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AFI RVSM PROGRAMME

FUNCTIONAL HAZARD ASSESSMENT

APPROVAL

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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:

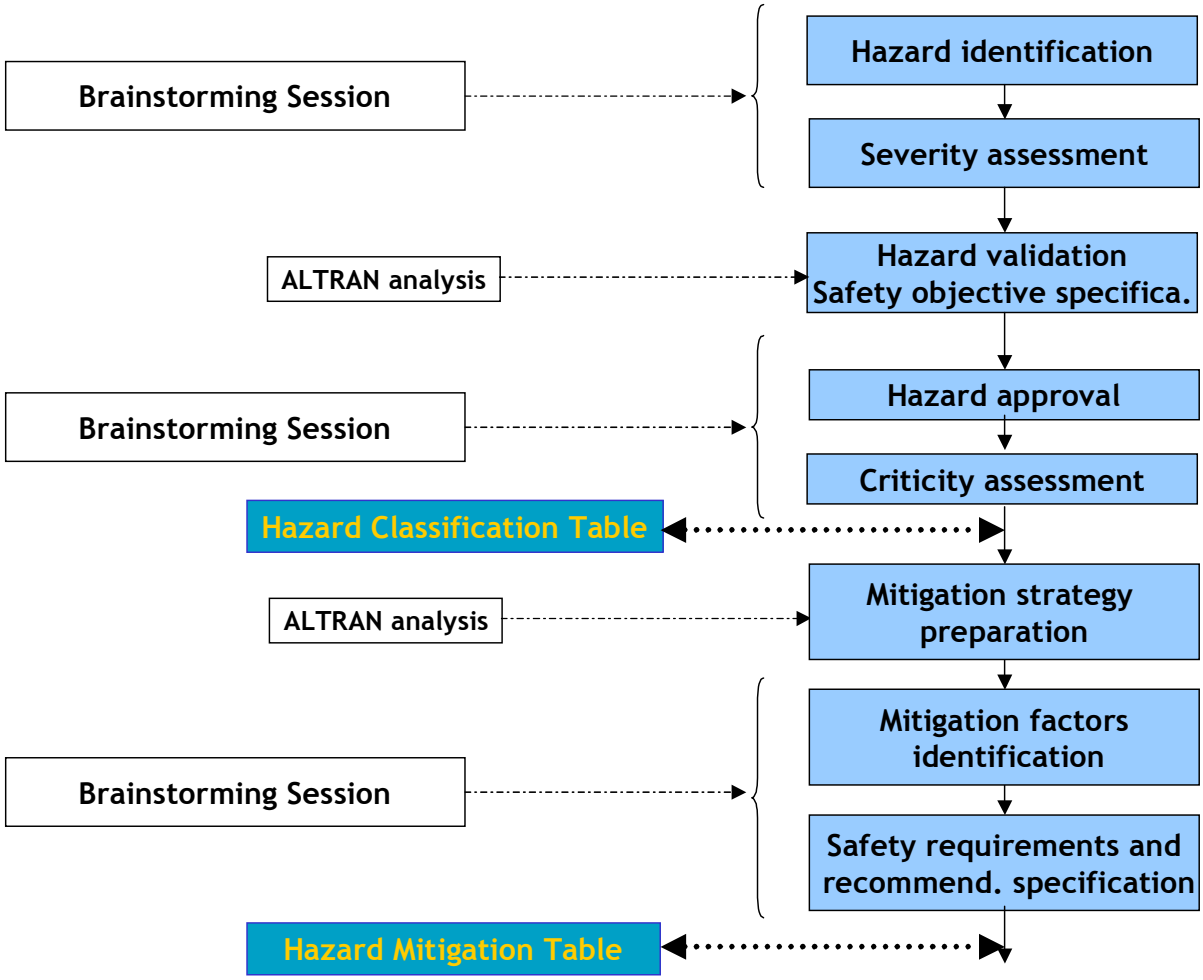

Figure 1: Methodological framework (brainstorming sessions)

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:

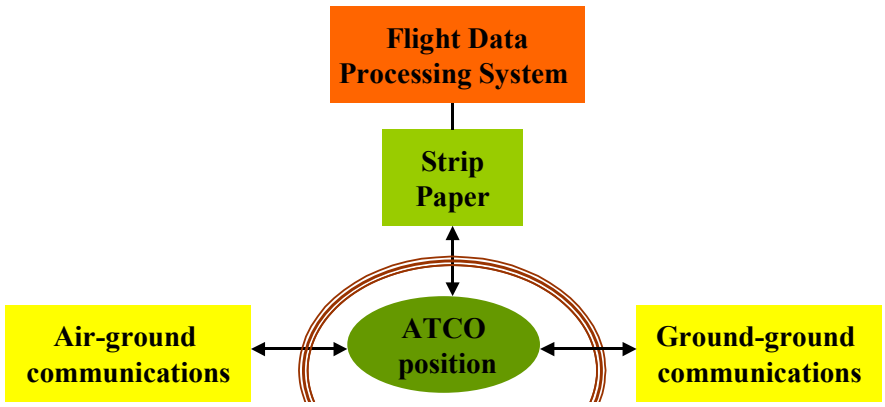

Figure 2 : Non radar/Non ADS basic ATC environment

3.4.2. With radar or ADS surveillance capability

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

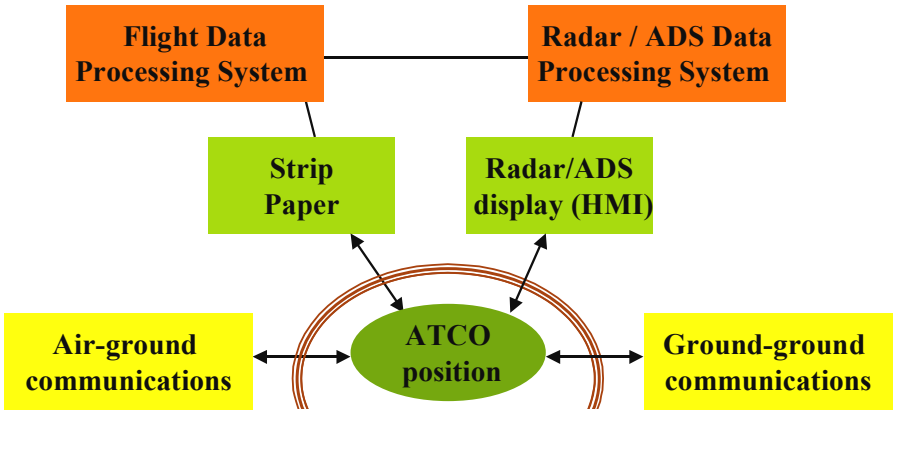

Figure 3 : Radar or ADS basic ATC environment

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:

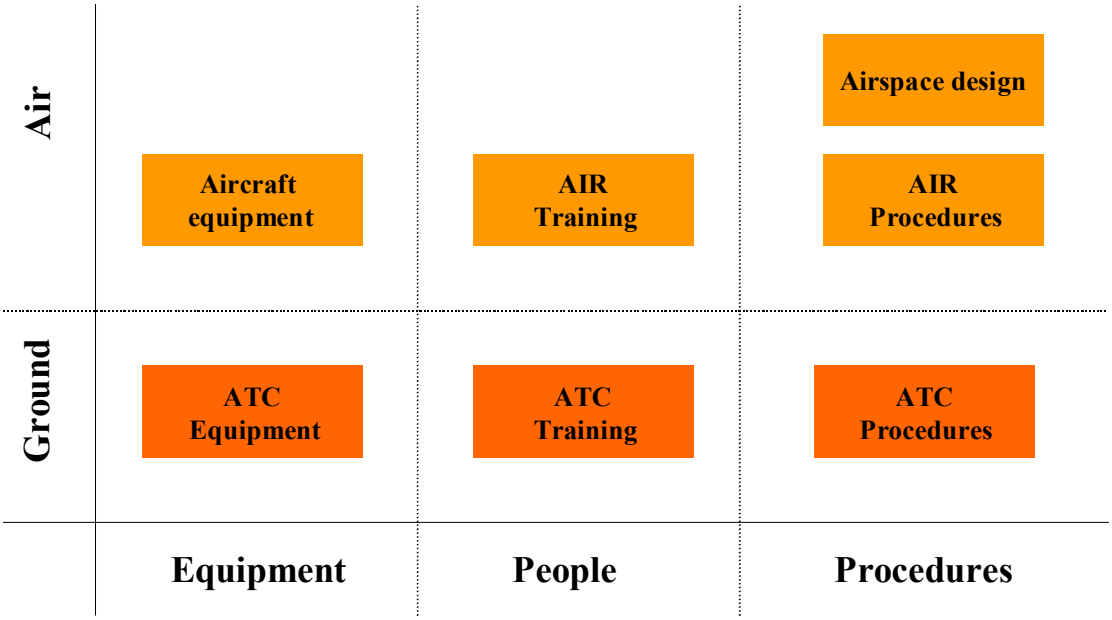

Figure 4 : AFI RVSM System high-level elements

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:

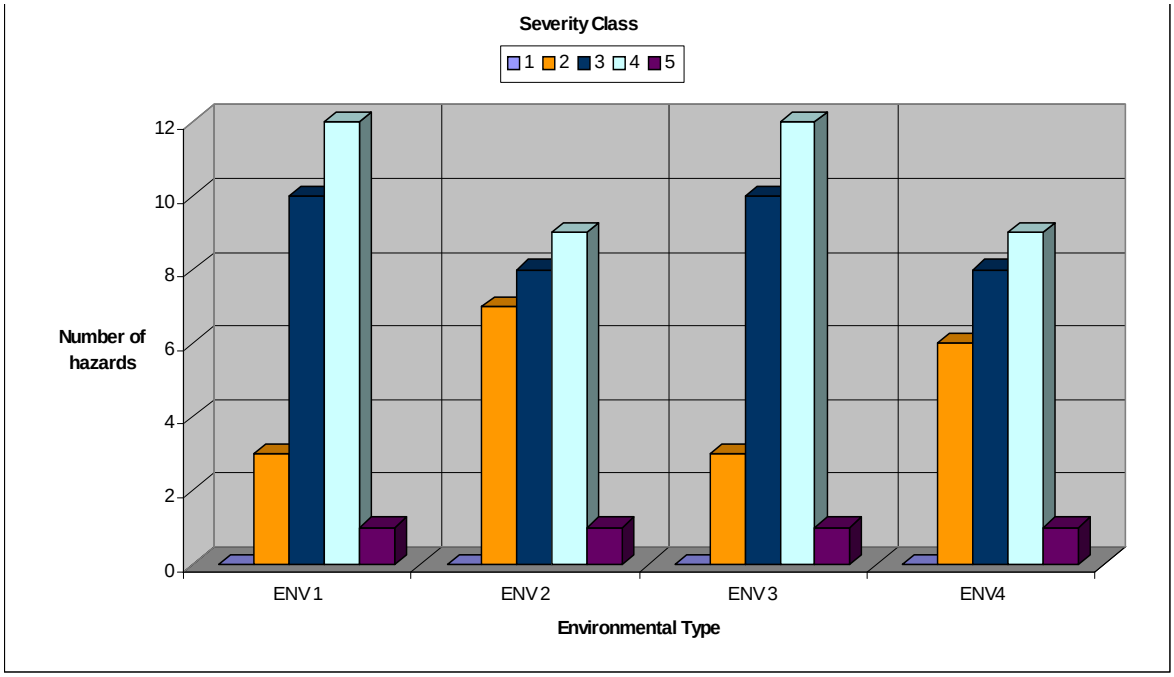

Figure 5: Hazard severity distribution (Core airspace)

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:

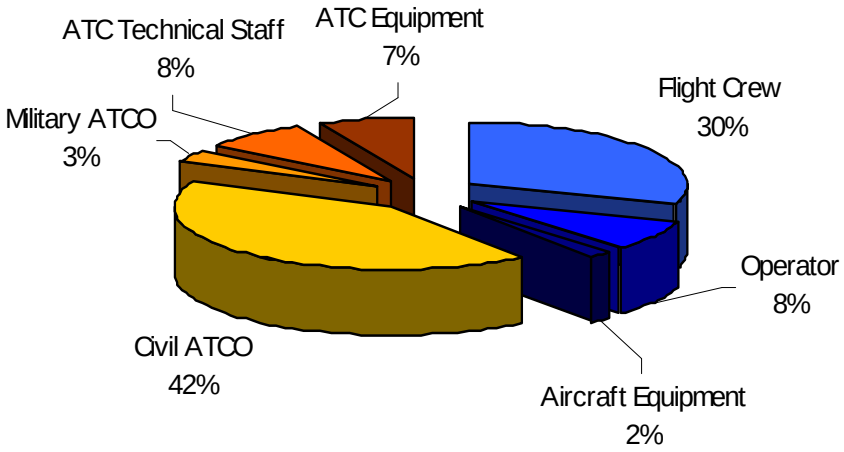

Figure 6: Allocation results (Core Airspace)

