EUROCONTROL

EUROCONTROL Guidelines for Minimum Safe Altitude Warning - Part I

Concept and Requirements

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EUROPEAN ORGANISATION
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EUROCONTROL Guidelines for Minimum Safe Altitude Warning

Part I - Concept and Requirements

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Abstract

These Guidelines specify the minimum requirements and provide comprehensive guidance for the definition, implementation, optimisation and operation of Minimum Safe Altitude Warning (MSAW).

Part I, **this document**, describes the MSAW concept of operations as well as the specific requirements on MSAW.

Part II contains overall guidance for the complete lifecycle of MSAW.

Part III specifies a generic example of an MSAW implementation as well as detailed technical guidance for optimisation of MSAW.

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EXECUTIVE SUMMARY

These Guidelines specify the minimum requirements and provide comprehensive guidance for the definition, implementation, optimisation and operation of Minimum Safe Altitude Warning (MSAW).

Ground-based safety nets are functionalities within the ATM system with the sole purpose of monitoring the environment of operations in order to provide timely alerts of an increased risk to flight safety.

MSAW is a ground-based safety net that warns the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.

The main objective of these Guidelines is to support ANSPs in the definition, implementation, optimisation and operation of MSAW by means of:

- Part I, **this document**, describing the MSAW concept of operations as well as the specific requirements on MSAW
- Part II containing overall guidance for the complete lifecycle of MSAW
- Part III specifying a generic example of an MSAW implementation and providing detailed guidance for optimisation and testing of MSAW

Together with similar Guidelines for Short Term Conflict Alert (STCA), Approach Path Monitor (APM) and Area Proximity Warning (APW) these Guidelines provide “Level 3” documentation for evolutionary improvement of ground-based safety nets, i.e.:

- “Level 1” – documented in the EUROCONTROL Operational Requirement Document for EATCHIP Phase III ATM Added Functions (Volume 2), published in 1998 with emphasis on automation
- “Level 2” – documented in EUROCONTROL Specifications and Guidance Material for STCA, MSAW, APM and APW, published in 2007-2008 providing a broader context than automation alone, e.g. pointing out the importance of policy, organisational clarity and training
- “Level 3” – documented in EUROCONTROL Guidelines for STCA, MSAW, APM and APW, published in 2017 incorporating the results of SESAR I as well as lessons learned

1. Introduction

1.1 Objective of this document

These Guidelines are aimed at all Air Navigation Service Providers (ANSPs) in the EUROCONTROL Member States (41) and Comprehensive Agreement States (2). Part I (this document) specifies the minimum requirements for the development, configuration and use of Minimum Safe Altitude Warning (MSAW). MSAW is a ground-based safety net intended to warn the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.

The European Single Sky Implementation (ESSIP) contained an Objective (ATC02.6) for standardisation of MSAW in accordance with the EUROCONTROL Guidelines for MSAW (this document). This document specifies, in qualitative terms, the common performance characteristics of MSAW as well as the prerequisites for achieving these performance characteristics.

Note 1: ESSIP Objective ATC02.6 referred to “Level 2” MSAW whist this document refers to “Level 3” MSAW (see Executive Summary for explanation). However, the minimum requirements specified in this document are identical to those specified in “Level 2” documentation. The traceability between “Level 2” and “Level 3” documentation is contained in Table 1.

Note 2: Whilst the implementation of ESSIP Objective ATC02.6 has been completed, ANSPs are required to continue to operate and ensure the effectiveness of MSAW in the context of an evolving operational environment. Hence, the “Level 3” documentation provides support for evolutionary improvement of MSAW.

It should also be noted that Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (the interoperability Regulation) contains, inter alia, the following essential requirements:

- *“Systems and operations of the EATMN shall achieve agreed high levels of safety. Agreed safety management and reporting methodologies shall be established to achieve this.”*
- *“In respect of appropriate ground-based systems, or parts thereof, these high levels of safety shall be enhanced by safety nets which shall be subject to agreed common performance characteristics.”*

These Guidelines facilitate harmonisation of the MSAW elements of the ground based safety nets and sets up the prerequisites for the refinement, in quantitative terms, of the common performance characteristics which might be developed in a further step in response to the requirements of the SES interoperability Regulation.

