European Aviation Safety Agency

Notice of Proposed Amendment 2017-21

Technical and operational requirements for remote tower operations

RMT.0624 (PHASE 2)

EXECUTIVE SUMMARY

The concept of remote provision of aerodrome air traffic services (ATS) (commonly known as 'remote towers' or 'remote tower operations', sometimes referred to as 'digital towers') enables provision of aerodrome ATS from locations/facilities where direct visual observation is not available. Instead, provision of aerodrome ATS is based on a view of the aerodrome and its vicinity through means of technology. The term that is used to describe this in this NPA is 'remote aerodrome ATS'.

This Notice of Proposed Amendment (NPA) addresses the technological, procedural and operational aspects of remote aerodrome ATS, in order to facilitate its safe and harmonised implementation throughout EASA member states, in accordance with the objectives of ATS.

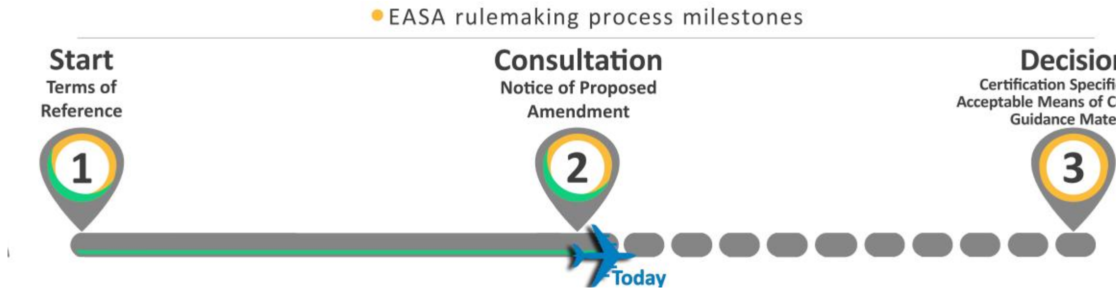
The overall objective of this rulemaking task is a maintained or increased level of safety in cases where ATS is provided from a remote tower, compared to ATS provided from a conventional tower.

Therefore, this NPA introduces 'guidelines on remote aerodrome air traffic services' – which is within the scope of the current regulatory framework (Commission Implementing Regulations (EU) No; 1034/2011, 1035/2011, 2017/373, 139/2014 and 923/2012) – intended to support ATS providers and aerodrome operators implementing remote aerodromes ATS, as well as to support their competent authorities. At the same time, this NPA proposes a set of updated Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Commission Regulation (EU) 2015/340 laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates.

In addition to a safe and harmonised implementation of remote aerodrome ATS, the proposed changes are expected to promote the development of new technology and to facilitate an efficient and proportionate ATS.

The content of this NPA does not address social or economic aspects related to remote aerodrome ATS which would need to be addressed at a local level.

Action area:	SESAR		
Affected rules:	EDD 2015/014/R (GM on the implementation of the remote tower concept for single mode of operation) EDD 2015/010/R (AMC/GM to Part-ATCO)		
Affected stakeholders:	Competent authorities, ANSPs and aerodrome operators		
Driver:	Efficiency and proportionality	**Rulemaking group:**	Yes
Impact assessment:	None	**Rulemaking Procedure:**	Standard



09.12.2014	23.03.2015 (Phase 1) 20.12.2017 (Phase 2)	03.07.2015 (Phase 1) 2018/Q2 (Phase 2)

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1. About this NPA

1.1. How this NPA was developed

The European Aviation Safety Agency (EASA) developed this NPA in line with Regulation (EC) No 216/2008[1] (hereinafter referred to as the 'Basic Regulation') and the Rulemaking Procedure[2]. This rulemaking activity is included in the EASA 5-year Rulemaking Programme[3] under rulemaking task (RMT).0624. The proposals contained in this NPA have been developed by EASA based on the input of the Rulemaking Group (RMG)[4] of RMT.0624. It is hereby submitted to all interested parties[5] for consultation.

1.2. How to comment on this NPA

Please submit your comments using the automated **Comment-Response Tool (CRT)** available at **http://hub.easa.europa.eu/crt/**[6].

The deadline for submission of comments is **3 April 2018.**

Furthermore, it is highlighted that, within Chapter 3.1 of this NPA, EASA explicitly invites stakeholders to express their opinion related to a specific question. EASA is addressing the said question to stakeholders in order to receive further guidance during the consultation of this NPA with a view to gain additional information and the opinion of a wider audience.

1.3. The next steps

Following the closing of the public commenting period, EASA will review all comments and may perform a focused consultation which composition will depend on the subject and nature of the comments received.

Based on the comments received, EASA will develop two separate decisions:

— A decision issuing 'Guidelines on Remote Aerodrome Air Traffic Service' — Issue 2.

— A decision related to the qualification and training of air traffic controllers, amending acceptable means of compliance (AMC) and guidance material (GM) to Commission Regulation (EU) 2015/340.

The comments received and the EASA responses thereto will be reflected in a comment-response document (CRD). The CRD will be annexed to the respective ED Decisions.