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

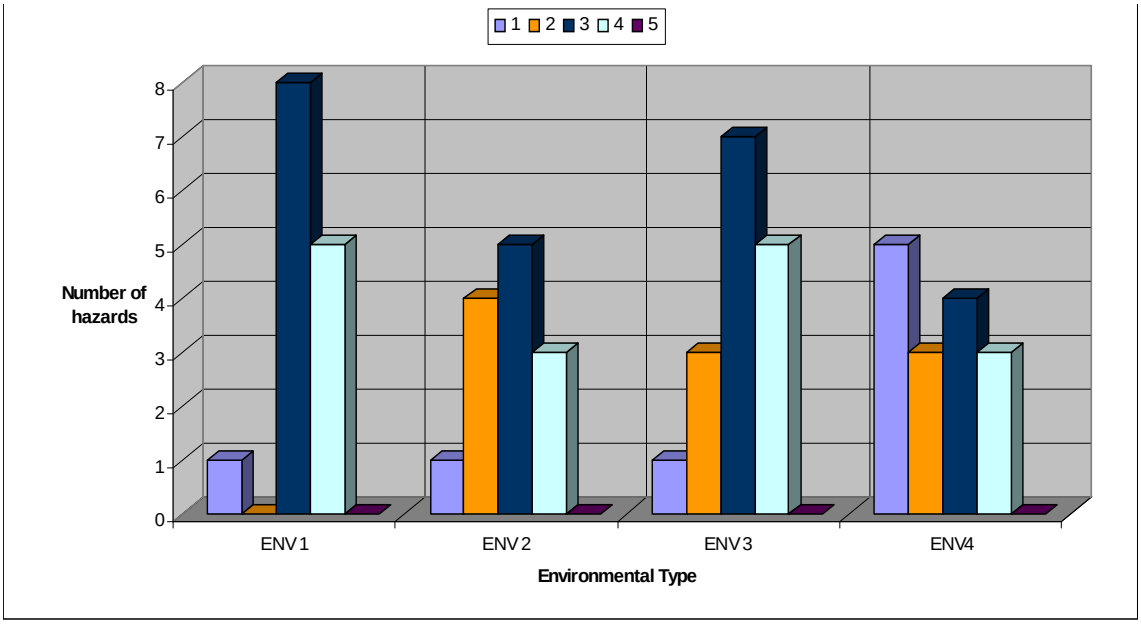
The severity of the 20 hazards have been assessed in the worst-credible conditions. The assessment was made in accordance with the **AFI RVSM Severity Classification Scheme** (refer to **Annex D**) and based on the operational expertise of the working group.

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:

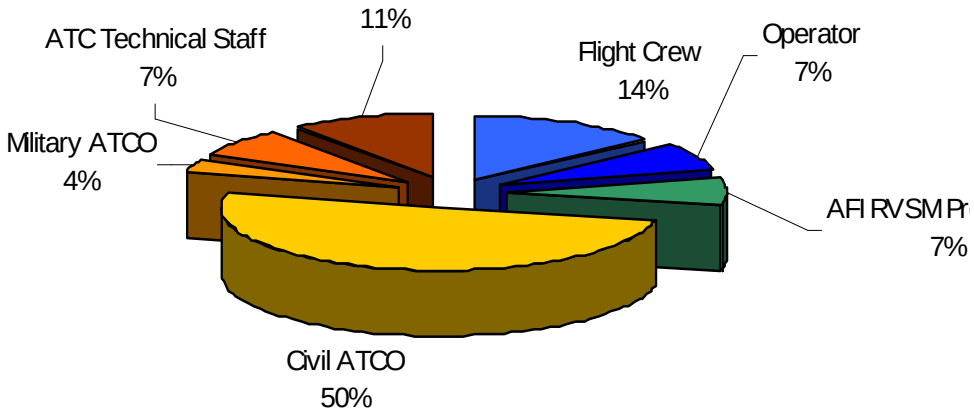


Figure 8: Allocation results (Switch-over Period)

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;

A.3 Other RVSM Implementation references

EUR RVSM

26. Reduced Vertical Separation Minimum (RVSM) Safety Policy, Edition 1.0, 18 September 2000, EUROCONTROL
27. The EUR RVSM Mathematical Supplement, RVSM 830, Version 1.0, EUROCONTROL, Brussels, August 2001.
28. Eurocontrol. RVSM 691. The EUR RVSM Pre-Implementation Safety Case. Version 2.0 14 August 2001;
29. Eurocontrol. RVSM A1190. The EUR RVSM Post-Implementation Safety Case. Version 1.0, 27 January 2003;
30. Eurocontrol, ATC Manual for RVSM Implementation in Europe, version 2.0, 1st February 2001;
31. EUR RVSM Functional Hazard Assessment, Version 1.0, 12 February 2001, RVSM 697, EUROCONTROL;
32. ESARR 4, Risk Assessment and Mitigation Methodology in ATM, version 1.0, 5 April 2001.

NAT RVSM

33. Risk assessment and system monitoring for the verification and operation of a 300 m (1000 ft) vertical separation minimum in the Minimum Navigation Performance Specification airspace of the North Atlantic Region, Supplement to NAT Doc 002, Draft Version 2.0, March 1996.

South Pacific RVSM

34. RVSM Safety assessment - Final Report, RVSM safety assessment for the Australian FIRs, Air services Australia, September 1999.
35. Guidance Material on the Implementation of a 1 000 ft Vertical Separation Minimum for application in the airspace of the Pacific Region;

South Atlantic RVSM

36. Risk assessment of RNP10 and RVSM in the South Atlantic Flight Identification Regions Including an Assessment for Limited Application of RVSM on RN741, ARINC, 21054, Rev. A, August 2001, NLR-CR-2002-015, January 2002.

CAR/SAM RVSM

37. CAR/SAM RVSM Concept of Operations – CONOPS – CAR/SAM RVSM TF – August 2003
38. Safety Bulletin on CAR/SAM implementation – IFALPA – January 2005

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.

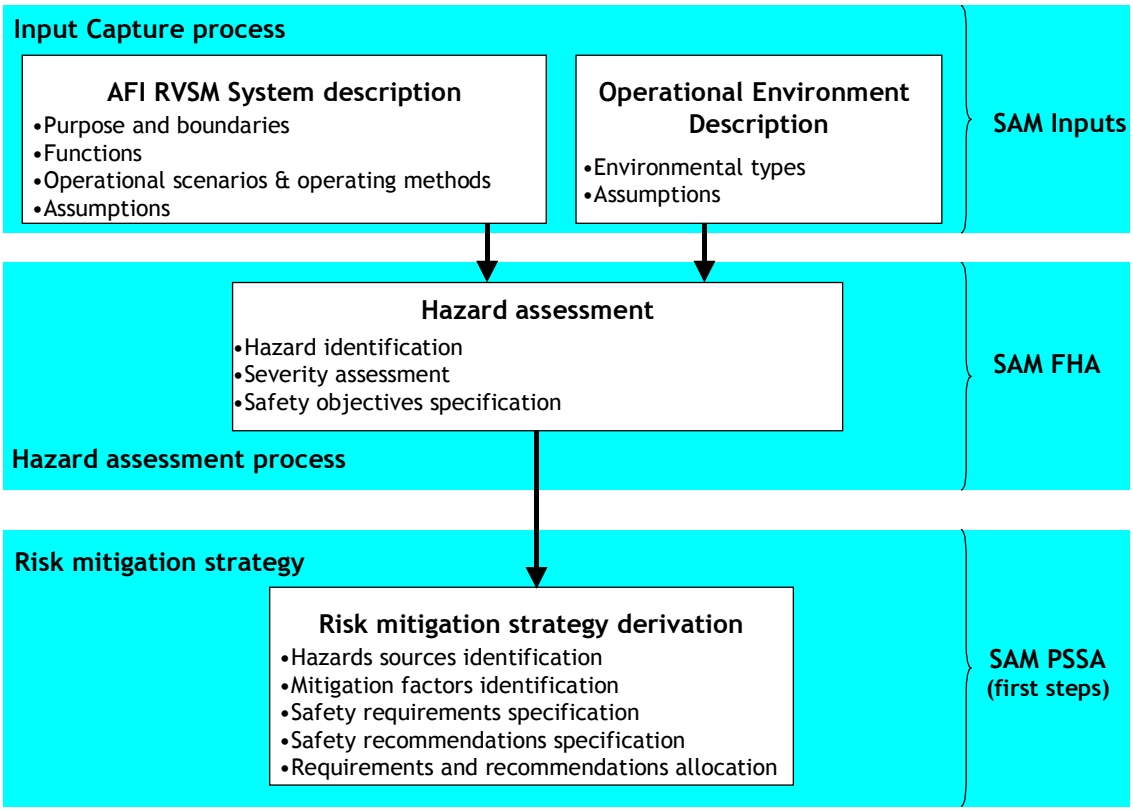

Figure 9 : AFI RVSM FHA methodology overview

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:

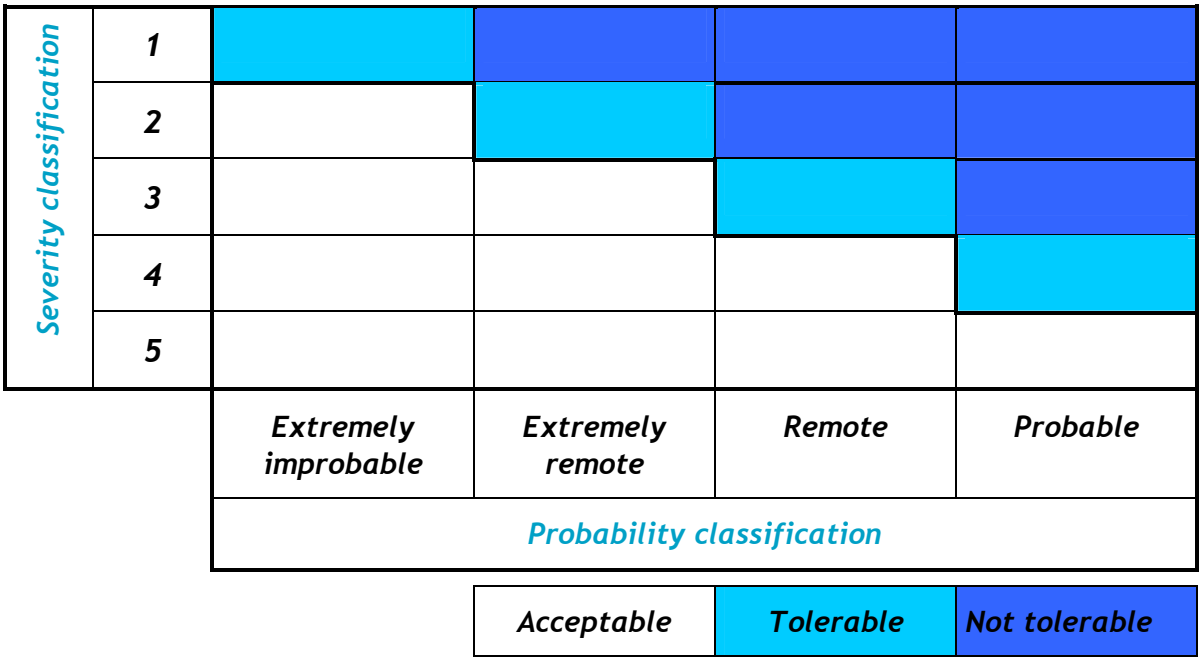

Figure 12 : AFI RVSM risk classification scheme

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	**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)
Backtrace to the hazard applicable to the requirement/recommendation	**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

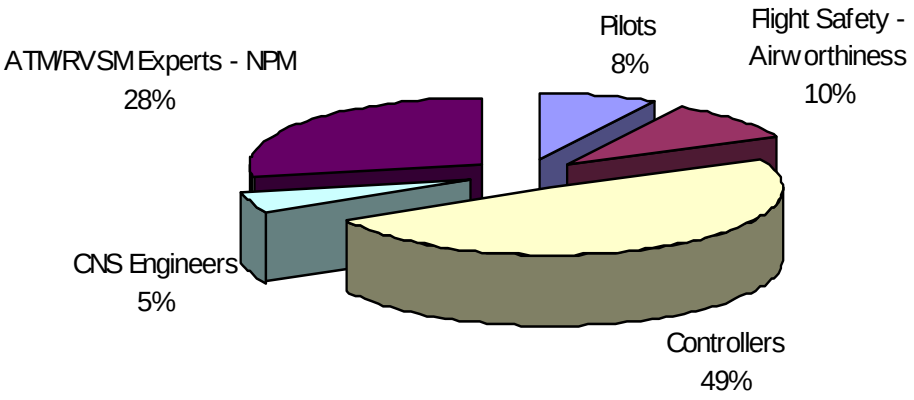

Figure 1: AFI RVSM working group composition

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

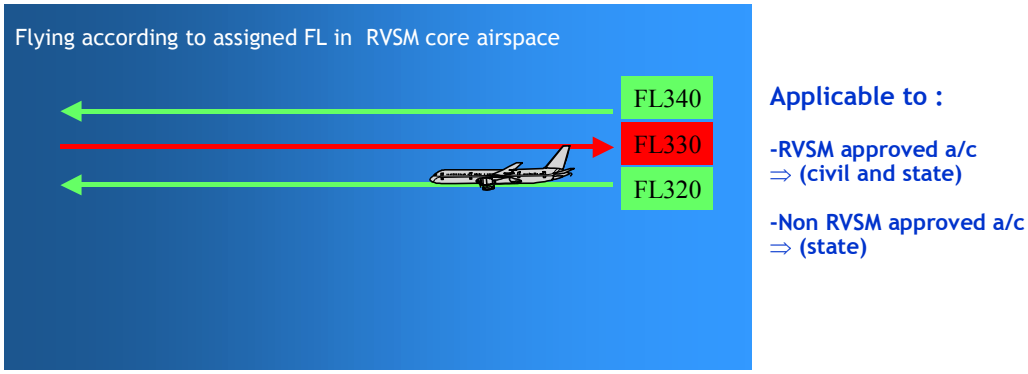
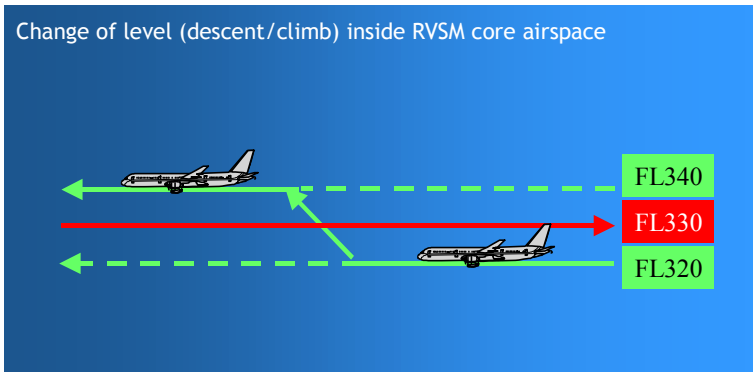


