control area" is intended to signify at least those portions of the TMA used by international IFR flights in association with approach, holding, departure and noise abatement procedures.

1.2 Instrument flight rules (IFR)
(A2 – 2.2 and Chapter 5)

Note.- Annex 2, 2.2 permits a choice for a flight to comply with either the instrument flight rules or the visual fight rules when operated in visual meteorological conditions subject to certain limitations in Chapter 4 of the Annex. The following indicates certain further restrictions to that choice.

1.2.1 Special application of instrument flight rules

1.2.1.1 Flights shall be conducted in accordance with the instrument flight rules (even when not operating in instrument meteorological conditions) when operated above flight level 150.

1.3 Changes of flight levels
(A2 – 5.2.2)

1.3.1 All changes of flight levels required by transition from the system of designated cruising levels for flights along controlled routes to the semicircular system of cruising levels, or vice versa, shall be made at points within controlled airspace.

1.3.2 The specific points to be used for the changes of flight levels mentioned in 1.3.1 shall be subject of coordination between the ATS units concerned, bearing in mind the need to avoid border points or other points where transfer of communications/transfer of responsibility would be adversely affected.

1.4 Air traffic advisory service
(P-ATM, 9.1.4)

Note.- The PANS-ATM leaves it to the discretion of the pilot whether or not to obtain air traffic advisory service when available. The following procedures make it compulsory to obtain such service under certain circumstances.

1.4.1 All IFR flights shall comply with the procedures for air traffic advisory service when operating in advisory airspace.

1.5 Reduced Vertical Separation Minimum (RVSM) of 300 m (1,000 ft)

1.5.1 Area of Applicability

1.5.2 RVSM shall be applicable in that volume of airspace between FL290 and FL410 inclusive in the following flight information regions/upper flight information regions (FIRs/UIRs):

Accra, Addis Ababa, Algiers, Antananarivo, Asmara, Beira, Brazzaville, Cairo, Canarias, Cape Town, Casablanca, Dakar, Dar es Salaam, Entebbe, Gaborone, Harare, Johannesburg, Kano, Khartoum, Kinshasa, Lilongwe, Luanda, Lusaka, Mauritius,
Mogadishu, Nairobi, N'Djamena, Niamey, Roberts, Sal Oceanic, Seychelles, Tripoli,
Tunis, Windhoek

Note. – The volume of airspace specified in 1.5.2 will be referred to as " AFI RVSM airspace.

2.0 FLIGHT PLANS

2.1 Contents of flight plans
(A2 – 2.3; P-ATM, 4.4.1 and Appendix 2)

2.1.1 Route

2.1.1.1 Whenever possible, flights should be authorized to fly direct between any two intermediate or terminal points of the AFI ATS route network. In this case, flight progress reports should be made in relation to the significant points defining the basic route.

2.1.2 Mach number

2.1.2.1 For turbo-jet aircraft intending to operate at or above FL 250 with FIR Canarias. The Mach number planned to be used shall be specified in Item 15 of the flight plan.

2.2 Presentation of flight plan
(A2 – 3.3.1.4)

2.2.1 The appropriate ATS authority exercising the Annex 2 provision, 3.3.1.4, to prescribe a lead-time other than 60 minutes before departure for the submission of a fight plan concerning a flight to be provided with air traffic control service, air traffic advisory service or flight information service shall, as far as practicable, prescribe a period of 30 minutes for that purpose.

2.3 RVSM Approval status and aircraft registration

2.3.1 Item 10 of the flight plan (Equipment) shall be annotated with the letter W if the aircraft and operator have received RVSM State approval. Furthermore, the aircraft registration shall be indicated in Item 18 of the flight plan.

2.3.2 Submission of a flight plan

2.3.2.1 Information relative to an intended flight or portion of a flight, to be provided to air traffic services units, shall be in the form of a flight plan.

2.3.2.2 In addition to military operations, operators of customs or police aircraft shall insert the letter M in Item 8 of the ICAO flight plan form.

2.3.3 Use of repetitive flight plans

2.3.3.1 Provision shall be made so that repetitive flight plans be accepted for any flight conducted on 19 January 2006 in the AFI RVSM airspace.

2.3.3.2 Flight planning for RVSM approved aircraft

2.3.3.3 Operators of RVSM approved aircraft shall indicate the approval status by inserting the letter W in Item 10 of the ICAO flight plan form, regardless of the requested flight level.

2.3.3.4 Operators of RVSM approved aircraft shall also include the letter W in Item Q of the RPL, regardless of the requested flight level. If a change of aircraft operated in accordance with a repetitive flight plan results in a modification of the RVSM approval status as stated in Item Q, a modification message (CHG) shall be submitted by the operator.

2.3.3.5 Operators of RVSM approved aircraft and non-RVSM approved State aircraft intending to operate within the AFI RVSM airspace, as specified in 2.1, shall include the following in Item 15 of the ICAO flight plan form:

a) the entry point at the lateral limits of the AFI RVSM airspace and the requested flight level for that portion of the route commencing immediately after the RVSM entry point; and

b) the exit point at the lateral limits of the AFI RVSM airspace and the requested flight level for that portion of the route commencing immediately after the RVSM exit point.

2.3.3.6 Operators of non-RVSM approved State aircraft with a requested flight level of FL 290 or above shall insert STS/NON RVSM in Item 18 of the ICAO flight plan form.

2.3.4 Flight planning for non-RVSM approved aircraft

2.3.4.1 Except for operations within the AFI RVSM transition airspace, operators of non-RVSM approved aircraft shall flight plan to operate outside the AFI RVSM airspace.

2.3.4.2 Operators of non-RVSM approved aircraft intending to operate from a departure aerodrome outside the lateral limits of the AFI RVSM airspace to a destination aerodrome within the lateral limits of the AFI RVSM airspace shall include the following in Item 15 of the ICAO flight plan form:

a) the entry point at the lateral limit of the AFI RVSM airspace; and

b) a requested flight level below FL 290 or above FL410 for that portion of the route commencing immediately after the entry point.

2.3.4.3 Operators of non-RVSM approved aircraft intending to operate from a departure aerodrome to a destination aerodrome which are both within the lateral limits of the AFI RVSM airspace shall include in Item 15 of the ICAO flight plan form a requested flight level below FL 290 or above FL410.

2.3.4.4 Operators of non-RVSM approved aircraft intending to operate from a departure aerodrome within the lateral limits of the AFI RVSM airspace to a destination aerodrome outside the lateral limits of the AFI RVSM airspace shall include the following in Item 15 of the ICAO flight plan form:

a) a requested flight level below FL 290 or above FL410 for that portion of the route within the lateral limits of the AFI RVSM airspace; and

b) the exit point at the lateral limit of the AFI RVSM airspace, and the requested flight level for that portion of the route commencing immediately after the exit point.

2.3.4.5 Operators of non-RVSM approved aircraft intending to operate from a departure aerodrome to a destination aerodrome which are both outside the lateral limits of the AFI RVSM airspace, with a portion of the route within the lateral limits of the AFI RVSM airspace, shall include the following in Item 15 of the ICAO flight plan form:

a) the entry point at the lateral limit of the AFI RVSM airspace, and a requested flight level below FL 290 or above FL 410 for that portion of the route commencing immediately after the entry point; and

b) the exit point at the lateral limit of the AFI RVSM airspace, and the requested flight level for that portion of the route commencing immediately after the exit point.

3.0 AIR-GROUND COMMUNICATIONS AND IN-FLIGHT REPORTING

Note.- Annex 2, 3.6.3, 3.6.5.1 and 5.3.3 and PANS-ATM, 4.11, require controlled flights and certain IFR flights outside controlled airspace to maintain a continuous listening watch on the appropriate radio frequency and to report positions in specified circumstances. The following expands such requirements and specifies additional details regarding the transmission and contents of in-flight reports.

3.1 Application
(A2 – 3.6.3, 3.6.5, 5.3.3; P-ATM, 4.11)

3.1.1 All aircraft on VFR flights, and aircraft on IFR flights outside controlled airspace, shall maintain a watch on a radio station furnishing communications for the unit providing flight information service in the flight information region and file with that station information as to their position unless otherwise authorized by the State overflown.

3.2 Time or place of position reports
(A2 – 3.6.3, 3.6.5, 5.3.3; P-ATM, 4.11)

3.2.1 Position reports additional to those required by the general position-reporting procedures shall be made when entering or leaving controlled or advisory airspace.

3.3 Transmission of position reports
(P-ATM, 4.11)

3.3.1 The last position report before passing from one flight information region to an adjacent flight information region shall also be made to the ATS unit serving the airspace about to be entered.

3.4 Air-Ground Communication Failure Procedures

3.4.1 As soon as it is known that two-way communication has failed, ATC shall maintain a vertical separation of 600m (2000ft) between an aircraft with radio communication failure and another aircraft when both aircraft are operating within the AFI RVSM airspace, unless the horizontal separation between the aircraft is considered adequate. The foregoing is based on the assumption that the aircraft will operate in accordance with 3.4.2 or 3.4.3.

Visual Meteorological Conditions (VMC)

3.4.2 Except as provided for in 3.4.3, a controlled flight experiencing communication failure in VMC shall:
a) set transponder to Code 7600;
b) continue to fly in VMC;
c) land at the nearest suitable aerodrome;
d) report its arrival time by the most expeditious means to the appropriate ATS unit.

Instrument Meteorological Conditions (IMC)

3.4.3 A controlled IFR flight experiencing communication failure in IMC, or where it does not appear feasible to continue in accordance with 3.4.2, shall:

a) set transponder to Code 7600; and

b) maintain for a period of 7 minutes the last assigned speed and level or the minimum flight altitude, if the minimum flight altitude is higher than the last assigned level.

FIRs.