1 Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1) (http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1467719701894&uri=CELEX:32008R0216).

2 EASA is bound to follow a structured rulemaking process as required by Article 52(1) of Regulation (EC) No 216/2008. Such a process has been adopted by the EASA Management Board (MB) and is referred to as the 'Rulemaking Procedure'. See MB Decision No 18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by EASA for the issuing of opinions, certification specifications and guidance material (http://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-18-2015-rulemaking-procedure).

3 http://easa.europa.eu/rulemaking/annual-programme-and-planning.php

4 Rulemaking group composition: https://www.easa.europa.eu/system/files/dfu/GC%20RMT.0624%20Issue%202.pdf

5 In accordance with Article 52 of Regulation (EC) No 216/2008 and Articles 6(3) and 7) of the Rulemaking Procedure.

6 In case of technical problems, please contact the CRT webmaster (crt@easa.europa.eu).

2. In summary — why and what

2.1. Why we need to change the rules — issue/rationale

The development and introduction of new technologies enables the provision of aerodrome ATS from locations/facilities where direct visual observation is not available. Instead, provision of aerodrome ATS is based on a view of the aerodrome and its vicinity through the means of technology. A remote tower can be located away from the aerodrome or it can be located in a building on or close to the aerodrome. System elements of the concept of remote aerodrome ATS could also be introduced in a conventional tower, in order to enhance/complement situational awareness or to provide a visual view of parts of the aerodrome or its vicinity which is otherwise inadequate or non-existent.

The concept of remote aerodrome ATS has been studied for many years, initially independently within some of the EASA Member States and subsequently also within the context of the Single European Sky ATM Research Joint Undertaking (SESAR JU) programme. The first remote tower implementation providing aerodrome ATS based on a situational awareness in accordance with ICAO Documents 4444 and 9426 was approved and introduced into operations in Sweden in April 2015, with further implementations in other EASA Member States well underway.

In order to support this development and in order to develop an appropriate and proportionate regulatory framework, EASA initiated RMT.0624 in 2014.

As a first step, based primarily on the SESAR results available at that time, EASA published, in July 2015, ED Decision 2015/014/R 'adopting Guidance Material on the implementation of the remote tower concept for single mode of operation' and ED Decision 2015/015/R 'amending Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) 2015/340' related to 'Requirements on Air Traffic Controller licensing regarding remote tower operations'. The scope of the published material was limited to single mode of operation, targeting primarily 'low density aerodromes'. It was acknowledged that the published material represented a first step of regulatory developments in the field of remote aerodrome ATS and that further work would be needed to address the continued development of the concept as well as to address the development of industry standards.

Since the publication of the aforementioned Decisions, SESAR has published further results[7] within the field of remote aerodrome ATS, EUROCAE has published the first related technical standard[8] and operational experience has been gained within some EASA Member States. In addition, research and validation activities have been performed outside of SESAR, e.g. in the US[9]. The concept of remote aerodrome ATS has continued to evolve to more complex operational contexts, such as the provision of ATS to more than one aerodrome simultaneously (multiple mode of operation), the provision of ATS to larger aerodromes, the use of a remote tower as a backup facility for conventional towers and operations supported by new technical enablers which have traditionally not been available for aerodrome ATS. The latter – if introduced properly, carefully and wisely – may have the potential to increase efficiency and safety of operations.

7 SESAR Solution #12: Single remote tower operations for medium traffic volumes,
SESAR Solution #52: Remote tower for two low density aerodromes,
SESAR Solution #13: Remotely provided air traffic service for contingency situations at aerodromes,
SESAR Large Scale Demonstrations performed in in Germany, Hungary, Ireland, the Netherlands and Sweden.

8 EUROCAE ED-240, 'Minimum Aviation System Performance Specification for Remote Tower Optical Systems', September 2016.

9 Presentation on US projects from ICAO RPAS and Remote ATS Symposium, 9-10 May 2016.

An increasing number of initiatives to provide remote aerodrome ATS are being undertaken within numerous EASA Member States as well as worldwide. Many of these initiatives consider operational context and applications that lie beyond the scope of the previously published EASA Decisions.

In order to address the larger scope of the remote aerodrome ATS concept as well as the latest SESAR developments and results from other available research and validation activities, to benefit from gained operational experiences and to support implementation initiatives as well as to meet expectations from the ATM community on EASA, RMT.0624 was relaunched in a second phase mid-2016. The result from the work of this second phase is contained this NPA.

While recognising that the concept of 'multiple mode of operation' is still in the development phase, EASA considers that there is already sufficient information and data available to provide regulatory support and guidance to facilitate its safe implementation and to provide a basis for its further development and industrialisation.

It can also be noted that ICAO, with State Letter AN 7/63.1.1-17/23 of 6 March 2017, has proposed amendments to PANS-ATM (Doc 4444) that will fully open up for remote aerodrome ATS in the context of ICAO provisions. Furthermore, the amended edition of PANS-ATM (Doc 4444), envisaged to be applicable on 8 November 2018, is proposed to introduce a reference to the material/guidelines published by EASA.