This document is targeted at stakeholders identified in ESSIP ATC02.6, and the requirements are placed on ANSPs.

1.2 EUROCONTROL Guidelines

EUROCONTROL guidelines, as defined in EUROCONTROL Regulatory and Advisory Framework (ERAF), are advisory materials and contain:

“Any information or provisions for physical characteristic, configuration, material, performance, personnel or procedure, the use of which is recognised as contributing to the establishment and operation of safe and efficient systems and services related to ATM in the EUROCONTROL Member States.”

Therefore, the application of EUROCONTROL guidelines document is not mandatory.

In addition, EUROCONTROL Regulatory and Advisory Framework specifies that:

"EUROCONTROL Guidelines may be used, inter alia, to support implementation and operation of ATM systems and services, and to:

- *complement EUROCONTROL Rules and Specifications;*
- *complement ICAO Recommended Practices and Procedures;*
- *complement EC legislation;*
- *indicate harmonisation targets for ATM Procedures;*
- *encourage the application of best practice;*
- *provide detailed procedural information."*

1.3 Structure of the document

Part I is structured as follows:

- Chapter 1 describes the purpose, scope and structure of the document.
- Chapter 2 describes the MSAW concept of operations. It provides the contextual information for interpretation of the requirements contained in Chapter 3.
- Chapter 3 specifies the minimum qualitative requirements that are regarded as necessary for effective MSAW. It does not prescribe implementation aspects. Only the ***minimum*** requirements that are considered essential for ensuring the effectiveness of MSAW in the area of EUROONTROL Member States (41) and Comprehensive Agreement States (2) are specified. These requirements are necessarily of a qualitative nature considering the implications of local factors that need to be considered.
- Chapter 4 lists reference documents, explains terms and contains a list of abbreviations.

1.4 Use of this document

This document is intended to be read and used by all Air Navigation Service Providers (ANSPs) in the EUROCONTROL Member States (41) and Comprehensive Agreement States (2).

EUROCONTROL makes no warranty for the information contained in this document, nor does it assume any liability for its completeness or usefulness. Any decision taken on the basis of the information is at the sole responsibility of the user.

1.5 Convention

The requirements in chapter 3 are normative in the sense that:

- ***"Shall"*** – requirements are mandatory to claim compliance with the Guidelines. Mandatory requirements are explicitly numbered with the prefix "MSAW-"
- ***"Should"*** - indicates a recommendation or best practice, which may or may not be applied
- ***"May"*** indicates an optional element
- ***"Will"*** denotes a statement of intent

Use of the word "shall" is avoided in Chapter 2 of Part I as well as in Part II and Part III of these Guidelines in order to emphasise the introductory and explanatory rather than normative nature of the information provided.

Some of the terms in section 4.2 and the requirements on procedures in section 3.2 are derived from paragraph 15.7.4 of ICAO Doc 4444. Any differences in formulation are intended to remove ambiguity and not to imply deviation from ICAO provisions. For example, no references to “minimum safe altitude” are included in these Guidelines. ICAO uses this term but does not provide a definition. Use of the term in the Guidelines could introduce ambiguity regarding the purpose of MSAW: the sole purpose of MSAW is to enhance safety and not to monitor adherence to legal minima.

2. MSAW concept of operations

2.1 Purpose of MSAW

As illustrated in Figure 1, today's ATS system is human centred; based on processing of a continuous stream of information, the controller issues clearances and instructions to prevent or resolve conflicts.

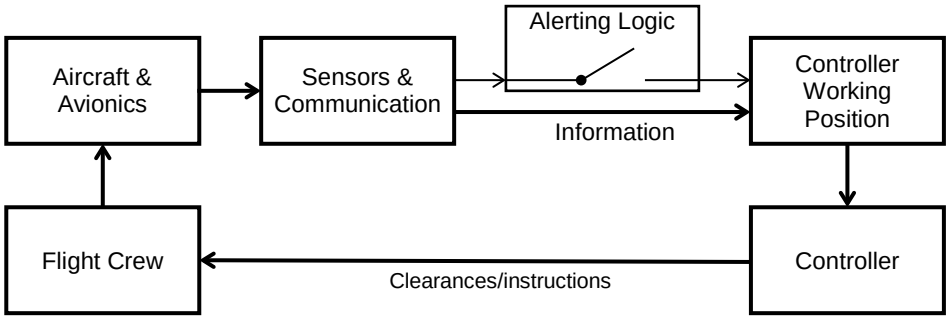

Figure 1: Simplified ATC control loop

However, the drive for consistency in cognitive information processing tasks leads to selective perception/exposure, selective attention and selective interpretation. As a result, conflicts and deviations from clearances or instructions leading to an unsafe aircraft altitude can remain unnoticed.