The period of 7 minutes commences:
i) if the aircraft is operating on a route without compulsory reporting points or has been instructed to omit position reports:

1) at the time the last assigned level or minimum flight altitude is reached, or

2) at the time the aircraft sets transponder to Code 7600, whichever is later; or if the aircraft is operating on a route with compulsory reporting points and has not been instructed to omit position reports:

i) at the time the last assigned level or minimum flight altitude is reached, or

ii) at the previously reported pilot estimate for the compulsory reporting point, or

iii) at the time the aircraft fails to report its position over a compulsory reporting point, whichever is later;

Note 1:-The period of 7 minutes is to allow the necessary air traffic control and co-ordination measures.

Note 2:- instrument meteorological conditions (IMC), aircraft will maintain the last assigned speed and level or minimum flight altitude for a period of 20 minutes instead of 7 minutes.

c) thereafter adjust level and speed in accordance with the filed flight plan;

Note: As regards changes to levels and speed, the Filed Flight Plan, which is the flight plan as filed with an ATS unit by the pilot or a designated representative, without any subsequent changes will be used.

d) if being radar vectored or proceeding offset according to RNAV without a specified limit, proceed in the most direct manner possible to rejoin the current flight plan route no later than the next significant point, taking into consideration the applicable minimum flight altitude;

Note: As regards the route to be flown or the time to begin descent to the arrival aerodrome, the Current Flight Plan, which is the flight plan, *including changes, if any, brought about by subsequent clearances, will be used.*

e) proceed according to the current flight plan route to the appropriate designated navigation aid serving the destination aerodrome and, when required to ensure compliance with (f) below, hold over this aid until commencement of descent;

f) commence descent from the navigation aid specified in (e) above at, or as close as possible to, the expected approach time last received and acknowledged; or, if no expected approach time has been received and acknowledged, at, or as close as possible to, the estimated time of arrival resulting from the current flight plan;

g) complete a normal instrument approach procedure as specified for the designated navigation aid; and

h) land, if possible, within thirty minutes after the estimated time of arrival specified in (f) above or the last acknowledged expected approach time, whichever is later.

4.0 SPECIAL PROCEDURES FOR IN-FLIGHT CONTINGENCIES EUR/SAM CORRIDOR

4.1 Introduction

4.1.1 The following procedures are intended for guidance only and will be applicable within the EUR/SAM corridor. Although all possible contingencies cannot be covered, they provide for cases of:

a) inability to maintain assigned flight level due to weather, aircraft performance, pressurization failure and problems associated with high-level supersonic flight;

b) loss of, or significant reduction in, the required navigation capability when operating in parts of the airspace where the navigation performance accuracy is prerequisite to the safe conduct of flight operations; and

c) en-route diversion across the prevailing EUR/SAM traffic flow.

4.1.2 With regard to 4.1.1 a) and c) above, the procedures are applicable primarily when rapid descent, turnback, or both are required. The pilots's judgement shall determine the sequence of actions to be taken, having regard to the specific circumstances. Air traffic control (ATC) shall render all possible assistance.

4.2 General procedures

4.2.1 The following general procedures apply to both subsonic and supersonic aircraft. Although all possible contingencies cannot be covered, they provide for cases of inability to maintain assigned level due to weather, aircraft performance, pressurization failure and problems associated with high-level supersonic flight. They are applicable primarily when rapid descent and/or turnback or diversion to an alternate airport are required. The pilot's judgment shall determine the sequence of actions taken, taking into account specific circumstances.

4.2.1.1 If an aircraft is unable to continue flight in accordance with its ATC clearance, and/or an aircraft unable to maintain the navigation performance accuracy specified for the airspace, a revised clearance shall whenever possible, be obtained prior to initiating any action, using the distress or urgency signals as appropriate. Subsequent ATC action with respect to that aircraft shall be based on the intentions of the pilot and the overall traffic situation.

4.2.1.2 If prior clearance cannot be obtained, an ATC clearance shall be obtained at the earliest possible time and, until revised clearance is received, the pilot shall:

a) if possible, deviate away from an organized track or route system before commencing emergency descent;

b) establish communications with and alert nearby aircraft by broadcasting, at suitable intervals, aircraft identification, flight level, aircraft position (including the ATS route designator or the track code) and intentions, on the frequency in use, ~~and~~ as well as on frequency 121.5 MHz (or, as a back-up[, on the inter-pilot air-to-air frequency 123.45 MHz);

c) watch for conflicting traffic both visually and by reference to ACAS (if equipped);

d) turn on all aircraft exterior lights (commensurate with appropriate operating limitations);

e) switch on the SSR transponder at all times; and

f) initiate such action as necessary to ensure the safety of the aircraft.

4.3 Subsonic aircraft

4.3.1 Initial action

4.3.1.1 If unable to comply with the provisions of 4.2.1.1 to obtain a revised ATC clearance, the aircraft should leave its assigned route or track by turning 90 degrees to the right or left whenever this is possible. The direction of the turn should, where possible, be determined by the position of the aircraft relative to any organized route or track system,
eg. whether the aircraft is outside, at the edge of, or within the system. Other factors ~~that may affect the direction of the turn~~ to consider are the direction to ~~an~~ the alternative airport, terrain clearance and the flight levels allocated to adjacent routes or tracks.

4.3.2 Subsequent action (RVSM airspace)

4.3.2.1 In RVSM airspace, an aircraft able to maintain its assigned flight level should turn to acquire and maintain in either direction a track laterally separated by 46 km (25 NM) from its assigned route or track in a multi-track system space at 93 km (50 NM) or otherwise, at a distance which is mid-point from the adjacent parallel route or track and:

a) if above FL 410, climb or descend 300 m (1 000 ft); or

b) if below FL 410, climb or descend 150 m (500 ft); or

c) if at FL 410, climb 300 m (1 000 ft) or descend 150 m (500 ft).

4.3.2.2 An aircraft that is unable to maintain its assigned flight level should:

a) initially minimize its rate of descent to the extent that it is operationally feasible;

b) turn while descending to acquire an d maintain in either direction a track laterally separated by 46 km (25 NM) from its assigned route or track in a multi-track system spaced at 93 km (50 NM) or otherwise, at a distance which is the mid-point from the adjacent parallel route or track; and

c) for the subsequent level flight, select a level which differs from those normally used by 300 m (1 000 ft) if above FL 410, or by 150 m (500 ft) if below FL 410.

4.3.3 Subsequent action (non-RVSM airspace)

4.3.3.1 In non-RVSM airspace, an aircraft able to maintain its assigned flight level should turn to acquire and maintain in either direction or track laterally separated by 46 km (25 NM) from its assigned route or track in a multi-track system spaced at 93 km (50 NM) or otherwise, at a distance which is mid-point from the adjacent parallel route or track and:

a) if above FL 290, climb or descend 300 m (1 000 ft); or

b) if below FL 290, climb or descend 150 m (500 ft); or

c) if at FL 290, climb 300 m (1 000 ft) or descend 150 m (500 ft).

4.3.3.2 An aircraft unable to maintain its assigned flight level should:

a) initially minimize its rate of descent to the extent that it is operationally feasible;

b) turn while descending to acquire and maintain in either direction a track laterally separated by 46 km (25 NM) from its assigned route or track in a multi-track system spaced at 93 km (50 NM) or otherwise, at a distance which is mid-point from the adjacent parallel route or track; and

c) for the subsequent level flight, a level should be selected which differs from those normally used by 300 m (1 000 ft) if above FL 290 or by 150 m (500 ft) if below FL 290.

4.3.2 En-route diversion across the prevailing SAT air traffic flow

4.3.2.1 Before diverting across the flow of adjacent traffic, the aircraft should climb above FL 410 or descend below FL 280 using the procedures specified in 4.3.1 or 4.3.2 or 4.3.3. However, if the pilot is unable or unwilling to carry out a major climb or descent, the aircraft should be flown at a level as defined in 4.3.2.1 or 4.3.3.1 until a revised ATC clearance is obtained.

4.3.3 Extended range operations by aeroplanes with two-turbine power-units (ETOPS)

4.3.3.1 If these contingency procedures are employed by a twin-engine aircraft as a result of an engine shutdown or failure of an ETOPS critical system, the pilot should advise ATC as soon as practicable of the situation reminding ATC of the type of aircraft involved, and request expeditious handling.

4.4 Supersonic aircraft

4.4.1 Turnback procedures

4.4.1.1 If a supersonic aircraft is unable to continue flight to its destination and a reversal of track is necessary, it should:

a) when operating on an outer track of a multi-track system, turn away from the adjacent track;

b) when operating on a random track or on an inner track of a multi-track system, turn either left or right as follows:

1) if the turn is to be made to the right, the aircraft should attain a position 46 km (25 NM) to the left of the assigned track and then turn to the right into its reciprocal heading, at the greatest practical rate of turn;

2) if the turn is to be made to the left, the aircraft should attain a position 46 km (25 NM) to the right of the assigned track and then turn to the left into its reciprocal heading, at the greatest practical rate of turn;

c) while executing the turnback, the aircraft should lose height so that it will be at least 1 850 m (6 000 ft) below the level at which turnback was started, by the time the turnback is completed;

d) when turnback is completed, heading should be adjusted to maintain a lateral displacement of 46 km (25 NM) from the original track in the reverse direction, if possible maintaining the flight level attained on completion of the turn.

Note.- for multi-track systems where the route spacing is greater than 93 km (50 NM), the mid-point distance should be used instead of 46 km (25 NM).

4.5 Weather deviation procedures

4.5.1 General

4.5.1.1 The following procedures are intended to provide guidance. All possible circumstances cannot be covered. The pilot's judgement shall ultimately determine the sequence of actions to be taken. ATC shall render all possible assistance.

4.5.1.2 If the aircraft is required to deviate from track to avoid weather and prior clearance cannot be obtained, an ATC clearance shall be obtained at the earliest possible time. Until an ATC clearance is received, the aircraft shall follow the procedures detailed in 4.5.4 below.

4.5.1.3 The pilot shall advise ATC when weather deviation is no longer required, or when a weather deviation has been completed and the aircraft has returned to the center line of its cleared route.