2.2. What we want to achieve — objectives

The overall objectives of the EASA system are defined in Article 2 of the Basic Regulation. This proposal will contribute to the achievement of the overall objectives by addressing the issues outlined in this Chapter 2.

The overall objective of the material proposed by this NPA is to ensure that remote aerodrome ATS meet the applicable EU and ICAO requirements and to ensure a maintained or increased level of safety as when service is provided from a conventional tower. Other objectives are; to support technological evolution and a cost-efficient and proportionate ATS, to facilitate harmonised implementation, and to provide a level playing field for the stakeholders. In addition, a specific objective is to satisfactorily address air traffic service provision personnel licensing and qualification requirements.

2.3. How we want to achieve it — overview of the proposals

This NPA contains two main proposals with regard to remote aerodrome ATS:

— a proposal for 'Guidelines on remote aerodrome Air Traffic Services – Issue 2'; and

— a proposal for a updated and partly new set of AMC and GM related to the qualification and training of air traffic controllers.

Compared to NPA 2015-04 (developed in the first phase of RMT.0624), followed by ED Decisions 2015/014/R and 2015/015/R, the proposals contained in this NPA (developed in the second phase of RMT.0624) extends the scope to the larger/full concept of remote aerodrome ATS, to address also more complex operational contexts and applications such as the provision of ATS to more than one aerodrome simultaneously (multiple mode of operation), the provision of ATS to larger aerodromes, the use of a remote tower as a backup facility for conventional towers and operations supported by new technical enablers which have traditionally not been available for aerodrome ATS. The proposals also incorporate new results stemming from SESAR and other available research and validation activities, as well as operational experiences gained among EASA Member States, in a way to elaborate further and improve the material concerning aspects which were already covered by ED Decisions 2015/014/R and ED Decision 2015/015/R.

The reasons for the level of 'guidelines' ('Guidelines on remote aerodrome Air Traffic Services'), in favour of e.g. AMC/GM, are several. Most importantly, remote aerodrome ATS is consistent with and within the scope of the existing regulatory framework (ICAO and EU) and there is no change in service provision (aerodrome ATS). Furthermore, in the EU regulatory framework, requirements related to the assessment of changes to functional systems and their oversight are included in Regulations 1034/2011, 1035/2011 and 2017/373. The latter has already a large set of AMC and GM to support the air navigation service providers (ANSPs) and their National Supervisory Authorities (NSAs) to safely assess and oversee the changes to functional systems. In addition, in the field of ATS procedures, the proposals for EU regulation are still under development (under RMT.0464 and NPA 2016-09[10]). EASA considers that it is easier for the ones wishing to implement remote aerodrome ATS to have a single source of information encompassing all the aspects together, rather than specific AMC or GM to higher level provisions/regulations, which would make the overall application complex. For the reasons described, the guideline level has been chosen in order to provide a single document with guidance and proportionate regulatory support for the implementation of remote aerodrome ATS. The only exemption is the material addressing the ATCO licensing aspect for which EASA has chosen to have separate AMC and GM focusing on the establishment of high-level guidance for the training and qualifications of ATCOs.

Chapter 10 of the proposed 'Guidelines on Remote Aerodrome Air Traffic Services' contained in this NPA addresses qualification and training considerations for the ATS providers' personnel. In addition, EASA has identified a possible need for inclusion of theoretical knowledge about remote aerodrome ATS as part of the training for pilots. EASA will therefore perform an assessment to this regard. Following this assessment, EASA may initiate actions as appropriate and necessary for this area.

2.4. What are the expected benefits and drawbacks of the proposals

The main benefit of the proposals is to provide guidance and regulatory support that facilitates safe and harmonised implementation for the ANSPs and their competent authorities. As such, it allows them to consider all the necessary safety aspects without impairing technological developments.

The main drawback of the proposals is that, at the time of writing, the concept for multiple mode of operation is less mature than the single mode of operation. SESAR has, to date, published one solution related to the multiple mode of operation[11] and, in addition, several SESAR large scale demonstrations of the multiple mode of operation have been performed. Yet, at the time of publication of this NPA, no operational implementation of this concept category exists and, subsequently, no operational experience is available. However, implementation plans comprising the multiple mode of operation exists among Members States, hence operational implementation is likely to become a reality in the near future (subject to the operational approvals of the competent authorities). It is important to conclude that EASA tries to support the on-going implementation projects by providing as much guidance as possible based on the existing available information and data. It is also important to consider that EASA, as part of the proposed guidelines, proposes some recommended limitations, as

[10] The related Opinion is expected to be issued by EASA in Q1 2018.
[11] SESAR Solution #52: Remote tower for two low density aerodromes.

well as mitigation measures for how to handle related risks, for the multiple mode of operation, taking into account its current level of maturity.