MSAW adds independent alerting logic to the control loop in order to avoid controlled flight into terrain accidents by generating alerts of existing or pending situations, related to aircraft proximity to terrain or obstacles, which require attention/action.

MSAW is intended to function in the short term, if applicable providing warning times of up to 2 minutes.

2.2 Prerequisites for effective MSAW

2.2.1 Mature safety management system

MSAW is in widespread use during several decades. Effective implementation and operation of MSAW requires a number of attributes that are inherent to organisations that have adopted a mature Safety Management System. These attributes include:

- Management commitment, demonstrated by a formal policy for the use of MSAW and making available sufficient resources for a total life cycle approach
- Team effort, involving operational experts, technical experts, safety experts and air traffic controllers in ANSPs, working together with Industry and Regulators
- Sustained effort to optimise and improve MSAW, exploiting new technological developments and adapting for an increasingly complex operational environment

2.2.2 Adequate surveillance infrastructure

Conventional Mode 3A/C SSR infrastructure may still be sufficient for effective MSAW in less complex operational environments.

Mode S SSR infrastructure is an essential enabler for effective MSAW in more complex operational environments.

Complementary Multi-lateration infrastructure could be needed to obtain effective MSAW at lower altitudes with demanding terrain.

2.2.3 Sufficient transponder equipage

MSAW can only generate alerts for aircraft that are equipped with pressure altitude-reporting transponders. MSAW will be more effective for altitude-reporting in 25 ft increments rather than 100 ft increments, provided that the surveillance infrastructure can exploit the benefits of such reporting.

2.3 Operational context

When MSAW was first introduced, ATS surveillance services were in most cases provided using mixed (raw radar data supplemented with computer-generated synthetic data) situation displays. In the meantime, the norm for provision of ATS surveillance services has become full-synthetic situation displays. Decision support tools are gradually being introduced to enable the controller to handle more traffic in order to cope with the ever increasing demand. At the same time, automated support systems have become more robust and trustworthy but also more complex and interdependent. These changes imply a different operational context for MSAW.

Note: Ground-based safety nets and decision support tools are different. Ground-based safety nets are exclusively intended to increase safety and they do not change the way of working of the controller. Decision support tools are intended to increase the overall performance of the system (often by providing a combination of capacity, efficiency and safety benefits), and may change the way of working of the controller.

It is essential that individual ANSPs establish a clear MSAW policy for their particular operational context to avoid ambiguity about the role and use of MSAW using the following generic policy statements as a starting point:

MSAW IS A GROUND-BASED SAFETY NET; ITS SOLE PURPOSE IS TO ENHANCE SAFETY AND ITS PRESENCE IS IGNORED WHEN CALCULATING SECTOR CAPACITY.

MSAW IS DESIGNED, CONFIGURED AND USED TO MAKE A SIGNIFICANT POSITIVE CONTRIBUTION TO AVOIDANCE OF CONTROLLED FLIGHT INTO TERRAIN ACCIDENTS BY GENERATING, IN A TIMELY MANNER, AN ALERT OF AIRCRAFT PROXIMITY TO TERRAIN OR OBSTACLES.

MSAW is only effective if the number of nuisance alerts remains below an acceptable threshold according to local requirements and if it provides sufficient warning time to resolve hazardous situations, governed by the inherent characteristics of the human centred system.

Figure 2 illustrates the nominal sequence of events to resolve a particular situation as two loosely coupled loops. Being a human centred system, the Ground loop reflects the states of the controller and the Air loop reflects the states of the flight crew. For each state transition to occur certain preconditions have to be met and actions performed, complicated by many fixed or variable delays and anomalous cases.