4.5.2 Obtaining priority from ATC when weather deviation is required.

4.5.2.1 When the pilot initiates communications with ATC, rapid response may be obtained by stating "WEATHER DEVIATION REQUIRED" to indicate that priority is desired on the frequency and for ATC response.

4.5.2.2 The pilot still retains the option of initiating the communications using the urgency call "PAN PAN" (preferably spoken three times) to alert all listening parties to a special handling condition which will receive ATC priority for issuance of a clearance or assistance.

4.5.3 Actions to be taken when controller-pilot communications are established

4.5.3.1 The pilot notifies ATC and requests clearance to deviate from tract, advising when possible, the extent of the deviation expected.

4.5.3.2 ATC takes one of the following actions:

a) If there is no conflicting traffic in the horizontal plane, ATC will issue clearance to deviate from track; or

b) If there is conflicting traffic in the horizontal plane, ATC separates aircraft by establishing appropriate separation; or

c) If there is conflicting traffic in the horizontal plane and ATC is unable to establish appropriate separation, ATC shall:

1) advise the pilot of inability to issue clearance for requested deviation;

2) advise the pilot of confliction traffic; and

3) request the pilot's intentions.

SAMPLE PHRASEOLOGY

"UNABLE (*requested deviation), TRAFFIC IS (call sign, position, altitude, direction*), ADVISE INTENTIONS".

4.5.3.3 The pilot will take the following actions:

a) advise ATC of intentions by the most expedious means; and

b) comply with the ATC clearance issued; or

c) execute the procedures detailed in 4.5.4 below. ATC will issue essential traffic information to all aircraft and;

d) if necessary, establish voice communications with ATC to expedite dialogue on the situation.

4.5.4 Actions to be taken if a revised ATC clearance cannot be obtained

4.5.4.1 The provisions of this section apply to situations where a pilot has the need to exercise the authority of a pilot-in-command under the provisions of Annex 2, 2.3.1.

4.5.4.2 If a revised ATC clearance cannot be obtained and deviation from track is required to avoid weather, the pilot shall take the following actions:

a) if possible, deviate away from the organized track or route system;

b) establish communications with and alert nearby aircraft broadcasting, at suitable intervals: flight level, aircraft identification, aircraft position (including ATS route designator or the track code) and intentions, on the frequency in use and on frequency 121.5 MHz (or, as a back-up, on the inter-pilot air-to-air frequency 123.45 MHz);

c) watch for conflicting traffic both visually and by reference to ACAS (if equipped);

Note.- if, as a result of actions taken under the provisions of 4.5.4.2 b) and c) above, the pilot determines that there is another aircraft at or near the same flight level with which a conflict may occur, then the pilot is expected to adjust the path of the aircraft, as necessary to avoid conflict.

d) turn on all aircraft exterior lights (commensurate with appropriate operating limitations);

e) for deviations of less than 19 km (10 NM), aircraft should remain at a level assigned by ATC;

f) for deviation of greater than 19 km (10 NM), when the aircraft is approximately 19 km (10 NM) from track, initiate a level change based on the following criteria in Table 1;

Table 1

Route center line track	Deviations >19 km (10 NM)	Level change
EAST $000^0 - 179^0$ magnetic	LEFT RIGHT	DESCEND 90 m (300 ft) CLIMB 90 m (300 ft)
WEST $180^0 - 359^0$ magnetic	LEFT RIGHT	CLIMB 90 m (300 ft) DESCEND 90 m (300 ft)

g) when returning to track, be at its assigned level, when the aircraft is within approximately 19 km (10 NM) of the center line; and

h) if contact was not established prior to deviating, continue to attempt to contact ATC to obtain a clearance. If contact was established, continue to keep ATC advised of intentions and obtain essential traffic information.

4.6 Special Procedures for in-flight contingencies involving a loss of vertical navigation performance required for flight within the AFI RVSM airspace

4.6.1 General

4.6.1.1 An in-flight contingency affecting flight in the AFI RVSM airspace pertains to unforeseen circumstances that directly impact on the ability of one or more aircraft to operate in accordance with the vertical navigation performance requirements of the AFI RVSM airspace, as specified in 1.5.2 Such in-flight contingencies can result from degradation of aircraft equipment associated with height-keeping, and from turbulent atmospheric conditions.

4.6.1.2 The pilot shall inform air traffic control as soon as possible of any circumstances where the vertical navigation performance requirements for the AFI RVSM airspace cannot be maintained. In such cases, the pilot shall obtain a revised air traffic control clearance prior to initiating any deviation from the cleared route and/or flight level, whenever possible. Where a revised air traffic control clearance could not be obtained prior to such a deviation, the pilot shall obtain a revised clearance as soon as possible thereafter.

4.6.1.3 Air traffic control shall render all possible assistance to a pilot experiencing an in-flight contingency. Subsequent air traffic control actions will be based on the intentions of the pilot, the over-all air traffic situation, and the real-time dynamics of the contingency.

4.6.2 Degradation of aircraft equipment — pilot reported

4.6.2.1 When informed by the pilot of an RVSM approved aircraft operating in the AFI RVSM airspace that the aircraft's equipment no longer meets the RVSM MASPS, as specified in 18, air traffic control shall consider the aircraft as non-RVSM approved.

4.6.2.2 Air traffic control shall take action immediately to provide a minimum vertical separation of 600 m (2 000 ft) or an appropriate horizontal separation from all other aircraft concerned operating in the AFI RVSM airspace. An aircraft rendered non-RVSM approved shall normally be cleared out of the AFI RVSM airspace by air traffic control, when it is possible to do so.

4.6.2.3 Pilots shall inform air traffic control, as soon as practicable, of any restoration of the proper functioning of equipment required to meet the RVSM MASPS.

4.6.2.4 The first ACC/UAC to become aware of a change in an aircraft's RVSM status shall coordinate with adjacent ACCs/UACs, as appropriate.

4.6.3 Severe turbulence — not forecast

4.6.3.1 When an aircraft operating in the AFI RVSM airspace encounters severe turbulence due to weather or wake vortex that the pilot believes will impact the aircraft's capability to maintain its cleared flight level, the pilot shall inform ATC. Air traffic control shall establish either an appropriate horizontal separation or an increased minimum vertical separation.

4.6.3.2 Air traffic control shall, to the extent possible, accommodate pilot requests for flight level and/or route changes, and pass traffic information, as required.

4.6.3.3 Air traffic control shall solicit reports from other aircraft to determine whether RVSM should be suspended entirely or within a specific flight level band and/or area.

4.6.3.4 The ACC/UAC suspending RVSM shall coordinate any such suspension(s), and any required adjustments to sector capacities with adjacent ACCs/UACs, as appropriate, to ensure an orderly progression to the transfer of traffic.

4.6.4 Severe turbulence — forecast

4.6.4.1 Where a meteorological forecast is predicting severe turbulence within the AFI RVSM airspace, air traffic control shall determine whether RVSM should be suspended and, if so, the period of time, and specific flight level(s) and/or area.

4.6.4.2 In cases where RVSM will be suspended, the ACC/UAC suspending RVSM shall coordinate with adjacent ACCs/UACs with regard to the flight levels appropriate for the transfer of traffic, unless a contingency flight level allocation scheme has been determined by letter of agreement. The ACC/UAC suspending RVSM shall also coordinate applicable sector capacities with adjacent ACCs/UACs, as appropriate.

5.0 AIR TRAFFIC CONTROL CLEARANCES

5.1 Adherence to ATC-approved Mach number
(A2 – 3.6.2)

5.1.1 Air Traffic Control clearances

5.1.1 Turbojet aircraft operating at or above FL 250 within the Canarias FIR shall adhere to the Mach number approved by ATC and shall request ATC approval before making any change thereto. If it is essential to make an immediate change in the Mach number (eg. due to turbulence), ATC shall be notified as soon as possible that such a change has been made.

5.1.2 If it is not feasible, due to aircraft performance, to maintain the last assigned Mach number during en-route climbs and descents, pilots of aircraft concerned shall advise ATC at the time of the climb/descent request.

5.1.3 ATC clearance into the AFI RVSM airspace

5.1.3.1 Except for operations within the AFI RVSM transition airspace and within specifically designated airspace, only RVSM approved aircraft and non-RVSM approved State aircraft shall be issued an air traffic control clearance into the AFI RVSM airspace.

5.1.3.2 Air traffic control clearance into the AFI RVSM airspace shall not be issued to formation flights of aircraft.

6.0 SEPARATION OF AIRCRAFT

6.1 Lateral separation
(A11 – Attachment B; P-ATM, 5.4.1 and 5.11)

6.1.1 Minimum lateral separation shall be 185 km (100 NM) except as provided for in 6.1.2 and 6.1.3 below.

6.1.2 Where aircraft are transiting into an airspace with a larger lateral minimum than the airspace being exited, lateral separation will continue to exist provided that:

a) the smaller separation minimum exists;

b) flight paths diverge by 15 degrees or more until the larger minimum is established; and

c) it is possible to ensure, by means approved by the appropriate ATS authority, that the aircraft have navigation capability necessary to ensure accurate track guidance.

6.1.3 For flights on designated controlled oceanic routes or areas within the Canarias FIR (southern sector), Dakar Oceanic, Recife and Sal Oceanic FIRs, the minimum lateral separation that shall be applied between RNAV-equipped aircraft approved to RNP 10 or better shall be 93 km (50 NM).

6.1.3.1 The letter R shall be annotated in Item 10 (Equipment) of the flight plan to indicate that the aircraft meets the RNP type prescribed.

6.1.3.2 Operators shall establish programmes to mitigate the occurrence of large lateral track errors due to equipment malfunction or operational error, which:

a) ensure that operating drills include mandatory navigation cross-checking procedures to identify navigation errors in sufficient time to prevent aircraft inadvertently deviating from an ATC-cleared route; and

b) provide for the continued airworthiness of aircraft navigation systems necessary to navigate to the degree of accuracy required.

Note.- Detailed guidance material on RNP is contained in the Manual on Required Navigation Performance (RNP) (Doc 9613).