Figure 2: Flying according to assigned level in core airspace (CORE_NOM_1)

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



Applicable to :

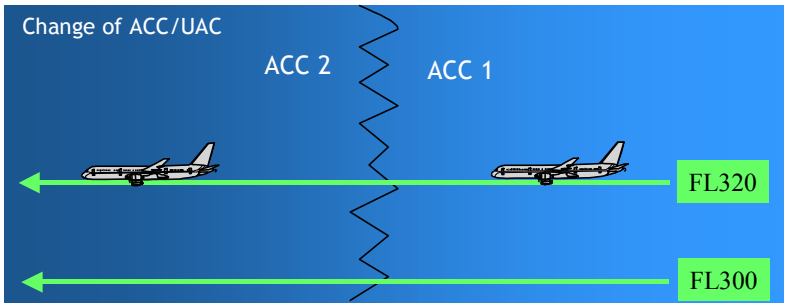
-RVSM approved a/c (civil and state)
-Non RVSM approved a/c (state)

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



Applicable to :

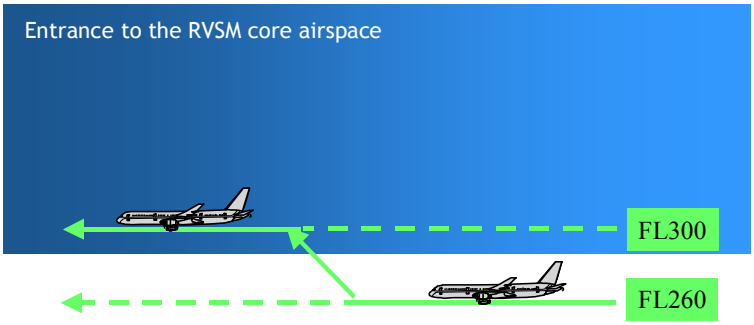
-RVSM approved a/c (civil and state)
-Non RVSM approved a/c (state)

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



Applicable to :

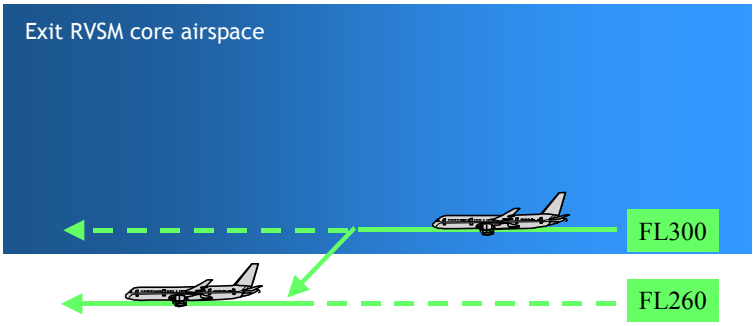
-RVSM approved a/c (civil and state)
-Non RVSM approved a/c (state)

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



Applicable to :

-RVSM approved a/c (civil and state)
-Non RVSM approved a/c (state)

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

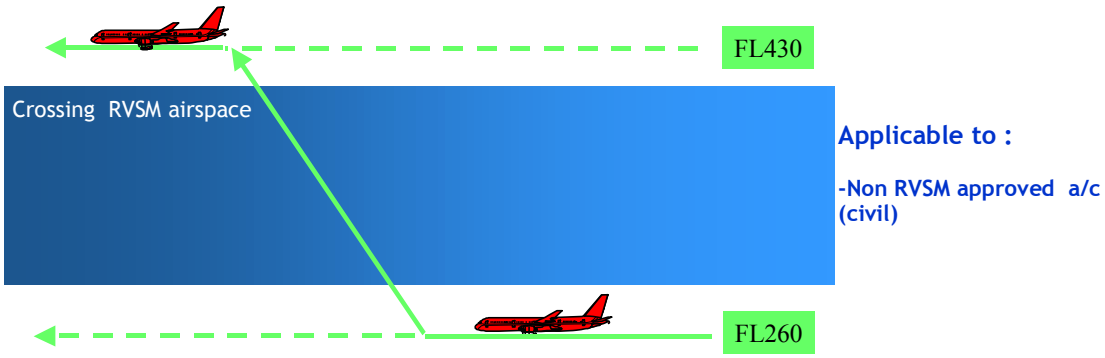


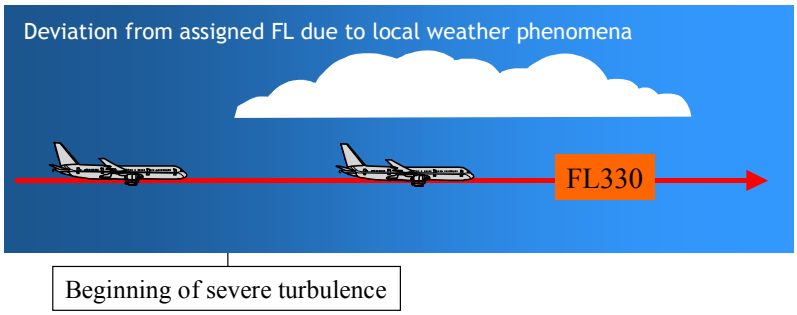
Figure 7: Crossing RVSM core airpsace (CORE_NOM_6)

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



Applicable to :
-RVSM approved a/c (civil and state)
-Non RVSM approved a/c (state)

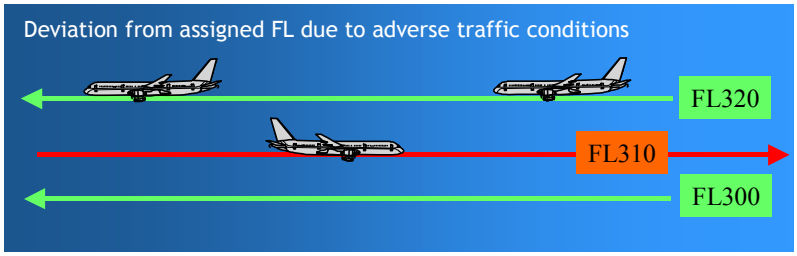
Adverse conditions :
-Severe turbulences
- *thunder storm*
- *Clear air turbulences*
- *Mountains waves*
- *Volcanic activities*
- *Sand storm*
- *…*

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



Applicable to :
-RVSM approved a/c (civil and state)
-Non RVSM approved a/c (state)

Adverse conditions :
-Severe turbulences
- *Vortices*

- Potential traffic conflict
- *Visual observation*
- *Traffic Advisory/Resolution Advisory*