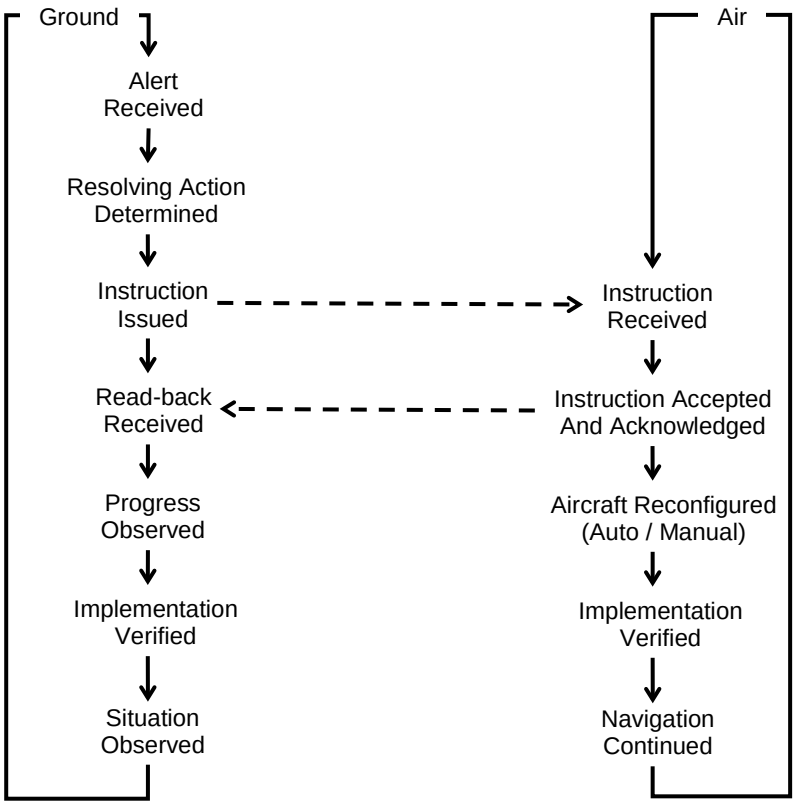

Figure 2: Expanded ATC control loop (triggered by MSAW)

2.4 Operational concept

2.4.1 Human performance considerations

In order to be able to process all available information, the controller must acquire situational awareness and build a mental model of the airspace and traffic pattern. To control the situation and make decisions, the controller has to establish strategies and tactics to handle the traffic flows and conflicts.

Hazardous situations related to aircraft altitude can remain unnoticed by the flight crew and the controller. The controller's workload and priorities may cause an imminent hazardous situation to remain undetected if not alerted by MSAW.

The use of MSAW will depend on the controller's trust. Trust is a result of many factors such as reliability and transparency. Neither mistrust nor complacency is desirable; training and experience is needed to develop trust at the appropriate level (see [EURO-HRS]).

For MSAW to be effective, the controller must have a positive attitude towards MSAW. This requires that the following aspects are addressed:

- **Appropriateness and timeliness**

  The rule set for generating alerts should be appropriate; dissonance with normal control practices should be avoided.

- **Effectiveness**

  The controller in charge may not notice or recognise the reason for an alert for the same reasons that left the potentially hazardous situation undetected. This should be addressed in HMI design.

- **Comprehensibility and performance monitoring**

  The increasing complexity of MSAW and the environment in which it is used should be addressed through appropriate training and competency assessment. Practices and controller perception of the effectiveness of MSAW should be evaluated periodically and following changes to MSAW. Lessons from particular situations or incidents in which MSAW was involved should be shared through appropriate mechanisms.

2.4.2 Design considerations

MSAW should perform in concert with the airspace design and classification, variety of airspace users, Flexible Use of Airspace (FUA) and the applicable procedures for air navigation services.

Special consideration should be given to making all ground-based safety nets and controller tools perform in concert.

Dependent on the diversity of these aspects, MSAW should be capable of using different parameters for generation of alerts. Different parameters may be applied in the case of system degradation (e.g. unavailability of one or more radar stations).