6.1.3.3 A target level of safety of 5×10^{-9} fatal accidents per flight hour per dimension shall be established for route systems operating a 93 km (50 NM) lateral separation minimum and the safety level of such airspace shall be determined by an appropriate safety assessment.

Note.- Detailed guidance on conducting safety assessments is contained in the Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689).

6.1.3.4 The following criteria are used in the operational assessment of airspace system safety:

a) the proportion of the total flight time spent by aircraft 46 km (25 NM) or more off the cleared track shall be less than 7.0×10^{-4}; and

b) the proportion of the total flight time spent by aircraft between 74 km and 111 km (40 NM and 60NM) off the cleared track shall be less than 4.1×10^{-5}.

6.1.3.5 Adequate monitoring of flight operations shall be conducted to provide data to assist in the assessment of continuing compliance of aircraft with the lateral navigation performance capabilities of RNP 10 and 6.1.3.3 above. Such data shall include operational errors dues to all causes. A safety assessment shall be carried out periodically, based on the data collected, to confirm that the safety level continues to be met.

Note:- Detailed guidance on monitoring is contained in the Air Traffic Services Planning Manual (Doc 9426) and the Manual of Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689).

6.2 Longitudinal separation
(P-ATM, 5.4.2 and 5.11)

6.2.1 Except as provided for in 6.2.2, the minimum longitudinal separation between turbo-jet aircraft shall be:

a) 20 minutes, except as specified below;

b) 15 minutes at or above FL 250 within the Canarias, Dakar Oceanic, Recife and Sal Oceanic FIRs, provided that the Mach number technique is applied, and, whether in level, climbing or descending flight, the aircraft have reported over the same entry point to the ATS routes or a common point into the oceanic-controlled airspace and follow the same track or continuously diverging tracks; or

c) 10 minutes or 150 km (80 NM), derived by RNAV, when the Mach number technique is applied on designated controlled oceanic routes in the EUR/SAM corridor within the Dakar Oceanic, Recife and Sal Oceanic FIRs.

6.2.2 For flight in the EUR/SAM corridor (Canarias (southern sector), Dakar Oceanic, Recife and Sal Oceanic FIRs), the minimum longitudinal separation minima between RNAV-equipped aircraft approved to RNP 10 or better on the same track shall be 93 km (50 NM) provided that:

a) the letter R shall be annotated in Item 10 (Equipment) of the flight plan to indicate that the aircraft meets the RNP type prescribed; and

b) a target level of safety of 5 x 10^{-9} fatal accidents per flight hour per dimension shall be established and the safety level of such airspace shall be determined by an appropriate safety assessment.

6.2.2.1 Adequate monitoring of flight operations shall be conducted to provide data to assist in the assessment of continuing compliance of aircraft with the longitudinal navigation performance capabilities of RNP 10. Such data shall include operational errors due to all causes. A safety assessment shall be carried out periodically, based on the data collected, to confirm that the safety level continues to be met.

Note.- Detailed guidance on monitoring is contained in the Air Traffic Services Planning Manual (Doc 9426) and the Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689).

6.3 Vertical separation Minimum

6.3.1. Between FL 290 and FL 410 inclusive within the AFI RVSM airspace, the vertical separation minimum shall be:

a) 300 m (1 000 ft) between RVSM approved aircraft;

b) 600 m (2 000 ft) between:

- non-RVSM approved State aircraft and any other aircraft operating within the AFI RVSM airspace; and

- non-RVSM approved State aircraft and any other aircraft operating within the AFI RVSM transition airspace and within specifically designated airspace.

6.3.2 ATC shall provide a minimum vertical separation of 600 m (2 000 ft) between an aircraft experiencing a communications failure in flight and any other aircraft, where both aircraft are operating within the AFI RVSM airspace.

~~The minimum vertical separation that shall be applied between FL 290 and FL 410 inclusive is 300 m (1 000 ft).~~

~~6.3.1 Area of applicability~~

~~The reduced vertical separation minimum (RVSM) shall be applied for flights between FL 290 and FL 410 inclusive, within the Canarias (Southern sector), Dakar Oceanic, Recife (oceanic portion) and Sal Oceanic FIRs.~~

~~*Note.- Implementation will be carried out in phases and will be promulgated by appropriate AIP Supplements and included in the respective AIPs.*~~

~~6.3.2 Establishment of RVSM transition areas (A2 Appendix 3; A6, Parts I and II, 7.2.3; A11 3.3.4; P-ATM, 5.3.2)~~

~~6.3.2.1 In order to allow for the transition of flights to and from EUR/SAM airspace, the ATS authorities responsible for Canarias, Dakar Oceanic, Recife and Sal Oceanic FIRs may establish designated RVSM transition areas. A 300 m (1 000 ft) vertical separation minimum can be applied between RVSM-approved aircraft within these transition areas.~~

~~6.3.2.2 An RVSM transition area shall have a vertical extent of FL 290 to FL 410 inclusive, be contained within horizontal dimensions determined by the provider States, be overlapping with or contained within EUR/SAM RVSM airspace and should have direct controller-pilot communications.~~

~~6.3.3 RVSM approval~~

~~The minimum separation in 6.3 shall only be applied between aircraft and operators that have been approved by the State of Registry or the State of the Operator, as appropriate, to conduct flights in RVSM airspace and that are capable of meeting the minimum aircraft system performance specification (MASPS) height-keeping requirements (or equivalent).~~

~~6.3.4 MASPS~~

~~The MASPS height-keeping requirements are as follows:~~

~~a) for all aircraft, the differences between cleared flight level and the pressure altitude actually flown shall be symmetric about a mean of 0 m (o ft), shall have a standard deviation no greater than 13 m (43 ft) and shall be such that the error frequency decreases with increasing magnitude at a rate which is at least exponential;~~

~~b) for groups of aircraft that are nominally of identical design and built with respect to all details that could influence the accuracy of height-keeping performance in the RVSM flight envelope (FL 290 to FL 410 inclusive):~~

~~4) the mean altimetry system error (ASE) of the group shall not exceed 25 m (80 ft) in magnitude; and~~

~~5) the sum of the absolute value of the mean ASE and of three standard deviations of ASE shall not exceed 75 m (245 ft);~~

~~e) for non-group aircraft for which the characteristics of the airframe and altimetry system fit are unique and so cannot be classified as belonging to a group of aircraft: the ASE shall not exceed 61 m (200 ft) in magnitude in the RVSM flight envelope (FL 290 to FL 410 inclusive); and~~

~~f) the following criteria shall be used in the operational assessment of airspace system safety: the total vertical error (TVE), which is the difference between the geometric height of the aircraft and the geometric height of the flight level to which it is assigned, is required to be such that:~~

~~1) the probability that TVE equal to or greater than 91 m (300 ft) in magnitude is equal to or less than~~ $\cancel{2.0 \times 10^{-3}}$~~;~~

~~2) the probability that TVE equal to or greater than 152 m (500 ft) in magnitude is equal to or less than~~ $\cancel{5.0 \times 10^{-6}}$~~;~~

~~3) the probability that TVE equal to or greater than 200 m (650 ft) in magnitude is equal to or less than~~ $\cancel{1.4 \times 10^{-6}}$~~;~~

~~4) the probability that TVE between 290 m and 320 m (950 ft and 1 050 ft), inclusive, in magnitude is equal to or less than~~ $\cancel{1.7 \times 10^{-7}}$~~; and~~

~~5) The proportion of time that aircraft spend at incorrect flight levels, 300 m (1 000 ft), or multiplies thereof, away from assigned flight levels is equal to or less than 7.1 x 10^{-7}.~~

~~*Note.- Guidance material regarding the initial achievement and contained maintenance of the height-keeping performance in 6.3.4 is contained in the Guidance Material on the Implementation of a 300 m (1 000 ft) Vertical Separation Minimum (VSM) for Application in the EUR/SAM corridor.*~~

~~6.3.5 Target level of safety (TLS)~~

~~Application of RVSM in the airspace designated in 6.3.1 shall meet a TLS of 5 x 10^{-9} fatal accidents per aircraft flight hour due to all causes of risk in the vertical dimension.~~

~~6.3.6 Approval status and aircraft registration~~

~~Item 10 of the flight plan (Equipment) shall be annotated with the letter W if the aircraft and operator have received RVSM State approval. Furthermore, the aircraft registration shall be indicated on Item 18 of the flight plan.~~

~~6.3.7 Operation of aircraft not approved for RVSM~~

~~6.3.7.1 Except for areas where transition areas have been established, aircraft not meeting the requirements of 6.3.4 shall not be allowed to operate in EUR/SAM RVSM airspace.~~

~~6.3.7.2 Exceptionally, aircraft that have not received RVSM State approval may be cleared to operate in airspace where RVSM may be applied in accordance with policy and procedures established by the State provided that 5=600 m (2 000 ft) vertical separation is applied.~~

~~*Note.- Transitions to and from EUR/SAM RVSM airspace will normally take place in the first FIR in EUR/SAM RVSM airspace.*~~

~~6.3.8 Monitoring~~

~~Adequate monitoring of flight operations in the EUR/SAM RVSM airspace shall be conducted to assist in the assessment of continuing compliance of aircraft with the height-keeping capabilities in 6.3.4. Monitoring shall include assessment of other sources of risk to ensure that the TLS specified in 6.3.5 is not exceeded.~~

~~*Note.- Details of the policy and procedures for monitoring established by the South Atlantic Monitoring Agency (SATMA) are contained in the Guidance Material on the Implementation of a 300 m (1 000 ft) Vertical Separation Minimum (VSM) for Application in the EUR/SAM Corridor.*~~

~~6.3.9 Wake turbulence procedures~~

~~6.3.9.1 The following special procedures are applicable to mitigate wake turbulence encounters in the airspace where RVSM is applied.~~

~~6.3.9.2 An aircraft that encounters wake turbulence should notify ATC and request a revised clearance. However, in situations where a revised clearance is not possible or practicable:~~