2.5. Non-consensus in the RMG

It is important to highlight that two members of the RMG, ETF and ATCEUC, did not agree with EASA's approach in two aspects:

— ETF wanted a regulatory approach not limited to the establishment of guidelines for the implementation of multiple mode of operation. They consider this level to be unsatisfactory, *'especially as this type of use case requires multiple tasks being conducted at the same time which has been proven to lead to more errors in many human performance studies'*[12]. ATCEUC was even in favour for a prohibition of the multiple mode of operation, *'since the handling of simultaneous/concurrent aircraft (+vehicle) movements at different aerodromes in our view is considered unsafe and disrespectful to ATCOs professionalism'*[13].

— Both associations disagree to the approach taken with regard to ATCO licensing (being to include remote aerodrome ATS aspects as part of the unit endorsement course). In their view a specific 'Remote Tower' rating endorsement should be introduced.

In both cases, ATCEUC and ETF requested EASA to develop implementing regulations for remote aerodrome ATS.

EASA's position

There are many reasons why EASA has chosen the guidelines/soft law level for this NPA instead of the implementing regulations level (as also discussed in Chapter 2.3):

— Most importantly, remote aerodrome ATS does not imply any changes to the provided service. The service is still the same (aerodrome ATS) and there are no, or only minimal, changes in operational procedures.

— Furthermore, the aviation community is in general moving towards a performance based regulatory approach. The ANSPs are certified and mature organisations and are already sufficiently regulated in order for ensuring an acceptable of level of safety. The technical solutions which may be used for remote aerodrome ATS can be different from implementation to implementation. The regulation should therefore not limit the technological development by introducing hard law constraints. Instead, implementation of new technology needs to be facilitated. The regulation should provide the objectives to be met, whereas the technological means to achieve these objectives should be left open to the industry. Hard rules development is costly and time consuming and moreover not always necessary. By the time the hard law regulation has been developed and implemented, constraints put forward for a concept/technology may already be obsolete and/or overcome by technological developments.

— In relation to the argument of a possible ban of multiple mode of operation, EASA recognises that several of each other independent SESAR validations and demonstrations have shown that multiple mode of operation can be performed in a safe manner under certain limited operational context and applications (and considered that appropriate mitigation measures to

[12] Quote verbatim from written communication at the request from ETF.

[13] Quote verbatim from written communication at the request from ATCEUC.

reduce the risks are implemented). It is also possible that, through future research and technological development as well as through gained operational experiences and trust, the operational context and application of multiple mode of operation may be extended. SEASR has to date published one related SESAR Solution (Solution #52 for 'two low density aerodromes'), which is indicates that this concept is sufficiently mature to be ready for 'industrialisation' , but would also rely on the support of a regulatory framework to be brought forward into 'deployment' and 'operations'. This is also why the proposal contained in this NPA propose recommendations for how to implement multiple mode of operations as well as for mitigation measures to be implemented by the ANSP if providing multiple mode of operation. If an ANSP is able to provide sufficient evidence for an acceptable level of safety to its competent authority, EASA does not have any reason to forbid/ban such implementations.

— In relation to the argument of the licensing scheme, EASA has currently not identified a need for the establishment of a specific rating endorsement for remote aerodrome ATS within the ATCO licensing scheme for the following reasons:

- EASA has proposed GM for the content of the unit endorsement course for remote aerodrome ATS aspects, which is not the case for other unit endorsement courses. This is considered to ensure an appropriate level of safety, taking into account that the unit endorsement course has to be approved by the competent authority.
- EASA is currently not able to identify a specific set of skills required for remote aerodrome ATS, that would be common for the different implementation projects (and taking into account that the technical solutions can be different from implementation to implementation) and that would justify to establish what should be part of said rating endorsement.
- EASA considers that the service provision is the same, regardless if being provided from a remote or a conventional tower.

3. Proposed amendments and rationale in detail

3.1. Draft guidelines (Draft EASA decision)

Draft resulting text

The proposal for 'Guidelines on Remote Aerodrome Air Traffic Services' is contained below.

The proposal will form Issue 2 and will replace Issue 1 that was introduced by ED Decision 2015/014/R 'adopting Guidance Material on the implementation of the remote tower concept for single mode of operation'. The title of Issue 2 will be changed compared to the title of Issue 1, mainly because of the extended scope of the document.

Rationale

The reasons behind the proposed 'Guidelines on Remote Aerodrome Air Traffic Services' as well as the justification for the level of 'guidelines' are explained in Chapter 2, in particular Chapter 2.3.

Question to stakeholders

Chapters 5.6, 5.14.1.2 and 5.14.3 of the proposed 'Guidelines on Remote Aerodrome Air Traffic Services' addresses communication aspects of remote aerodrome ATS. With regard to aerodrome mobile service (air–ground communications), EASA invites stakeholders to answer and provide inputs on the following question:

For the radio communication between the pilot and ATCO/AFISO, is there a need to indicate the provision of remote aerodrome ATS (e.g. by the addition of the word 'remote' to the ATS unit call sign on the initial call)?

European Aviation Safety Agency

Guidelines

on

Remote Aerodrome Air Traffic Services

Issue 2

[*dd*] [*month*] 2018[14]

[14] For the date of entry into force of Issue 2, please refer to Decision 2018/XXX/Y at the Official Publication of EASA.