Local instructions concerning the use of MSAW should be established to ensure that MSAW is used in a safe and effective manner. Pertinent data should be regularly analysed in order to monitor and optimise the performance of MSAW.

2.4.3 Technical aspects

MSAW is suitable for use in any airspace covered by adequate surveillance.

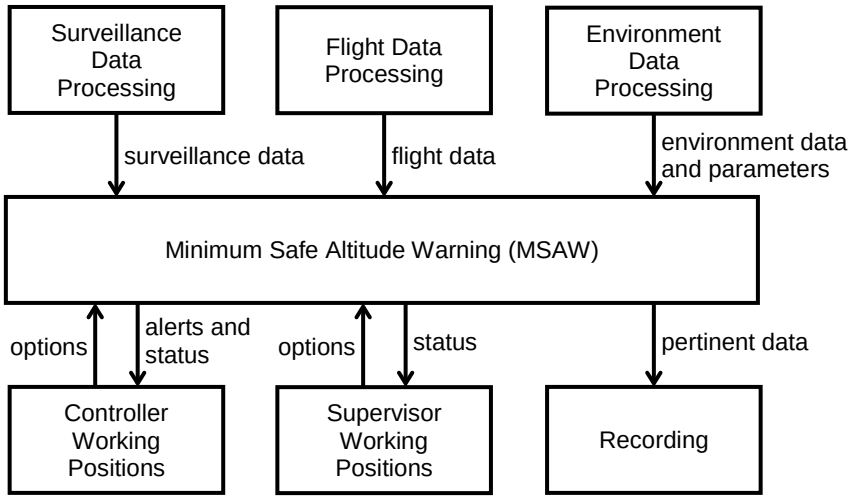

Figure 3: MSAW context diagram

As illustrated in Figure 3, MSAW should obtain information from Surveillance Data Processing, from Environment Data Processing and possibly from Flight Data Processing in order to generate alerts:

- Surveillance data
  - State vector and tracked pressure altitude information: to predict or detect hazardous situations

  - Selected Vertical Intent: to increase relevance of conflict prediction

    Note: Although Selected Vertical Intent downlinked from the aircraft will sometimes be QNH corrected it is commonly referred to as the Selected Flight Level (SFL), which is the term used in these Guidelines.

- Flight data should be used as follows:
  - Type/category of flight/flight rules: to determine the eligibility for alert generation and possibly also the parameters applied
  - Concerned sector(s): to address alerts
  - Cleared Flight Levels: to increase the relevance of alert generation
- Environment data and parameters should include:
  - Terrain and obstacle data
  - Alerting parameters
  - Additional items (QNH, temperature, etc.)

Alerts should be generated at least at a Controller Working Position of the control sector responsible for the infringing aircraft and/or for the airspace subject to unauthorised penetration. Status information regarding the technical availability of MSAW is to be provided to all Working Positions. Selectable options of MSAW related to eligibility, configuration and technical availability may be available at Controller and Supervisor Working Positions.

All pertinent MSAW data should be recorded for offline analysis.

2.5 Safety aspects

It is assumed that EUROCONTROL Safety Regulatory Requirements are effectively implemented. It is recommended to put emphasis on [SRC-ESARR4] and its guidance material for the implementation of, and changes to, APW applications.

2.6 Future directions and need for change

MSAW will have to meet future demands imposed by, amongst other things, further traffic increase, changing traffic patterns, changing aircraft characteristics, further automation in the air and on the ground and, potentially, the introduction of new concepts.

The compatibility of MSAW and other ground-based and airborne safety nets, in particular (E)GPWS, needs to be maximised.

This could, amongst others, lead to changes in the following aspects of MSAW:

- Correlation of ATC constraints with aircraft intent in order to further reduce the number of nuisance alerts
- Increased look ahead time and multi-level or different types of alerts
- Correlation of alerts from multiple sources (on the ground and in the air) to generate combined alerts

3. Specific requirements

3.1 Policy, organisational clarity and training requirements

3.1.1 Policy

MSAW-01 The ANSP ***shall*** have a formal policy on the use of MSAW consistent with the operational concept and safety management system applied to avoid ambiguity about the role and purpose of MSAW.