~~a) the pilot should establish contact with other aircraft, if possible, on the air-to-air frequency 123.45 MHz; and~~

~~b) one (or both) aircraft may initiate lateral offset(s) not to exceed 3.7 km (2 NM) from the assigned route(s) or track(s), provided that:~~

1) ~~as soon as it is practicable to do so, the offsetting aircraft notify ATC that temporary lateral offset action has been taken and specify the reason for doing so; and~~

2) ~~the offsetting aircraft notify ATC when re-established on assigned routes(s) or track(s).~~

~~*Note.- In the contingency circumstances above, ATC will not issue clearances for lateral offsets and will not normally respond to action taken by pilots.*~~

6.4 Information on application of separation minima
(A11 – 3.4; P-ATM, 5.4.1, 5.4.2 and 5.11)

6.4.1 Where, circumstances permitting, separation minima lower than those specified in 6.1 and 6.2 will be applied in accordance with the PANS-ATM~~, appropriate information should be published in Aeronautical Information Publications so that users of the airspace are fully aware of the portions of airspace where the reduced separation minima will be applied and of the navigation aids on the use of which those minima are based.~~

7.0 ALTIMETER SETTING PROCEDURES APPLICABLE TO AIR TRAFFIC SERVICES AND MINIMUM LEVELS
(P-ATM, 4.10 AND 4.10.3)

7.1 The lowest usable flight level for holding and approach manoeuvres shall be calculated from actual QNH, unless the pressure variation is so small that reference to climatological data is acceptable.

Note 1.- The lowest usable flight will provide a terrain clearance of at least 300 m (1 000 ft) and, for operation in the vicinity of an aerodrome will not be established below 450 m (1 500 ft) above aerodrome elevation.

Note 2.- MET Offices will inform ATS units when, in abnormal conditions, pressure goes below the minimum climatological value, in order that appropriate steps can be taken to cancel temporarily the use of the lowest flight level or levels that would not ensure the minimum terrain clearance.

7.2 Based on current and anticipated atmospheric pressure distribution, area control centers shall coordinate, where required, the lowest flight level to be used.

7.3 In determining the transition level, the table at Appendix A should be used when necessary. This table shows the transition level directly as a function of the transition altitude of the aerodrome and of the current QNH altimeter setting value.

8.0 FLIGHT INFORMATION SERVICE

8.1 Information on runway conditions
(A11 – 4.2.1; P-ATM, 6.6)

8.1.1 Unless otherwise provided, area control centers shall have available for transmission to aircraft on request immediately prior to descent, information on the prevailing runway conditions at the aerodrome of intended landing.

8.2 Transmission of SIGMET information
(P-ATM, 9.1.3.2)

8.2.1 Transmission of SIGMET information to aircraft shall be at the initiative of the appropriate ATS unit, by the preferred method of directed transmission followed by acknowledgement, or by a general call when the number of aircraft would render the preferred method impracticable.

8.2.2 SIGMET information passed to aircraft shall cover a portion of the route up to two hours' flying time ahead of the aircraft.

8.3 Transmission of amended aerodrome forecast
(P-ATM, 9.1.3.5)

8.3.1 Amended aerodrome forecasts shall be passed to aircraft within 60 minutes from the aerodrome of destination, unless the information would have been made available through other means.

8.4 Transmission of trend forecasts
(A11 – 4.2.2)

8.4.1 The latest trend forecasts available to the ATS unit, provided it is no more than one hour old, shall always be transmitted to an aircraft together with the latest report of routine or special observation, when the aircraft requests the latter information.

9.0 AIR TRAFFIC SERVICES COORDINATION

9.1 Coordination between units providing area control service
(P-ATM, 10.3)

9.1.1 If a flight should enter an adjacent area information concerning any review of estimate of three minutes or more shall be forwarded to the adjacent area control center.

10. AIR TRAFFIC SERVICES MESSAGES

10.1 Flight plan and departure messages
~~(P-ATM, 11.3.3 and 11.4.2.2)~~

10.1.1 The procedures applicable for the AFI RVSM airspace are contained in the PANS-ATM Doc.4444 paragraphs 11.3.3 and 11.4.2.

~~10.1.1 Filed flight plan messages for flights intending to operate within the NAT Region at a distance of 60 NM or less from the northern and southern boundaries of Gander Oceanic and Shanwick Oceanic flight information regions shall be addressed to the area control centers in charge of the NAT flight information regions along the route and, in addition, to the area control centers in charge of the nearest adjacent NAT flight information regions.~~

~~10.1.2 For flights departing from points within the adjacent regions and entering the NAT Region without intermediate stops, filed flight plan message shall be transmitted to the appropriate area control centers immediately after the flight plan has been submitted.~~

10.1 Computer-assisted coordination process

10.1.1 Procedures

10.1.1.1 *Operational procedure*

10.1.1.1.1 The following basic rules shall apply for the use of EST and ACT messages:

a) These messages shall be automatically generated, exchanged and processed to obviate human intervention to the extent practicable.

b) A single message shall be sent in respect of each flight due to be transferred and any subsequent revision shall be the subject of verbal coordination.

c) The message shall provide the most recent information available on all transfer conditions at the time of transmission.

d) Acceptance by the receiving unit of the transfer conditions implied in the message shall be assumed, unless the receiving unit initiates verbal coordination to amend the transfer conditions.

Note.— Bilateral arrangement may be required to cover the event of failure of the ATS direct speech circuit.

e) There shall be bilateral agreement as to the boundary point and transmission times for each route. The normal transmission time shall be 15 minutes before the flight concerned is expected to cross the boundary.

f) In the event of data not being correlated by the receiving computer with an appropriate entry in its flight plan database, the computer shall originate a warning to the appropriate air traffic control sector to take necessary action for the acquisition of missing flight plan details. This shall normally involve a telephone inquiry.

g) In the event of incomprehensible or illogical data being detected within the message, the computer shall initiate an appropriate warning to the air traffic control sector involved, if this can be determined, for further action.

Note.— Any system-initiated warning shall require reversion to verbal coordination.

h) If the receiving unit has not received a flight plan, the sending air traffic control unit shall verbally inform the receiving unit of whether or not the aircraft is RVSM approved.

i) When an automated message does not contain the information filed in Item 18 of the ICAO flight plan form relevant to RVSM operations, the sending air traffic control unit shall inform the receiving unit of that information by supplementing the ACT message verbally, using the term "NEGATIVE RVSM" or "NEGATIVE RVSM STATE AIRCRAFT", as applicable.

j) When a verbal coordination process is being used, the sending air traffic control unit shall include the information filed in Item 18 of the ICAO flight plan form relevant to RVSM operations at the end of the verbal estimate message, using the term "NEGATIVE RVSM" or "NEGATIVE RVSM STATE AIRCRAFT", as applicable.

k) When a single aircraft is experiencing an in-flight contingency which impacts on RVSM operations, the associated coordination message(s) shall be supplemented verbally by a description of the cause of the contingency.

11.0 ALERTING AND SEARCH AND RESCUE SERVICES

11.1 Routes and equipment of private aircraft
(P-ATM, 11.3.3 and 11.4.2.2)

11.1.1 General aviation aircraft operating over designated areas, land or sea, where search and rescue operations would be difficult, should:

a) carry appropriate survival equipment:

b) follow the route or specified procedures if not equipped with two-way radio, except that under special circumstances, the appropriate authority may grant specific exemptions from this requirement.

11.2 Alerting services
(P-ATM, 9.2)

11.2.1 The procedures for "Alerting Service" detailed in the PANS-ATM, 9.2, are applicable to all fights except those conducted wholly in the vicinity of an aerodrome when exempted by the appropriate air traffic control unit.

12.0 IDENTIFICATION OF ATS ROUTES (A11, Appendix 1 – 2.4)

12.1 Composition of designators

12.1.1 The letter D to indicate that on a route or portion thereof advisory service only is provided and the letter F to indicate that on a route or portion thereof flight information service only is provided shall be added after the basic designators of the ATS route in question.

13.0 USE OF SECONDARY SURVEILLANCE RADAR (SSR) (P-ATM, Chapter 8)

13.1 Secondary surveillance radar information may be used alone for the provision of horizontal separation between properly equipped aircraft in the circumstances and under the conditions specified below:

a) Within the coverage area of the associated primary radar, in order to overcome known deficiencies of that radar, eg. the fact that primary radar echoes of cetin aircraft are not, or not continuously, presented on the radar display due to the reflecting characteristics of such aircraft, clutter, etc. In this case, SSR responses may be used for the separation of transponder-equipped aircraft and, additionally, for the separation of transponder-equipped aircraft from other known aircraft not using SSR but displayed clearly on the primary radar display, provided that the SSR responses from any aircraft (not necessarily the one being provided separation) coincide with the primary radar echo of the same aircraft.

Note.-Where SSR accuracy cannot be verified by means of monitor equipment or by visual correlation of the SSR response with the primary radar echo from a given aircraft, SSR responses alone may be use only to provide identification.

b) Outside the coverage area of the associated primary radar, or in certain areas (which shall be defined horizontally as well as vertically) and under circumstances specified by the appropriate authority in consultation with the operators, provided:

1) reliable SSR coverage exists within the area;

2) the area is designated as controlled airspace;

3) the control of the air traffic in the area is vested in one ATC unit unless adequate means of coordination exists between all ATC units concerned;

4) actual operating experience has shown that loss of SSR responses is not occurring at a rate affecting the safety of operations and adequate measures for earliest possible detection of such losses have been developed;

5) density and/or complexity of air traffic in the area and provision of navigational guidance allow a safe reversion to other forms of separation in case of SSR failure;

6) the aircraft concerned have previously been identified and identification has been maintained;

7) procedural separation is applied between aircraft with

functioning transponders and other aircraft; and

8) when primary radar fails and until procedural separation is established:

i) the positional accuracy of the SSR responses has been verified (see 13.1 a) and Note): and

ii) the pilots of the aircraft concerned have been advised.

c) In the case of aircraft emergency.