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GUIDELINES ON REMOTE AERODROME ATS

1. Introduction

The concept of 'remote provision of aerodrome air traffic services (ATS)' (commonly known as 'remote towers' or 'remote tower operations', sometimes referred to as 'digital towers') enables provision of aerodrome ATS from locations/facilities where direct visual observation is not available. Instead, provision of aerodrome ATS is based on a view of the aerodrome and its vicinity through means of technology. Throughout this document, the term used to describe this is 'remote aerodrome ATS'.

1.1. Purpose and intended readership

This document provides guidance to support both:

— organisations (e.g. air traffic service providers, aerodrome operators) implementing, or considering to implement remote aerodrome ATS, and

— their competent authorities (i.e. national supervisory authorities or EASA in the case of pan-European or third country service providers, aerodrome competent authorities), when approving remote aerodrome ATS implementation.

The purpose is also to describe the general concept of remote aerodrome ATS to the ATM community by establishing a common baseline and understanding thereof, as well as to clarify and provide consistency with related terms and definitions.

The document lists areas and issues for consideration when implementing remote aerodrome ATS, in particular those related to safety and human factors. However, it should be noted that every implementation is unique and is subject to a local safety assessment, in accordance with the procedures accepted by the relevant competent authority.

1.2. Scope

The scope of this document is the overall concept of remote aerodrome ATS – covering single and multiple mode of operations (described in Sections 3.2 and 3.3), remote tower centre operations (described in Section 3.4) and the use of technical enablers (some which traditionally have not been available for aerodrome ATS) (described in Section 5.2.5). As such the guidelines provided in this document can be seen as generic. In addition, the document provides an overview of the operational context and applications that have been validated (or that are operational) to date (chapter 4).

This document covers the technological, procedural and operational aspects of remote aerodrome ATS, in order to facilitate a safe and harmonised implementation throughout EASA member states in accordance with the objectives of ATS. It does not address social or economic aspects related to remote aerodrome ATS which would need to be addressed at a local level.

This document focuses primarily on the unique implementation aspects of **remote** aerodrome ATS and therefore does not list all applicable EU regulations, or the still applicable relevant ICAO provisions, related to aerodrome ATS provision. ATS providers or aerodrome operators considering implementation of remote aerodrome ATS are responsible for ensuring compliance with the international standards and EU/national requirements as may be applicable to individual operations.

1.3. Document structure

This document is structured as follows:

— Section 1 'Introduction' – introduces the purpose, scope, intended readership, structure, background and justification of this document;

— Section 2, 'Definitions' – lists the terms and definitions used in this document;

— Section 3, 'Introduction to remote aerodrome ATS' – provides a general overview of the concept of remote aerodrome ATS via a short historical retrospect and by introducing; its main operational categories; remote tower centre operations; technical enablers that support remote aerodrome ATS, and also lists possible operational applications;

— Section 4, 'Operational context/applications and related recommendations' – describes the operational context and applications that have been validated or introduced into operation to date and provides related recommendations – as well as elaborating some foreseen possible developments;

— Section 5, 'Operational and system considerations' – describes the operational and procedural needs and requirements for remote aerodrome ATS as well as considerations for a remote tower system;

— Section 6, 'Management of change' – provides considerations and guidance related to the change management of the introduction of remote aerodrome ATS, divided into the fields of; safety assessment, human factors assessment, information and cyber security, contingency planning, transition/implementation plan and remote tower system constituents;

— Section 7, 'Aerodrome related aspects' – outlines aspects to take into account for the aerodrome operator as well as outlines the coordination needs between the ATS provider and the aerodrome operator;

— Section 8, 'Possible impact on airspace users' – shortly discusses the aspect on potential airspace users impact;

— Section 9, 'Aeronautical information products and services' – gives indications on information that may need to be included in the various aeronautical information products and services;

— Section 10, 'Qualification and training considerations' – describes qualification and training considerations for Air Traffic Control Officers (ATCOs), Aerodrome Flight Information Service Officers (AFISOs) and Air Traffic Safety Electronics Personnel (ATSEPs);

— Section 11, 'References' – lists documents which have been used to provide input/guidance/information/other for the production of this document and/or which are being referenced from this document;

— Section 12, 'Appendices' – lists all the appendices to this document.

1.4. Background and justification

The concept of remote aerodrome ATS has been studied for many years, initially independently within some of the EASA Member States and subsequently also within the context of the Single European Sky ATM Research Joint Undertaking (SESAR JU) programme. The first approved remote aerodrome ATS implementation has been in operation since April 2015 and an increasing number of initiatives to provide remote aerodrome ATS are being undertaken throughout Europe as well as worldwide.

In order to support this development and in order to provide appropriate regulatory guidance, EASA published, in July 2015, 'Guidance Material on the implementation of the remote tower concept for single mode of operation' [9]. Within the aforementioned Decision, it was acknowledged that it represented a first step and that further work would be needed to address the continued development of the concept of remote aerodrome ATS as well as to address the development of industry standards.