The policy ***should*** be consistent with the generic policy statements in section 2.3 of these Guidelines but ***may*** contain more detail or additional aspects called for by local factors.

The policy ***should*** be communicated to all relevant staff in order to ensure consistency of all design, configuration, operational use and monitoring activities in compliance with the intended use of MSAW.

3.1.2 Responsibility for management of MSAW

MSAW-02 The ANSP ***shall*** assign to one or more staff, as appropriate, the responsibility for overall management of MSAW.

It ***should*** be possible for other staff in the organisation to identify the assigned staff. The assigned staff ***should*** seek advice from the MSAW manufacturer, as appropriate.

3.1.3 Training and competence

MSAW-03 The ANSP ***shall*** ensure that all controllers concerned are given specific MSAW training and are assessed as competent for the use of the relevant MSAW system.

Note: The primary goal of the training is to develop and maintain an appropriate level of trust in MSAW, i.e. to make controllers aware of the likely situations where MSAW will be effective and, more importantly, situations in which MSAW will not be so effective (e.g. sudden, unexpected manoeuvres).

3.2 Requirements on procedures

3.2.1 Local instructions

MSAW-04 Local instructions concerning use of MSAW ***shall*** specify, *inter alia*:

a) The types of flight (GAT/OAT, IFR/VFR, etc.) which are eligible for generation of alerts

b) The volumes of airspace within which MSAW is implemented

c) the method of displaying the MSAW to the controller

d) In general terms, the parameters for generation of alerts as well as alert warning time

e) The volumes of airspace within which MSAW can be selectively inhibited and the conditions under which this will be permitted as well as applicable procedures

f) Conditions under which MSAW alerts may be inhibited for individual flights as well as applicable procedures

3.2.2 Controller actions

MSAW-05 In the event an alert is generated in respect of a controlled flight, the controller ***shall*** without delay assess the situation and if necessary the flight ***shall*** be given appropriate instructions to avoid terrain.

3.2.3 MSAW performance analyses

MSAW-06 MSAW performance ***shall*** be analysed regularly to identify possible shortcomings related to MSAW.

3.2.4 Statistical Analyses

The appropriate ATS authority ***should*** retain electronic records of all alerts generated. The data and circumstances pertaining to each alert ***should*** be analysed to determine whether an alert was justified or not. Non-justified alerts ***should*** be used to further optimise MSAW in order to minimise the number of nuisance alerts. A statistical analysis ***should*** be made of justified alerts in order to identify possible shortcomings in airspace design and ATC procedures as well as to monitor overall safety levels.

3.3 Requirements on MSAW capabilities

3.3.1 Alerting performance

MSAW-07 MSAW ***shall*** detect operationally relevant situations for eligible aircraft.

MSAW-08 MSAW ***shall*** alert operationally relevant situations.

Note 1: Situations are operationally relevant when covered by the adopted rule set and optimisation strategy. The rule set and optimisation strategy should be determined taking into account the relevant local factors.

Note 2: Optimisation aims to maximise the number of operationally relevant situations which are alerted with adequate warning time and minimise the number of nuisance alerts. As a balance must be struck, MSAW should not be expected to alert all operationally relevant situations with adequate warning time.

MSAW-09 MSAW alerts ***shall*** attract the controller's attention and identify the aircraft involved in the situation; MSAW alerts ***shall*** be at least visual.

An airspace volume identification element ***may*** be included to improve the controller's ability to assess the situation.

An audible element ***may*** be included to improve the system's ability to draw the controller's attention to the alert as appropriate (e.g. in Control Towers). If a continuous audible element is included, an acknowledgement mechanism ***may*** be provided to silence an alert.

MSAW-10 The number of nuisance alerts produced by MSAW ***shall*** be kept to an effective minimum.

Note: Human factors and local circumstances determine what constitutes an effective minimum.

MSAW-11 The number of false alerts produced by MSAW ***shall*** be kept to an effective minimum.

Note: Local circumstances determine what constitutes an effective minimum.

3.3.2 Warning time

MSAW-12 When the geometry of the situation permits, the warning time ***shall*** be sufficient for all necessary steps to be taken from the controller recognising the alert to the concerned aircraft successfully executing an appropriate manoeuvre.