~~13.2 Carriage and operation of pressure-altitude reporting SSR transponders~~

~~13.2.1 With effect from 1 January 2000, all aircraft operating as IFR flights in the AFI Region shall be equipped with a pressure-altitude reporting SSR transponder.~~

~~13.2.2 Unless otherwise directed by air traffic control, the last assigned identity (Mode A) code shall be retained. If no identity code has been assigned, Mode A code 2000 shall be selected and retained.~~

~~14.0 USE OF AIRBORNE COLLISION AVOIDANCE SYSTEMS (ACAS)~~
~~(A2 – 3.2; A6, Part I – 6.18; A10 – Vol. IV; A11 – 2.4.2; P-OPS, Vol. I, Part VIII; P-ATM, Chapter 4)~~

~~14.1 Carriage and operation of ACAS II~~

~~14.1.1 ACAS II shall be carried and operated in the AFI Region by all aircraft that meet the following criteria:~~

a) ~~With effect from 1 January 2000 all civil fixed-wing turbine-engined aircraft having a maximum take-off mass exceeding 15 000 kg or maximum approved passenger seating configuration of more than 30.~~

b) ~~With effect from 1 January 2005, all civil fixed-wing turbine-engined aircraft having a maximum take-off mass exceeding 5 700 kg or a maximum approved passenger seating configuration of more than 19.~~

~~14.2 Responsibility for separation of aircraft during manoeuvres in compliance with a resolution advisory (RA)~~

~~14.2.1 The use of ACAS II does not alter the respective responsibilities of pilots and controllers for the safe operation of aircraft.~~

~~14.2.2 On being notified that an aircraft, under air traffic control, is manoeuvres in accordance with a resolution advisory (RA), a controller should not issue instructions to that aircraft which are contrary to the RA as communicated by the pilot. Once an aircraft departs from the current ATC clearance compliance with an RA, the controllers cease to be responsible for providing separation between that aircraft and other aircrafts affected as a direct consequence of the manoeuvre induced by the RA. However, when circumstances permit, the controller should endeavour to provide traffic information to aircraft affected by the manoeuvre. The controller's responsibility for providing separation for all the affected aircraft resumes when:~~

a) ~~the controller acknowledges a report from the pilot that the aircraft has resumed the current clearance; or~~
b) ~~the controller acknowledges a report from the pilot hat the aircraft is resuming the current clearance and issues an alternative clearance which is acknowledged by the flight crew.~~

~~**14.3 ACAS**~~

~~14.3.1 ACAS can have a significant effect on air traffic control. Therefore there is a continuing need to monitor the performance of ACAS in the developing air traffic management environment.~~

~~14.3.2 Following and RA event, or other significant ACAS event, pilots and controllers should complete an ACAS RA report; aircraft operators and ATS authorities should forward the completed reports through established channels.~~

14. Special procedures applicable to designated airspaces

14.1 RVSM approved aircraft and non-RVSM approved State aircraft entering the AFI RVSM airspace from a non-RVSM environment

14.2 RVSM approved aircraft and non-RVSM approved State aircraft entering the AFI RVSM airspace from a non-RVSM environment shall be established at a flight level in accordance with:

a) the Tables of Cruising Levels, as published in ICAO Annex 2, Appendix 3, a); and/or

b) a flight level allocation scheme, if applicable; and/or

c) as specified in an inter area control centre (ACC) letter of agreement.

14.3 Any changes from non-RVSM levels to RVSM flight levels shall be initiated by the first ACC/upper area control centre (UAC) providing air traffic control service to the aircraft within the AFI RVSM airspace, and shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC, unless otherwise specified in an inter ACC letter of agreement.

14.4 *Aircraft entering a non-RVSM environment from the AFI RVSM airspace*

14.4.1 Aircraft entering a non-RVSM environment from the AFI RVSM airspace shall be established with the applicable vertical separation minimum.

14.4.2 The applicable vertical separation minimum shall be established by the last ACC/UAC providing air traffic control service to the aircraft within the AFI RVSM airspace, and before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

14.4.3 Such aircraft shall be established at a flight level in accordance with:

a) the Tables of Cruising Levels, as published in ICAO Annex 2, Appendix 3, b); and/or

b) a flight level allocation scheme, if applicable; and/or

c) as specified in an inter ACC letter of agreement.

14.5 *Non-RVSM approved civil operations*

14.5.1 Non-RVSM approved State aircraft operating from a departure aerodrome outside the lateral limits of the AFI RVSM airspace with a destination aerodrome within the lateral limits of the AFI RVSM airspace:

a) shall be cleared to a flight level below FL 290; and

b) any such flight level changes shall be initiated by the first ACC/UAC providing air traffic control service to the aircraft within the AFI RVSM airspace, and shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

14.5.2 Non-RVSM approved aircraft operating from a departure aerodrome to a destination aerodrome which are both within the lateral limits of the AFI RVSM airspace, but did not comply with the provision of paragraph 2.3.4.3, shall be cleared to a flight level below FL 290.

14.5.3 Non-RVSM approved aircraft operating from a departure aerodrome within the lateral limits of the AFI RVSM airspace to a destination aerodrome outside the lateral limits of the AFI RVSM airspace:

a) shall be cleared to a flight level below FL 290; and

b) may be cleared to FL 290 or above by the last ACC/UAC providing air traffic control service to the aircraft within the AFI RVSM airspace, and any such flight level changes shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

14.5.4 Non-RVSM approved aircraft operating from a departure aerodrome to a destination aerodrome which are both outside the lateral limits of the AFI RVSM airspace, with a portion of the route within the lateral limits of the AFI RVSM airspace:

a) shall be cleared to a flight level below FL 290 or above FL 410 by the first ACC/UAC providing air traffic control service to the aircraft within the AFI RVSM airspace, and any such flight level changes shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC, in accordance with the flight level allocation system (FLAS), if applicable, and/or as specified in an inter ACC letter of agreement; and

c) may subsequently be cleared to a requested flight level within, or through, the AFI RVSM airspace by the last ACC/UAC providing air traffic control service to the aircraft within the AFI RVSM airspace, and any such flight level changes shall be achieved before the aircraft passes the transfer of control point to the adjacent ACC/UAC.

14.6 Operation of non-RVSM aircraft within RVSM airspace

1.4.6.1 ATC may clear non-RVSM aircraft to climb or descend through RVSM airspace, provided they DO NOT climb or descend at less than standard rate and they DO NOT stop at any intermediate flight level within the RVSM airspace.

15 Phraseology related to RVSM Operations in the AFI RVSM AIRSPACE

15.1 Controller/pilot RTF phraseology

Phrase Meaning	**Phrase Meaning**
(*call sign*) CONFIRM RVSM APPROVED	For a controller to ascertain the RVSM approval status of an aircraft.
NEGATIVE RVSM*	For a pilot to report non-RVSM approval status: a) on the initial call on any frequency within the AFI RVSM airspace (controllers shall provide read back with this same phrase); and b) in all requests for flight level changes pertaining to flight levels within the AFI RVSM airspace; and
	c) in all read backs to flight level clearances pertaining to flight levels within the AFI RVSM airspace. Additionally, except for State aircraft, pilots shall include this RTF phrase to read back flight level clearances involving the vertical transit through FL 290 or FL 410.

AFFIRM RVSM*	For a pilot to report RVSM approval status.
NEGATIVE RVSM STATE AIRCRAFT*	For a pilot of a non-RVSM approved State aircraft to report non-RVSM approval status, in response to the RTF phrase (*call sign)* CONFIRM RVSM APPROVED.
UNABLE RVSM DUE TURBULENCE*	Denial of air traffic control clearance into the AFI RVSM airspace.
UNABLE RVSM DUE EQUIPMENT*	For a pilot to report that the aircraft's equipment has degraded below the MASPS required for flight within the AFI RVSM airspace. This phrase is to be used to convey both the initial indication of the non-MASPS compliance, and henceforth, on initial contact on all frequencies within the lateral limits of the AFI RVSM airspace until such time as the problem ceases to exist, or the aircraft has exited RVSM airspace.
READY TO RESUME RVSM*	For a pilot to report the ability to resume operation within the AFI RVSM airspace after an equipment or weather-related contingency.

Phrase Meaning	**Phrase Meaning**
REPORT ABLE TO RESUME RVSM	For a controller to confirm that an aircraft has regained its RVSM approval status, or to confirm that the pilot is ready to resume RVSM operations.

*Note.-*indicates a pilot transmission*

15.2 Phraseology between ATS units

NEGATIVE RVSM *or* NEGATIVE RVSM STATE AIRCRAFT [*as applicable*]	To verbally supplement an automated estimate message exchange that does not automatically transfer Item 18 information. Also used to verbally supplement estimate messages of non-RVSM approved aircraft.
UNABLE RVSM DUE TURBULENCE [*or* EQUIPMENT, *as applicable*]	To communicate the cause of a contingency relating to an aircraft that is unable to conduct RVSM operations due to severe turbulence or other severe weather-related phenomenon [or equipment failure, as applicable]. End of new text.

16. RVSM Approval

16.1 Except for State aircraft, operators intending to conduct flights within the volume of airspace specified in 14.1.2 where RVSM is applied shall require an RVSM approval either from the State in which the operator is based or from the State in which the aircraft is registered. To obtain RVSM approval, operators shall satisfy the said State that:

a) aircraft for which the RVSM approval is sought have the vertical navigation performance capability required for RVSM operations through compliance with criteria of the RVSM minimum aircraft systems performance specifications (MASPS);

b) they have instituted procedures in respect of continued airworthiness (maintenance and repair) practices and programmes; and they have instituted flight crew procedures for operations in AFI RVSM airspace specified in 14.1.2

Note 1.— An RVSM approval is not restricted to a specific region. Instead, it is valid globally on the understanding that any operating procedures specific to a given region, in this case the AFI Region, should be stated in the operations manual or appropriate crew guidance.