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

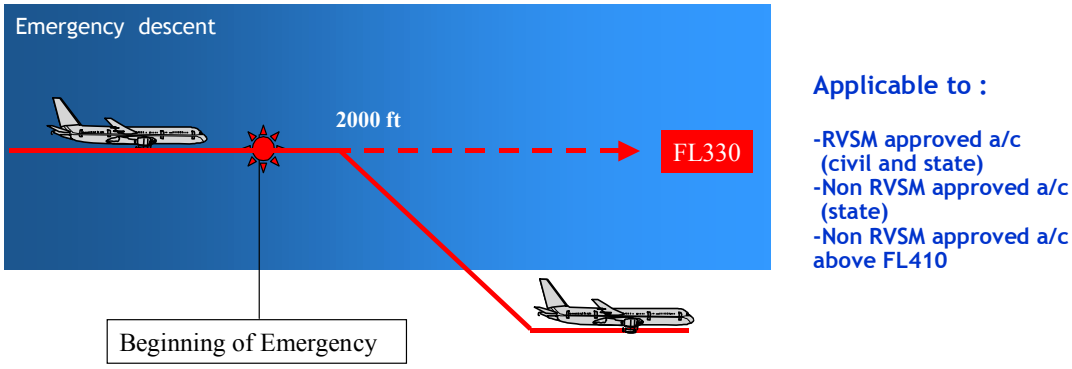


Figure 10: Emergency descent (CORE_ABN_13)

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

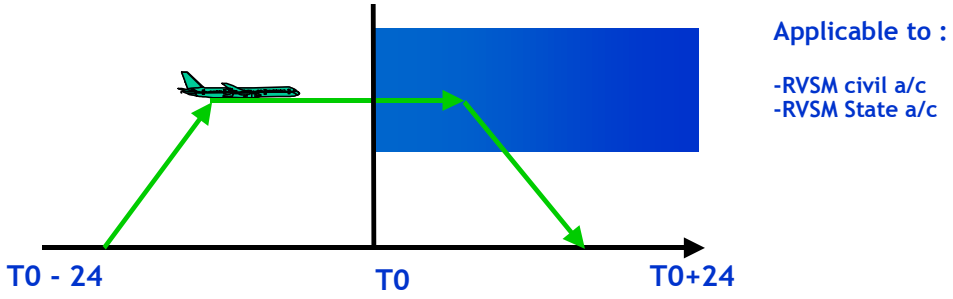


Figure 11: RVSM aircraft flying at T0 (SWIT_NOM_01a)

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

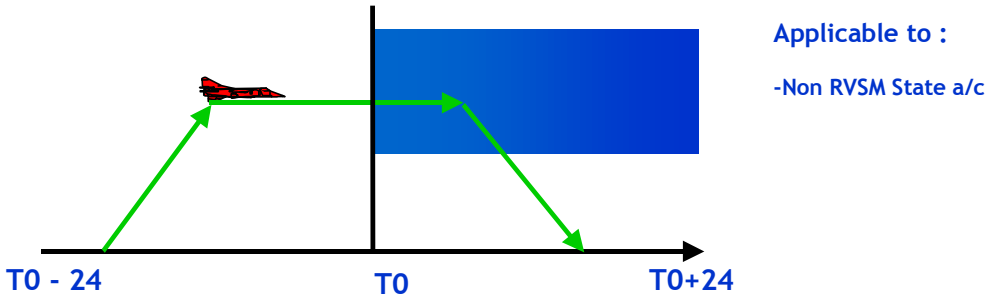


Figure 12: Non RVSM State aircraft flying at T0 (SWIT_NOM_01b)

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)

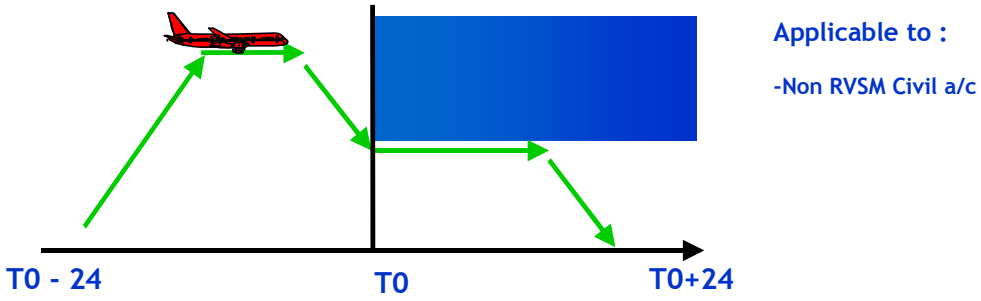


Figure 13: Non RVSM civil aircraft flying at T0 (SWIT_NOM_02a)

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)

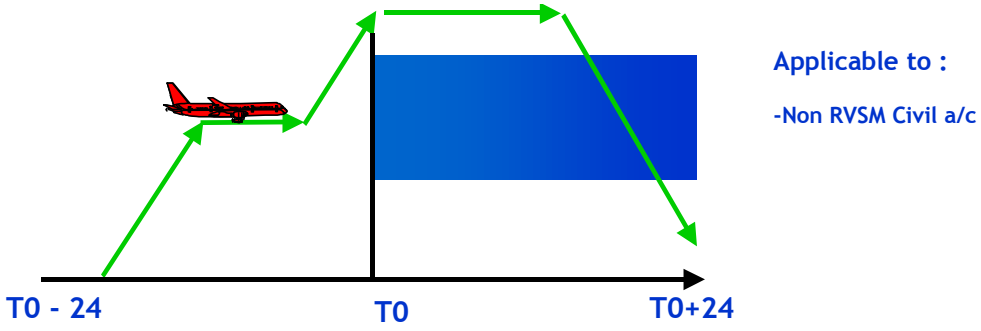


Figure 14: Non RVSM civil aircraft flying at T0 (SWIT_NOM_02b)

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)

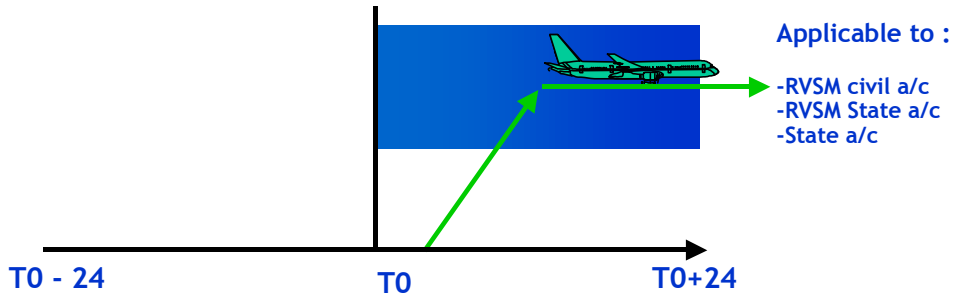


Figure 15: State or RVSM civil aircraft taking off after T0 (SWIT_NOM_03)

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)