Note: Warning time may be insufficient in cases of sudden, unexpected manoeuvres.

MSAW-13 MSAW ***shall*** continue to provide alert(s) as long as the alert conditions exist.

3.3.3 Alert inhibition

MSAW-14 MSAW ***shall*** provide the possibility to inhibit alerts for predefined volumes of airspace and for individual flights.

Note: It may be necessary to inhibit alerts for predefined volumes of airspace (e.g. exercise areas) to suppress unnecessary alerts. It may be necessary to inhibit alerts for specific flights (e.g. Calibration Service Aircraft on a defined flight pattern) to suppress unnecessary alerts.

MSAW-15 Alert inhibitions ***shall*** be made known to all controllers concerned.

3.3.4 Status information

MSAW-16 Status information ***shall*** be presented to supervisor and controller working positions in case MSAW is not available.

3.3.5 Adaptability

MSAW ***should*** be adaptable for the procedures in use in all distinct volumes of airspace.

MSAW ***may*** need to take into account the type of flight as well as the specific volume of airspace in which the aircraft is flying, in order to apply appropriate parameters or trajectory estimation. Different parameters ***may*** be applied in the case of system degradation (e.g. unavailability of one or more radar stations).

3.3.6 Data recording

MSAW-17 All pertinent MSAW data shall be made available for off-line analysis.

Note: Off-line analysis may need access to other data sources as well (surveillance data and voice recordings) for complete analysis.

4. References, Definitions and Abbreviations

4.1 Reference documents

[EURO-HRS] Guidelines for Trust in Future ATM Systems: Principles, HRS/HSP-005-GUI-03, Edition 1.0, May 2003

[SRC-ESARR4] ESARR 4: Risk Assessment and Mitigation in ATM, Edition 1.0, 05-04-2001

4.2 Definitions

alert	Indication of an actual or potential hazardous situation that requires particular attention or action.
altitude	The vertical distance of a level, a point or an object considered as a point, measured from mean sea level (MSL).
approach path monitor	A ground-based safety net intended to warn the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of an unsafe aircraft flight path during final approach.
area proximity warning	A ground-based safety net intended to warn the controller about unauthorised penetration of an airspace volume by generating, in a timely manner, an alert of a potential or actual infringement of the required spacing to that airspace volume.
ATS surveillance service	Term used to indicate a service provided directly by means of an ATS surveillance system.
elevation	The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.
false alert	Alert which does not correspond to a situation requiring particular attention or action (e.g. caused by split tracks and radar reflections).
flight level	A surface of constant atmospheric pressure which is related to a specific pressure datum, 1 013.2 hecto-pascals (hPa), and is separated from other such surfaces by specific pressure intervals. Note 1: A pressure type altimeter calibrated in accordance with the Standard Atmosphere: a. when set to a QNH altimeter setting, will indicate altitude b. when set QFE altimeter setting, will indicate height above the QFE reference datum c. when set to a pressure of 1 013.2 hPa, may be used to indicate flight levels Note 2: The terms "height" and "altitude", used in Note 1 above, indicate altimetric rather than geometric heights and altitude.

ground-based safety net	A ground-based safety net is functionality within the ATM system that is assigned by the ANSP with the sole purpose of monitoring the environment of operations in order to provide timely alerts of an increased risk to flight safety which may include resolution advice.
height	The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.
human performance	Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.
level	A generic term relating to the vertical position of an aircraft in flight and meaning variously, height, altitude or flight level.
nuisance alert	Alert which is correctly generated according to the rule set but is considered operationally inappropriate.
minimum safe altitude warning	A ground-based safety net intended to warn the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.
short term conflict alert	A ground-based safety net intended to assist the controller in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima.
warning time	The amount of time between the first indication of an alert to the controller and the predicted hazardous situation. Note 1: The achieved warning time depends on the geometry of the situation. Note 2: The maximum warning time may be constrained in order to keep the number of nuisance alerts below an acceptable threshold.