Since the publication EASA ED Decision 2015/014/R [9]; research, development and validation activities have further evolved the concept with regard to e.g. provision of ATS to multiple aerodromes, provision of ATS to larger/more complex single aerodromes and operations supported by the introduction of new technical enablers. Also the first industry standard on the technical aspects of remote aerodrome ATS has been published by EUROCAE [18].

As remote aerodrome ATS is considered consistent with and within the scope of the existing regulatory framework (ICAO and EU) and as there is no change in service provision (aerodrome ATS), and in order to provide a single source of information encompassing all the aspects related to remote aerodrome ATS, the 'guideline level' has been chosen in order to provide guidance and proportionate regulatory support for the implementation of remote aerodrome ATS (the only exemption for specific remote aerodrome ATS aspects is the qualification and training of ATCOs, for which EASA has chosen to have separate AMC and GM.) EASA considers that it is easier for the ones wishing to implement remote aerodrome ATS to have a single source of information encompassing all the aspects together.

2. Definitions

For the purpose of this document, and in order to enhance its understanding, the definitions below apply.

Note: *The definitions below are intentionally not listed in alphabetical order, instead they are for pedagogical reasons grouped so that related definitions are listed/grouped together. For this reason, the definition 'Visual presentation' appears twice.*

'Remote aerodrome ATS' means provision of aerodrome ATS based on a view of the aerodrome and its vicinity through the means of a visual presentation system (and supported by other technology as needed).

'Conventional tower' means a facility located at an aerodrome from which aerodrome ATS can be provided to aerodrome traffic mainly through direct visual observation of the area of responsibility of the ATS unit.

'Remote tower' means a facility from which aerodrome ATS can be provided to aerodrome traffic through real-time visual presentation of the elements contained in its area of responsibility (manoeuvring area and vicinity of the aerodrome) together with other elements that support the operation. (It is to be seen as a generic term, equivalent in level to a conventional tower).

'Remote tower centre' (RTC) means a facility housing one or more remote tower modules.

'Remote tower module' (RTM*)* means a combination of systems and constituents from where remote aerodrome ATS can be provided, including one or more CWP(s) and the visual presentation. (It can be compared with the tower cabin of an aerodrome conventional tower.)

'Controller working position' (CWP) means the ATCO/AFISO workstation, which includes the ATS systems/functions as necessary for the service provision, but excludes the visual presentation.

'Visual presentation' means a view of the areas of responsibility of the aerodrome ATS unit, provided by a visual display.

'Single mode of operation' means the provision of ATS from one remote tower module for one aerodrome at a time.

'Multiple mode of operation' means the provision of ATS from one remote tower module for two or more aerodromes at the same time (i.e. simultaneously).

'Direct visual observation' means observation through direct eyesight of objects situated within the line of sight of the observer, possibly enhanced by external elements (e.g. binoculars).

'Out-the-window (OTW) view' means a view of the areas of responsibility of the aerodrome ATS unit from a conventional tower, obtained via direct visual observation.

'Visual presentation' means a view of the areas of responsibility of the aerodrome ATS unit, provided by a visual display.

'Visual presentation system'[15] means of a number of integrated elements, normally consisting of optical sensor(s), data transmission links, data processing systems and situation displays.

'Detect/detection' means to visually be able to see that there is something.

'Recognise/recognition' means to visually be able to determine the class/category/type of an object, e.g.:

— class/category/type of aircraft based on e.g.; size/fuselage, engine configuration, wing/stabilizer configuration, painting/colour marking, etc.;

— class/category/type of vehicle; e.g. ambulance/car/fuel truck/baggage trailer;

— class/category/type of personnel and obstructions, e.g. person/wildlife/FOD.

'Identify/identification' means the ability to couple a detected or recognised object with a specific individual aircraft/vehicle. This may be done via e.g. visual means (e.g. by reading the registration mark of an aircraft), by applying probability theory (e.g. 'the aircraft/object currently on final must be the same aircraft as I have on my flight strip as there are no other flight strips and no other known aircraft in the aerodrome vicinity'), by system support providing the call-sign or squawk code (or upon squawk ident request), by aircraft position reports, by requesting aircraft turns/movement/flashing lights to identify.

'Operational context' means the operational characteristics – such as aerodrome size/layout, traffic volume and complexity, related airspace and flight procedures, number of simultaneously served aerodromes, etc. – that should be considered when remote aerodrome ATS is to be implemented.

'Aircraft movement' means an aircraft take-off or landing at an aerodrome.

[15] ICAO is (with State Letter AN 7/63.1.1-17/23 of 6 March 2017) proposing the term 'visual surveillance system' for the same. (EASA is, as part of the ICAO State Letter procedure, proposing its member states to suggest ICAO to implement the term 'visual presentation system'. Subject to the outcome of ICAO State Letter process, this guidance material shall be updated to reflect the final amendment to PANS-ATM (before publication the EASA ED Decision). EUROCAE ED-240 [18] is using the term 'remote tower optical system' for the same.