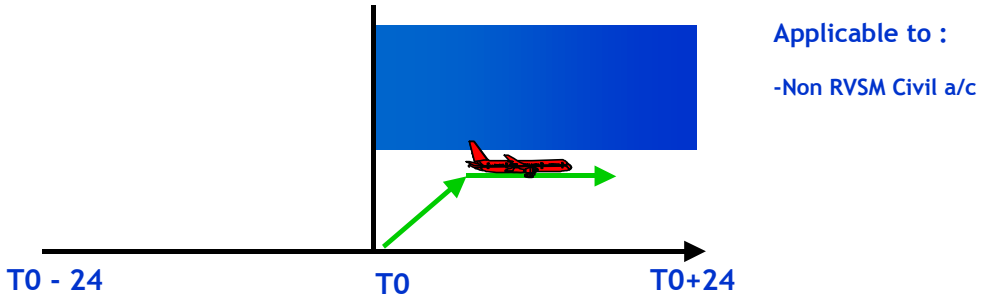


Figure 16: Non RVSM civil aircraft taking off after T0 (SWIT_NOM_04a)

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)

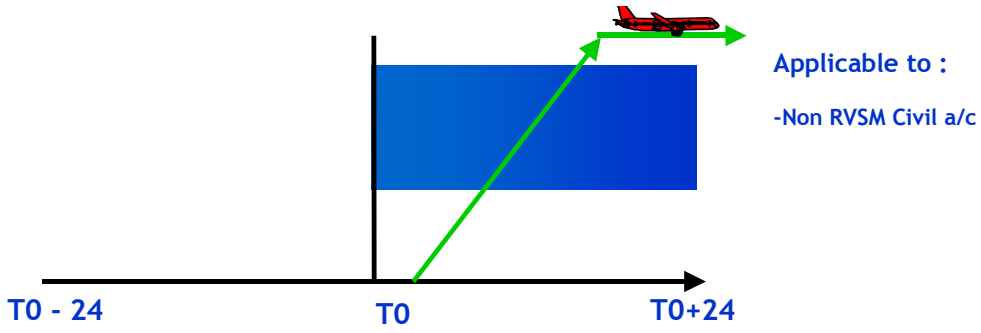


Figure 17: Non RVSM civil aircraft taking off after T0 (SWIT_NOM_04b)

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
		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.
		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.
		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.
		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.

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

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

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
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.

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

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
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
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.
		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

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
		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

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
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
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
		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

Ref	Hazard Description	Env. type(s)	Sev	Rationale	Id. Haz.	Safety Objective Hazard criticity and rationale
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
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

APPENDICES E-F

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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 for non RVSM civil aircraft **Req $_{Core}$_3** Contingency Procedures shall be defined to

Hazard description	Env. Type	Sev	Safety objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
							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)

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 $_{Core}$_16** Transfer procedures shall be defined in the LoA (including communications failure contingencies) **Req $_{Core}$_17** Controller shall be trained appropriately with regards to LoA transfer procedures	**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 <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)	**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 performed	**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 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	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 performed	**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 should be implemented

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_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	**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 procedures

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 $_{Core}$_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 **Safety Recommendation:** **Rco $_{Core}$_8** Silent transfer procedures should be defined	**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 $_{Core}$_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 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 procedures

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

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 procedures

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 checking before departure	**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-over period	**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-over period	**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)
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 $_{Swit}$**_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) **Req** $_{Swit}$**_10** A NOTAM shall be issued for the activation of the new FLAS during the switch-over period	**Req** $_{Swit}$**_13** Flight crew shall be trained appropriately with regards to switch-over procedures(read back for level clearance) **Req** $_{Swit}$**_14** Switch-over Procedures shall be in place to recover from incorrect clearance issue **Req** $_{Swit}$**_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-over period	**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 reaching level

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 $_{Swit}$_10 An NOTAM shall be issued for Level changes 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)
	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 the new FLAS	**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 T0.

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						Req $_{Swit}$_8 A NOTAM shall be issued for the activation of the new FLAS during the switch-over period **Req $_{Swit}$_21** Awareness campaigns shall be organized before the switch-over period to reinforce the importance of read back	**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$_{swit}$_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

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 the new FLAS	**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 switch-over period

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 read back	**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 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 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 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 switch-over period

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 read back	**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)
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 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:** - 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)
AH_{swit}_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-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 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 $_{Swit}$_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 $_{Swit}$_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 $_{Swit}$_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 $_{Swit}$_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 $_{Swit}$_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 $_{Swit}$_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 $_{Swit}$_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 $_{Swit}$_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 $_{Swit}$_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 (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)
	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 <u>independent</u> 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 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}_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: 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)
	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: o From the transferring ATCO o 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 the new LOA	**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 to reinforce the knowledge of the new FLAS	**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 checked for non RVSM civil aircraft to leave the FL band 410 and above before ToS	

Hazard Description	Env. type	Sev	Safety Objective Criticity	After mitigation	Risk elimination (hazard)	Risk reduction (causes)	Risk control (effects)
						(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 *AH $_{Core}$ 1, AH $_{Core}$ 2, AH $_{Core}$ 3, AH $_{Core}$ 4, AH $_{Core}$ 5*	AIR	☺		
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		

		Procedures	Training	Equipment
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 Radio Communications Failure procedures. *AH $_{Core}$ 6, AH $_{Core}$ 7*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req $_{Core}$_11 Flight crew shall be trained appropriately with regards to Radio Communications Failure procedures	AIR		☺	
	ENV 1			

		Procedures	Training	Equipment
AH Core 6, AH Core 7	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			
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		☺	

		Procedures	Training	Equipment
	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. *AH $_{Core}$ 8*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	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			☺
	AIR			

		Procedures	Training	Equipment
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			
	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	AIR			
	ENV 1		☺	

		Procedures	Training	Equipment
RVSM Procedures (including read back for clearance) *AH Core 9*	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 *AH Core 9, AH Core 10*	AIR		☺	
	ENV 1			
	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		☺	

		Procedures	Training	Equipment
	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 back) *AH $_{Core}$ 12*	AIR			
	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	AIR			

		Procedures	Training	Equipment
(due to RDPS/ADS system failure) *AH Core 13*	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			
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	AIR			
	ENV 1		☺	
	ENV 2		☺	

		Procedures	Training	Equipment
AH Core 14	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	☺		
	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		☺	

		Procedures	Training	Equipment
Req Core_56 Transfer procedures shall be defined in LoA (including RVSM/Non RVSM Status) *AH Core 16*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	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 *AHCore 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	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 encountered en-route *AH Core 19, AH Core 20*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			

		Procedures	Training	Equipment
	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			
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			
	AIR	☺		

		Procedures	Training	Equipment
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		☺	
	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	AIR			
	ENV 1		☺	

		Procedures	Training	Equipment
contingency procedures related to wake turbulence *AH Core 21*	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 *AH Core 22, AH Core 23*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_86 Controllers shall be trained appropriately with regards to emergency contingencies *AH Core 22, AH Core 23*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_87 Climbing/descent rate shall be limited during the level change to avoid nuisance RA (e.g.500ft/min to 1000ft/min) *AH Core 25*	AIR	☺	☺	
	ENV 1	☺	☺	
	ENV 2	☺	☺	
	ENV 3	☺	☺	