4.3 Abbreviations and acronyms

ADS	Automatic Dependent Surveillance
AGDL	Air-Ground Data Link
ANSP	Air Navigation Service Provider
APM	Approach Path Monitor
APW	Area Proximity Warning
ASM	Airspace Management
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATM	Air Traffic Management
ATS	Air Traffic Service
EATCHIP	European ATC Harmonisation and Integration Programme
EATMN	European Air Traffic Management Network

EC	European Commission
(E)GPWS	(Enhanced) Ground Proximity Warning System
ESARR	EUROCONTROL Safety Regulatory Requirement
ESSIP	European Single Sky Implementation
FUA	Flexible Use of Airspace
GAT	General Air Traffic
HMI	Human Machine Interface
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
MSAW	Minimum Safe Altitude Warning
MSL	Mean Sea Level
OAT	Operational Air Traffic
QFE	Atmospheric pressure at aerodrome elevation *(or at runway threshold)*
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
RVSM	Reduced Vertical Separation Minima
SES	Single European Sky
SESAR	Single European Sky ATM Research
SFL	Selected Flight Level
SRC	Safety Regulation Commission
STCA	Short Time Conflict Alert
VFR	Visual Flight Rules

ANNEX A

Table 1: Traceability between "Level 2" and "Level 3" documentation for MSAW

"Level 2" documentation	**"Level 3" documentation**
EUROCONTROL Specification for MSAW, i.e. the MSAW concept of operation as well as the specific requirements on MSAW	EUROCONTROL Guidelines for MSAW Part I: Concept and Requirements, i.e. as "Level 2" with the following evolutions: • New section 2.2 identifying the prerequisites for effective MSAW. • Note added explaining the difference between ground-based safety nets and decision support tools (section 2.3). • Guidance for use of SFL added (section 2.4.3).
EUROCONTROL Guidance Material for MSAW, i.e. a general description of the full MSAW lifecycle, aimed at staff with responsibility for overall management of MSAW	EUROCONTROL Guidelines for MSAW Part II: Lifecycle Description, i.e. as "Level 2" with the same evolutions as in Part I.
Appendix A: Reference MSAW System, i.e. a detailed technical explanation of typical implementation details of MSAW with emphasis on parameterisation and performance optimisation; optimisation concepts are also covered in detail.	EUROCONTROL Guidelines for MSAW Part III: Implementation and Optimisation Examples, i.e. as "Level 2" with the same evolutions as in Part I.
Appendix B: Safety Assurance, i.e. a set of three documents that can be used as starting point for MSAW safety assurance work in a particular local context.	As "Level 3" MSAW is an evolution of "Level 2" MSAW, the "Level 2" safety assurance work should be reusable. If required, the "Level 2" guidance remains a valid starting point for safety assurance work and consequently no "Level 3" equivalent has been developed.
Appendix B-1: Initial Safety Argument for MSAW System, i.e. ANSPs may find it convenient to present the safety argument as a stand-alone document initially, as is the case with this document. However, the argument will ultimately become part of the safety case document and the stand-alone version will then become defunct.	
Appendix B-2: Generic Safety Plan for MSAW Implementation, i.e. a description of what safety assurance activities should be considered at each lifecycle phase, who should do them, and what the criteria for success are.	

Appendix B-3: Outline Safety Case for MSAW System, i.e. addressing in detail the assurance and evidence from the System Definition stage and outlining the likely assurance and evidence for the later stages.	
Appendix C: Cost Framework for the Standardisation of MSAW, i.e. assistance in identifying potential financial implications of standardisation of MSAW in compliance with the EUROCONTROL Specification for MSAW.	As “Level 3” MSAW is an evolution of “Level 2” MSAW, the “Level 2” financial planning work should be reusable. If required, the “Level 2” guidance remains a valid starting point for financial planning work and consequently no “Level 3” equivalent has been developed.
Appendix D: Case Study, i.e. a description of the (partial) application of the guidance material in a demanding environment.	As “Level 3” MSAW is an evolution of “Level 2” MSAW, no “Level 3” equivalent has been developed.
Appendix D-1: Enhancement of MSAW for Skyguide, i.e. identification of potential solutions for extending MSAW coverage throughout Skyguide’s Area of Responsibility.	
Appendix D-2: Functional Hazard Assessment of MSAW for Skyguide, i.e. a description of the Functional Hazard Assessment of the identified potential solutions for extending MSAW, performed as an initial step of safety assurance activities.	

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