Note 2.— Aircraft that have received State approval for RVSM operations will be referred toas "RVSM approved aircraft".

Note 3.— Aircraft that have not received State approval for RVSM operations will be referred to as "non-RVSM approved aircraft".

17. Minimum Aircraft Systems Performance (MASPS)

17.1 The characteristics of total vertical error (TVE) distribution form the basis of the MASPS which were developed to support the introduction of RVSM operations in accordance with agreed global safety standards. The MASPS were designed to ensure that:

a) in respect of groups of aircraft that with respect to all details that could influence the accuracy of height-keeping performance, height-keeping capability shall be such that TVE for the group of aircraft shall have a mean no greater than 25 m (80ft) in magnitude and shall have standard deviation no greater than 92 – 0.004z for 0<_z<0 where z is the magnitude of the mean TVE in feet or 28 – 0.013z for 0 <_ z <_ 25 when z is in metres. In addition, the components of TVE must have the following characteristics:

1) the mean altimetry system error (ASE) of the group shall not exceed 25 m (80ft) in magnitude;

2) the sum of the absolute value of the mean ASE and of three standard deviations of ASE shall not exceed 75 m (245 ft); and

3) the differences between cleared flight levels and the indicated pressure altitude actually flown shall be symmetric about a mean of 0 m, with standard deviation no greater than 13.3 m (43.7 ft), and in addition, the decrease in frequency of differences with increasing difference magnitude shall be at least exponential.

b) in respect of a non-group aircraft for which the characteristics of the airframe and altimetry system fit are unique and so cannot be classified as belongings to a group of aircraft, height-keeping performance capability shall be such that the components of the TVE of the aircraft have the following characteristics:

1) the ASE of non-group aircraft shall not exceed 60 m (200 ft) in magnitude under all flight conditions; and

2) the differences between the cleared flight level and the indicated pressure altitude actually flown shall be symmetric about a mean of 0 m, with a standard deviation no greater than 13.3 m (43.7 ft), and in additional, the decrease in frequency of differences with increasing difference magnitude shall be at least exponential.

17.2 Guidance material of use to those involved in the initial achievement and continued maintenance of the height-keeping performance capability has been issued by ICAO under the title Manual on the Implementation of a 300 m (1,000 ft) Vertical Separation Minimum (VSM) between FL290 and FL410 Inclusive. Detailed technical guidance material on the airworthiness, continued airworthiness, and the operational practices and procedures for AFI airspace is provided in the Joint Aviation Authorities Administrative and Guidance Material, Section one: General, part 3: Leaflet No. 6

18. RVSM Monitoring

18.1 Adequate monitoring of flight operations in the AFI RVSM airspace shall be conducted to assist in the assessment of continuing compliance of aircraft with the height-keeping capabilities in 17. Monitoring shall include assessment of other sources of risk to ensure that the TLS specified in 19 is not exceeded.

Note.— Details of the policy and procedures for monitoring established by the AFI Monitoring Agency (South Africa) are contained in the Guidance Material on the Implementation of a 300 m (1000 ft) Vertical Separation Minimum (VSM) for Application in the AFI Region are contained in ICAO Doc 9574 and other appropriate documentations on the subject.

19. Target level of safety (TLS)

19.1 Application of RVSM in the airspace designated in 6.3.1.1 shall meet a TLS of 5×10^{-9} fatal accidents per aircraft flight hour due to all causes of risk in the vertical dimension.

~~21. Wake turbulence procedures~~

~~21.1 The following special procedures are applicable to mitigate wake turbulence encounters in the airspace where RVSM is applied.~~

~~21.2 An aircraft that encounters wake turbulence should notify air traffic control (ATC) and request a revised clearance. However, in situations where a revised clearance is not possible or practicable:~~

~~a) the pilot should establish contact with other aircraft, if possible, on the appropriate VHF inter-pilot air-to-air frequency; and~~

~~b) one (or both) aircraft may initiate lateral offset(s) not to exceed 2 NM from the assigned route(s) or track(s), provided that:~~

~~-- as soon as it is practicable to do so, the offsetting aircraft notify ATC that temporary lateral offset action has been taken and specify the reason for doing so; an the offsetting aircraft notify ATC when re-established on assigned route(s) or track(s).~~

~~*Note. – In the contingency circumstances above, ATC will not issue clearances for lateral offsets and will not normally respond to action taken by pilots.*~~

20. Special procedures for strategic lateral offsets in Oceanic Controlled Area (OCA) and remote continental airspace within AFI Region

Note. — The following incorporates lateral offset procedures for both the mitigation of the increasing lateral overlap probability due to increased navigation accuracy, and wake turbulence encounters.

20.1 The use of highly accurate navigation systems (such as the global navigation satellite system (GNSS)) by an increasing proportion of the aircraft population has had the effect of reducing the magnitude of lateral deviations from the route centre line and consequently increasing the probability of a collision should a loss of vertical separation between aircraft on the same route occur.

20.2 The application of lateral offsets to provide lateral spacing between aircraft, in accordance with the procedures specified in 20.3 and 20.4, can be used to mitigate the effect of this reduction in random lateral deviations, thereby improving overall system safety.

Implementation considerations for ATS authorities

20.3 The application of lateral offsets requires authorization from the ATS authority responsible for the airspace concerned. The following considerations shall be taken into account by the ATS authority when planning authorization of the use of strategic lateral offsets in a particular airspace:

a) Strategic lateral offsets shall only be authorized in en-route oceanic or remote continental airspace. Where part of the airspace in question is within radar coverage, transiting aircraft should normally be allowed to initiate or continue offset tracking.

b) Strategic lateral offsets may be authorized for the following types of routes (including where routes or route systems intersect):

1) uni-directional and bi-directional routes; and

2) parallel route systems where the spacing between route centre lines is not less than 55.5km (30 NM).

c) In some instances it may be necessary to impose restrictions on the use of strategic lateral offsets, e.g. where their application may be inappropriate for reasons related to obstacle clearance.

d) These offset procedures should be implemented on a regional basis after coordination between all States involved.

e) The routes or airspace where application of strategic lateral offsets is authorized, and the procedures to be followed by pilots, shall be promulgated in aeronautical information publications (AIPs).

f) Air traffic controllers shall be made aware of the airspace within which strategic lateral offsets are authorized.

Lateral offset procedures to be applied by pilots

20.4 In the application of strategic lateral offsets, pilots should take the following points into consideration:

a) Offsets shall only be applied in airspace where this has been approved by the appropriate ATS authority.

b) Offsets shall be applied only by aircraft with automatic offset tracking capability.

c) The decision to apply a strategic lateral offset is the responsibility of the flight crew.

d) The offset shall be established at a distance of one or two nautical miles to the right of the centre line relative to the direction of flight.

e) The strategic lateral offset procedure has been designed to include offsets to mitigate the effects of wake turbulence of preceding aircraft. If wake turbulence needs to be avoided, one of the three available options (centreline, 1 NM or 2 NM right offset) shall be used.

f) In airspace where the use of lateral offsets has been authorized, pilots are not required to inform air traffic control (ATC) that an offset is being applied.

g) Aircraft transiting areas of radar coverage in airspace where offset tracking is permitted may initiate or continue an offset.

20.5 Pilots may, if necessary, contact other aircraft on the air-to-air frequency 123.45 MHz to coordinate offsets.

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c) Proposer's reason for amendment:

Implementation of Reduced Vertical Separation Minimum (RVSM) in the AFI Region. The reduction in vertical separation will improve the provision of air traffic services in the areas concerned and is in line with the implementation strategy adopted in the AFI CNS/ATM implementation plan. This will improve ATC efficiency and airspace capacity.

d) Proposed implementation date of the amendment:

Upon approval by Council.

e) Proposal has been circulated to the following States and International Organizations:

Afghanistan	Cape Verde	Ethiopia	Japan
Algeria	Central African Republic	Finland	Jordan
Angola	Chad	France	Kenya
Argentina	Chile	Gabon	Kuwait
Armenia	China	Gambia	Lebanon
Australia	Colombia	Germany	Lesotho
Austria	Congo	Ghana	Libyan Arab Jamahiriya
Bahrain	Comoros	Greece	Liberia
Bangladesh	Cote d'Ivoire	Guinea	Luxembourg
Belarus	Croatia	Guinea Bissau	Madagascar
Belgium	Cuba	Hungary	Malawi
Benin	Cyprus	Iceland	Malaysia
Bosnia and Herzegovina	Czech Republic	India	Maldives
Botswana	Democratic Republic of Congo	Indonesia	Mali
Brazil	Democratic Peoples' Republic of Korea	Iran, Islamic Republic of	Malta
Bulgaria	Denmark	Iraq	Mauritania
Burkina Faso	Djibouti	Ireland	Mauritius
Burundi	Egypt	Israel	Mexico
Cameroon	Equatorial Guinea	Italy	Morocco
Canada	Eritrea	Jamaica	Mozambique

Namibia
Netherlands
New Zealand
Niger
Nigeria
Norway
Oman
Pakistan
Philippines
Poland
Portugal
Qatar
Republic of Korea
Romania
Rwanda
Russian Federation
Sao Tome and Principe
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Slovakia
Slovenia
Somalia
South Africa
Spain
Sri Lanka
Sudan
Swaziland
Sweden
Switzerland
Syrian Arab Republic
Thailand
The former Yogoslav Republic of Macedonia
Togo
Tunisia
Turkey
Uganda
United Arab Emirates
United Kingdom
United Republic of Tanzania
United States
Uruguay
Viet Nam
Yemen
Zambia
Zimbabwe
ASECNA
IATA
IFALPA

f) Secretariat comments

a) This amendment proposal has been developed within the framework or the APIRG/12, 13 and 14 Meetings Conclusions/Decisions 12/66, 13/58 and 14/21 respectively concerning the planning and evolutionary implementation of RVSM in the AFI Region.

b) Implementation of RVSM in the AFI Region would enable aircraft operating in the AFI RVSM airspace to continue under RVSM in EUR/NAT, MID/ASIA, CAR/SAM and ASIA/PAC RVSM airspaces, thereby enhancing the efficiency of seamless flight operations.