		Procedures	Training	Equipment
	ENV 4	☺	☺	
Req Core_88 Aircraft shall be equipped with ACAS II (TCAS version 7.0) *AH Core 25*	AIR			☺
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_89 Pilots shall be trained appropriately to TCAS operation (initial and continuous training) *AH Core 25, AH Core 26*	AIR		☺	
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_90 Specific procedures to avoid deviation due to incorrect visual perspective shall be defined *AH Core 26*	AIR	☺		
	ENV 1			
	ENV 2			
	ENV 3			
	ENV 4			
Req Core_91 Coordination procedures shall be defined in the Civil – Military LoA *AH Core 27*	AIR			
	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_92 Controllers shall be trained appropriately with regards to RVSM Coordination Procedures (including military coordination) *AH Core 27*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_93 Military controllers shall be trained appropriately with regards to RVSM Coordination Procedures *AH Core 27*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_94 Military – Civil coordination Contingency procedures shall be	AIR			

		Procedures	Training	Equipment
defined in LoA *AH Core 27*	ENV 1	☺		
	ENV 2	☺		
	ENV 3	☺		
	ENV 4	☺		
Req Core_95 Controllers shall be trained appropriately with regards to coordination Contingency procedures (including Military coordination) *AH Core 27*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_96 Military Controllers shall be trained appropriately with regards to coordination Contingency procedures *AH Core 27*	AIR			
	ENV 1		☺	
	ENV 2		☺	
	ENV 3		☺	
	ENV 4		☺	
Req Core_97 Flight crew of Non-RVSM aircraft shall be trained to report significant weather encountered en-route *AH Core 28*	AIR		☺	
	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	AIR		☺	
	ENV 1			
	ENV 2			

		Procedures	Training	Equipment
facing severe icing or turbulence *AH Core 28*	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	☺		
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 *AH Swit 2, AH Swit 3, AH Swit 4, AH Swit 5, AH Swit 6, AH Swit 16, AH Swit 20*	AIR		☺		
	ENV 1				
	ENV 2				
	ENV 3				
	ENV 4				

		Procedure	Training	Equipment	RVSM Program
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) *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*	AIR		☺		
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req $_{Swit}$_7 ATC team shall be reinforced during the switch-over period *AH $_{Swit}$ 2, AH $_{Swit}$ 3, AH $_{Swit}$ 4, AH $_{Swit}$ 8, AH $_{Swit}$ 9, AH $_{Swit}$ 12, AH $_{Swit}$ 17, AH $_{Swit}$ 20*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	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 *AH $_{Swit}$ 2, AH $_{Swit}$ 4*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3				
	ENV 4				
Req $_{Swit}$_9 Controller shall be trained appropriately with regards to switch-over procedures (surveillance of the execution of the level clearance) *AH $_{Swit}$ 2, AH $_{Swit}$ 4*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3				
	ENV 4				
Req $_{Swit}$_10 A NOTAM shall be issued for the activation of the new FLAS during the switch-over period *AH $_{Swit}$ 2, AH $_{Swit}$ 3, AH $_{Swit}$ 4, AH $_{Swit}$ 5, AH $_{Swit}$ 7, , AH $_{Swit}$ 8, AH $_{Swit}$ 9, AH $_{Swit}$ 20*	AIR	☺			
	ENV 1	☺			
	ENV 2	☺			
	ENV 3	☺			
	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				

		Procedure	Training	Equipment	RVSM Program
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) *AH $_{Swit}$ 2, AH $_{Swit}$ 4*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3				
	ENV 4				
Req $_{Swit}$_13 Flight crew shall be trained appropriately with regards to switch-over procedures(read back for level clearance) *AH $_{Swit}$ 2, AH $_{Swit}$ 4*	AIR		☺		
	ENV 1				
	ENV 2				
	ENV 3				
	ENV 4				
Req $_{Swit}$_14 Switch-over Procedures shall be in place to recover from incorrect clearance issue *AH $_{Swit}$ 2*	AIR				
	ENV 1	☺			
	ENV 2	☺			
	ENV 3				
	ENV 4				
Req $_{Swit}$_15 Controller shall be trained appropriately with regards to switch-over procedures (recovering from incorrect clearance issue) *AH $_{Swit}$ 2*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3				
	ENV 4				
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		☺		

		Procedure	Training	Equipment	RVSM Program
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 *AH $_{Swit}$ 3*	AIR				
	ENV 1				
	ENV 2				
	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	AIR	☺	☺		
	ENV 1	☺	☺		

		Procedure	Training	Equipment	RVSM Program
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*	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 with regards to check in flight plan that Fl310, FL350 and FL390 are not intended to be used after ToS *AH $_{Swit}$ 7*	AIR				
	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				

		Procedure	Training	Equipment	RVSM Program
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 appropriately with regards to deliver 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 $_{Swit}$_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 *AH $_{Swit}$ 9*	AIR	☺			
	ENV 1				
	ENV 2				
	ENV 3				
	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) *AH $_{Swit}$ 9*	AIR				
	ENV 1				
	ENV 2				
	ENV 3	☺	☺	☺	
	ENV 4	☺	☺	☺	
Req $_{Swit}$_35 Transit of non-RVSM civil a/c shall be suspended for a period of XX hours after T0 *AH $_{Swit}$ 10, AH $_{Swit}$ 11*	AIR	☺	☺		
	ENV 1	☺	☺		
	ENV 2	☺	☺		
	ENV 3	☺	☺		
	ENV 4	☺	☺		

		Procedure	Training	Equipment	RVSM Program
Req $_{Swit}$_36 Operation above FL410 shall be suspended for non-RVSM a/c for a period of XX hours after T0 *AH $_{Swit}$ 10, AH $_{Swit}$ 11*	AIR	☺	☺		
	ENV 1	☺	☺		
	ENV 2	☺	☺		
	ENV 3	☺	☺		
	ENV 4	☺	☺		
Req $_{Swit}$_37 The switch-over period shall be performed during an appropriate low traffic density period *AH $_{Swit}$ 12*	AIR				
	ENV 1				☺
	ENV 2				☺
	ENV 3				☺
	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	AIR				
	ENV 1			☺	

		Procedure	Training	Equipment	RVSM Program
the switch over period *AH $_{Swit}$ 13*	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 and during switch over period shall not be performed *AH $_{Swit}$ 13*	AIR				
	ENV 1	☺		☺	
	ENV 2	☺		☺	
	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	AIR				
	ENV 1		☺	☺	

		Procedure	Training	Equipment	RVSM Program
reliability prior to switch over and during switch over period shall not be performed *AH $_{Swit}$ 14*	ENV 2				
	ENV 3		☺	☺	
	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	☺			
	ENV 4	☺			
Req $_{Swit}$_54 Controller shall be trained appropriately	AIR				

		Procedure	Training	Equipment	RVSM Program
with regards to LoAs and procedures before Switch-over period *AH Swit 17*	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 *AH Swit 18*	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 coordination procedures *AH Swit 18*	AIR				
	ENV 1		☺		
	ENV 2		☺		
	ENV 3		☺		
	ENV 4		☺		
Req Swit_60 Civil/Military coordination committee	AIR				
	ENV 1				☺

		Procedure	Training	Equipment	RVSM Program
shall be in place *AH $_{Swit}$ 18*	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	☺	☺	☺	

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