3. Introduction to remote aerodrome ATS

The concept of remote aerodrome ATS enables provision of aerodrome ATS from locations/facilities where direct visual observation is not available. Instead, provision of aerodrome ATS is based on a view of the aerodrome and its vicinity through means of technology.

The primary change introduced by remote tower operations, compared to conventional tower operations, relates to the manner by which visual observation of the aerodrome and its vicinity is achieved. When operating from a remote tower facility, this is no longer carried out by direct visual observation from a conventional tower. Instead, a visual presentation is provided to the ATCO/AFISO, to enable situational awareness in accordance with ICAO Documents 4444 and 9426.

A remote tower can be located away from the aerodrome it is providing a service to, or it can be located in a building on or close to the aerodrome but without an adequate direct view of the area of responsibility. System elements of the concept of remote aerodrome ATS could also be introduced in a conventional tower, in order to enhance/complement situational awareness or to provide a visual presentation of parts of the aerodrome or its vicinity which is otherwise either in-adequate or non-existent.

The concept was initially introduced and developed within some Member States in the early 2000's and it has been further developed and refined within the SESAR JU programme. At the time of publication of this document, four so-called SESAR Solutions[16] related to remote tower operations have been published by SESAR JU. (With reference to the European Operational Concept Validation Methodology (E-OCVM) [38], a SESAR Solution indicates that an operational concept has completed phase V3 of the Concept Lifecycle Model, thus being ready and mature for industrialisation (V4) and deployment (V5).)

When it comes to remote aerodrome ATS, Japan has been providing AFIS from remote locations since 1974[17], although in the beginning only with a limited visual presentation of the aerodrome and its vicinity. The first remote tower implementation providing aerodrome ATS based on a situational awareness fully in accordance with ICAO Documents 4444 and 9426 was approved and introduced into operations in Sweden in April 2015. Implementation has already commenced in other Member States as well as throughout the world.

The concept of remote aerodrome ATS is constantly evolving and over time, since the concept was initially defined, the operational framework/target environments as well as new applications have evolved. It is expected that this evolution will continue.

Results from research and development work (such as the SESAR JU programme) and experience from operations are important inputs to the development of formal specifications, standards and regulatory framework material (such as this document).

3.1. Concept overview

For the purpose of this document, the concept of remote aerodrome ATS is categorised into the two main categories of;

— single mode of operation, and

— multiple mode of operation.

[16] Solution #71: ATC and AFIS service in a single low-density aerodrome from a remote CWP,
Solution #12: Single remote tower operations for medium traffic volumes,
Solution #52: Remote tower for two low density aerodromes,
Solution #13: Remotely provided air traffic service for contingency situations at aerodromes.

[17] http://www.icao.int/Meetings/anconf12/WorkingPapers/ANConfWP130.2.1.ENonly.pdf

For both categories, ATS may be provided either as aerodrome control service (ATC) or aerodrome flight information service (AFIS).

Irrespectively of single or multiple mode of operations, remote aerodrome ATS could be provided both for the case when there is already a conventional tower at the concerned aerodrome, or for the case when there currently is no conventional tower. The remote provision of ATS to an aerodrome could be done on a permanent basis (fully replacing the conventional tower, if one exists) or it could be done on a temporary basis, for example during specific times such as during the night or for specific events.

When providing remote aerodrome ATS, the operational application will vary depending on various factors such as the operational environment and the individual needs of stakeholders (as is the case in any ATS provision).

Each category is further described in its respective subsection hereunder.

3.2. Single mode of operation

The single mode of operation refers to the provision of ATS to one aerodrome at a time, from a single remote tower module (RTM).

Operational applications which typically would fall under the remit of the single mode of operation category include, but are not limited to:

— The provision of ATS to one aerodrome from one RTM (by one or more ATCO(s)/AFISO(s)),

— The provision of ATS to more than one aerodrome from one RTM, however, not simultaneously, by providing service to one aerodrome, then change service provision to another aerodrome (i.e. still providing service to only one aerodrome at a time),

— The provision of ATS during planned or unplanned contingency situations, as a dedicated backup solution for an existing aerodrome ATS,

— The provision of ATS to distant areas of an aerodrome from which the view from an existing aerodrome tower is inadequate or non-existent, by implementing remote tower system elements into the existing aerodrome tower.
Note: *With regard to the definition of a remote tower module in Section 2, in this application the RTM is considered being a part of the conventional aerodrome tower cabin.* (This could therefore be in lieu of building a second aerodrome tower);

3.3. Multiple mode of operation

The multiple mode of operation refers to the provision of ATS to more than one aerodrome at a time, i.e. simultaneous service provision, from a single RTM.

Operational applications which typically would fall under the remit of the multiple-mode-of-operation category include, but are not limited to:

— The provision of ATS to more than one aerodrome simultaneously from one RTM (by one or more ATCO(s)/AFISO(s)).