ACTION PLAN FOR IMPLEMENTATION OF REDUCED VERTICAL SEPARATION MINIMA IN THE AFRICA-INDIAN OCEAN REGION

25 May 2005

Prepared by the Secretary of the RVSM/TF

AFI RVSM IMPLEMENTATION ACTION PLAN					
ID	**Description**	**Target Date**	**Status**	**Resources**	**Remarks**
	Program Management				
1	Agree on structure of TF to enable efficient handling of specialist technical tasks	21/11/03	Completed	Secretariat Support Team: ASECNA, SA, IATA, Nigeria, Tunisia	Completed 21 Nov 2003
2	RVSM SIP Report	21/11/03	Completed	RVSM/ITF2	Completed 21 Nov 2003
3	RVSM/RNAV/RNP TF/2 Meeting	21/11/03	Completed	RVSM/ITF2	Completed 21 Nov 2003
4	Identify resources for performing specialist technical tasks	21/11/03	Completed	RVSM/ITF2	Completed 21 Nov 2003
5	Investigate methods of funding any outside assistance required	31/03/04	Completed	ICAO/IATA	To address future funding as/when required
6	Finalize the RVSM Implementation Strategy/ Action Plan	31/12/03	Completed	ICAO	Sent 05 Dec 2003
7	Circulate RVSM Implementation Strategy/Action Plan for comments from States	5/01/04	Completed	ICAO	Sent 05 Dec 2003
8	(a) Doc 7030 amendment Proposal (b) Circulate proposal to States (c) ANC Approval	01/06/04 15/06/04 15/08/05	Completed Completed In Progress	ICAO ICAO ICAO	* Completed 31 May * Approval final draft by (TF/6)
9	States comments on RVSM implementation Strategy/Action Plan	31/-3/04	Completed	States, ICAO RVSM/ITF3	Completed 31 March 04
10	Regional RVSM informational Website	31/03/04	Completed	IACO/IATA/States	Completed 1 Feb 04
11	RVSM Seminar/RVSM ITF3	19-22/04/04	Completed	ICAO	Completed on Time
12	RVSM Seminar /RVSM/ITF/4	26-30/07/04	Completed	ICAO/RVSM ITF/4	Completed on Time
13	Coordination and harmonization of procedures with adjacent Regions	Ongoing	Ongoing	ICAO and AFI RMA	Continuous contact
14	States to send AIC re RVSM Implementation intention	31/05/04	In Progress	ICAO/States	Continuous
15	Confirm target AIRAC implementation date (AIP Supplement to be published)	15/11/05	In progress	ICAO/States	TF8 to review requirement
16	Regional RVSM implementation status reports	Ongoing	Ongoing	ICAO	Monthly

AFI RVSM IMPLEMENTATION ACTION PLAN

ID	Description	Target Date	Status	Resources	Remarks
17	State Readiness Assessment	May 2005	In Progress	ICAO	TF/6
18	RVSM/ARTF/5	15-16/11/04	Completed	ICAO/RVSM ITF/5	
19	Go/Delay Meeting	17-19/11/04	Completed	Meeting all Stakeholders	
20	RVSM/ARTF/6	25-27/05/05	In Progress	ARTF/6	
21	RVSM/ARTF/7/ATS/SG/8	08-09/08/05/ 10-12/08/5	In Progress	ARTF/7 ATS SG/8	
22	RVSM/ARTF/8	10-11/10/05	In Progress	ARTF	
23	Go/Delay Meeting 2005	12-14/10/05	In Progress	Meeting all Stakeholders	
24	Publish Trigger NOTAM	28/11/05	In Progress	States	TF8 to confirm date
25	Develop switch over plan	1/08/05		ICAO	TF7
	Aircraft Operations and Airworthiness				
26	Regional OPS/Airworthiness RVSM Guidance Doc	21/11/03	Completed	ICAO	Sent 05 Dec 2003 to states for action.
27	Develop regional Pilot Training RVSM Guidance Material	30/04/04	Completed	IATA	Sent to States for action May 2004.
28	Aircraft Operational approval process guidelines	31/05/04	Completed	States, ICAO	Sent to States for action June 2004.
29	Aircraft RVSM Approval Survey	May 2005	In progress	ICAO/States	Continuous
30	Monitor aircraft/operator approval process	May 2005	In progress	ARMA/ICAO	Continuous
	Air Traffic Management				
31	National RVSM plan	31/03/04	Completed	States, ICAO	Sent to States – 05/05/04
32	Regional ATC OPS Manual	31/03/04	Completed	ICAO	Sent to States – 05/05/04
33	Determine the limits of RVSM airspace	30/06/04	Completed	States/ICAO	TF4 verified limits.
34	Regional ATC Training Program & Guidance Material	31/03/04	Completed	South Africa/ ASECNA / Nigeria	State letter sent re course dates 28/05/04. First course commenced mid August. Five courses conducted by end of December 2004.
35	Simulations to assess ATC workload and possible need for airspace/air route Sector changes	31/05/05	In Progress	States	In National RVSM Plan
36	Identify issues to be addressed in Letters of Agreement	31/05/04	Completed	ICAO/States	Specimen LOA sent to States November 2004.
37	Military aviation preparation	31/05/05	In progress	States	In National RVSM Plan

AFI RVSM IMPLEMENTATION ACTION PLAN

ID	Description	Target Date	Status	Resources	Remarks
38	National RVSM Regulatory Material	31/05/05	In progress	States, ICAO	To Identify requirements
39	States assess the impact of RVSM implementation on controller automation systems and plan for upgrades/ modifications	31/05/05	In progress	States	In National Plan
40	Collect weather and turbulence data for analysis	31 /05/05	In progress	ARMA ICAO/States	TF/6
41	States to conduct local ATC RVSM training	31/10/05	In progress	States	TF/6
	RVSM Safety Assurance				
42	Conduct preliminary data collection and readiness assessment	31/05/05	In progress	ARMA/ICAO	Ongoing
43	Develop AFI RVSM Safety Policy	30/06/04	Completed	RVSM/ARTF4	Sent to States for publication July 2004.
44	a) Develop National RVSM Safety Plan	30/06/04	Completed	ICAO	Sent to States for Action July 2004.
	b) Conduct NSP workshops facilitated by ATC experts	July 05	In Progress	ICAO /IATA/ATNS/ASECNA	Nairobi & Dakar
	c) Submit NSP's for validation	30/07/05	In Progress	States	TF7
	d) Submit final NSP's after validation comments have being taken into account	15/09/05		States	TF7
	e) Once NSP's are validated, DCA's to confirm State readiness to Implement RVSM in writing	Sept 05		States	TF7
	f) Develop State letter of readiness document	15/08/05		ICAO	
45	RVSM Functional Hazard Assessment (FHA)	4-8/04/05	Completed	ARMA/ICAO	3 FHA meetings conducted Final FHA 4-8/04/05. Report Completed May 2005.
46	Validate Functional Hazard Assessment	31/05/05	In progress	RVSM ARTF/6	TF/6/25-27/05/05
47	RVSM Collision Risk Assessment	30/06/05	In progress	ARMA/ICAO	Draft Report July 2005.
48	Validate Collision Risk Assessment	30/07/05	In progress	RVSM ARTF/7	TF/7/ATS/SG/8 August 2005 interim PISC Report.
49	Develop AFI Pre-Implementation Safety Case	30/07/05	In Progress	ICAO	
50	AFI Pre-Implementation Safety Case: APIRG/ANC	31/09/05	In Progress	ARPO/ANC	September 2005

AFI RVSM IMPLEMENTATION ACTION PLAN

ID	Description	Target Date	Status	Resources	Remarks
	Monitoring Agency				
51	Evaluate options for setting up AFI RMA	21/11/03	Completed	RVSM/ITF2	Completed on time
52	Identify an AFI RMA	21/11/03	Completed	RVSM/ITF/2	Completed on time
53	Establish an AFI RMA.	31/03/04	Completed	South Africa/ICAO	Completed on time
	Post Implementation Safety Case (PISC)				
54	Validate implementation readiness assessment	15/11/04	Completed	ICAO/ARMA	Ongoing
55	Data collection to continue for submission to ARMA	Monthly	In Progress	States	
56	Evaluate system safety after implementation plus 3, 6, 12 and 24 months			ARMA	
57	Monitor system safety in adjacent Regions			ARMA	

SCHEDULE FOR AFI RVSM PRE-IMPLEMENTATION SAFETY CASE

	Nov. 04	Dec. 04	**Jan. 05**	**Feb. 05**	**March 05**	**April 05**	**May 05**	**June 05**	**July 05**	**Aug. 05**	**Sept. 05**	**Oct. 05**	**Nov. 05**	**Dec. 05**
FHA				2^{nd} Meeting		4 – 8 April Final FHA mtg.	Final Report 4 May review by TF							
CRA			State Data Collected by ICAO Input from WACAF SIP	State Data Collected by ICAO Input from WACAF SIP	State Data Collected by ICAO Input from WACAF SIP	State Data Collected by ICAO Input from WACAF SIP	State Data Collected By ICAO Input from WACAF SIP	State Data Collected by ICAO Input from WACAF SIP	CRA Report					
National Safety Plan (NSP)			Obtain NSP from States	Obtain NSP from States	Obtain NSP from States	Obtain NSP from States	Obtain NSP from States	Obtain NSP from States						
Pre-Implementation Safety Case (PISC)									Pre-Implementation Safety Case	PISC and CRA report Review by ARTF and ATS/SG/8	PISC Review by ANC and APIRG			
ARTF							ARTF/6 25 – 27 May 2005			ARTF/7 8 – 9 Aug. ATS/SG/8 10 – 12 Aug. 05		ARTF/8 and Stakeholders Mtg. (10 – 14 Oct. 05)		
GO/NO GO												GO/NO GO		