— The provision of ATS to one (or more) remote aerodrome(s) from a conventional tower cabin, in combination with the (simultaneous) provision of ATS to the local aerodrome.
Note: *With regard to the definition of a remote tower module in Section 2, in this application the RTM is considered being a part of the conventional aerodrome tower cabin.*

— The simultaneous provision of service to a specific area or a specific function for more than one aerodrome, e.g. a clearance delivery position for more than one aerodrome. (The given example in this application would not require a visual presentation and would as such therefore not be considered either as a 'remote tower' or an 'RTM' as defined in Section 2 of this document, but could even so be considered as 'remote aerodrome ATS' and is given here as an example to facilitate the understanding of this application.)

3.4. Remote Tower Centre (RTC)

The ATS provider may decide that the remote provision of ATS is performed from a centralised facility known as a remote tower centre (RTC). The RTC (see Figure 1) can house one or several RTMs.

An RTC can be set up as shown in Figure 1, with multiple RTMs and possibly one or more supervisor positions (depending on the size and requirements of the RTC). The RTMs can have an independent combination of either single-mode-of-operation or multiple-mode-of-operation scenario per each RTM, which may also change over time (i.e. changing from single to multiple mode of operation for one RTM, or vice versa). The ATS provider may decide to change the allocation of aerodromes between RTMs on a flexible basis (similar to procedures for sector allocation within an ACC) in order to improve the efficiency of resources or to respond to specific operational needs and demands. The ability to switch aerodromes between RTMs will depend on many factors, such as ATCO/AFISO qualification and training, technical configuration of the RTMs, traffic schedule and distribution between aerodromes etc.

The ATS provider's decision on the number of available RTMs in an RTC will depend on the number of aerodromes connected to the RTC, the complexity and size of the connected aerodromes as well as the need for additional/spare RTMs, based on contingency and service availability requirements.

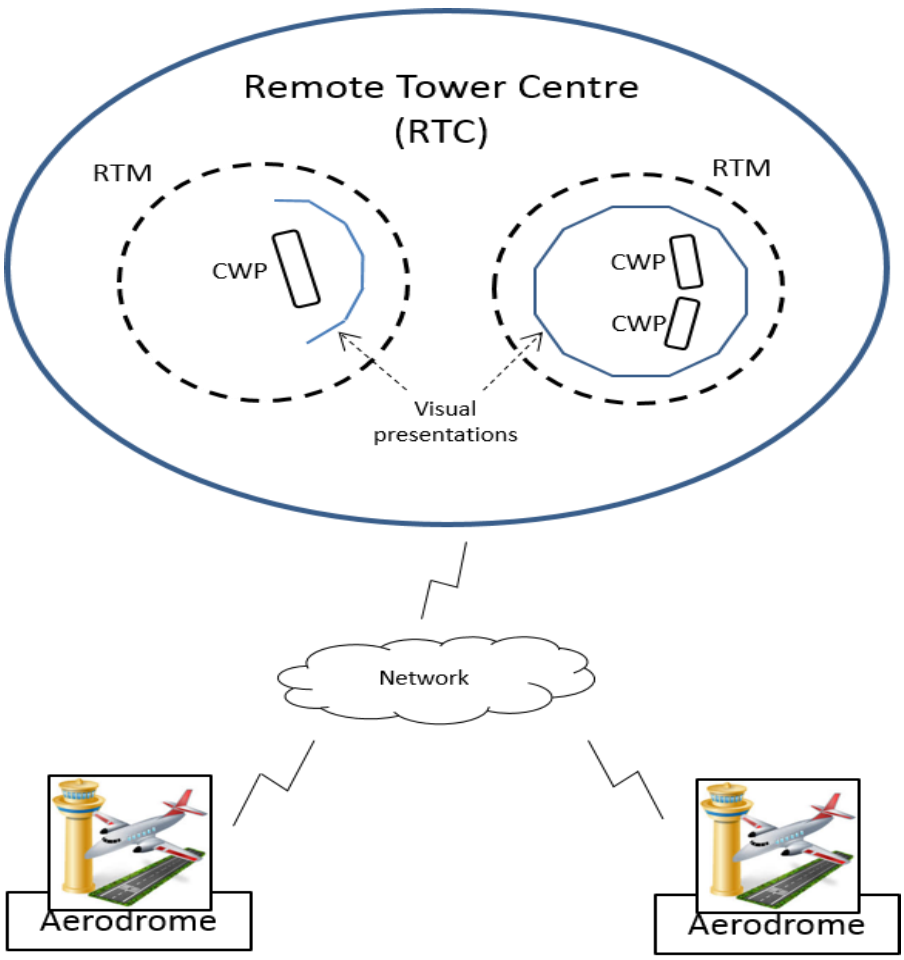

Figure 1: Example high-level overview of remote aerodrome ATS from an RTC

3.5. Technical enablers for remote aerodrome ATS

The solutions which are available for remote aerodrome ATS are not based on a unique system configuration but on a varied set of technical enablers. The appropriate configuration of technical enablers should be assessed and selected according to the operational needs of each implementation and supported and identified by the safety, security, and human factors assessments.

Below is a (non-exhaustive) list of possible technical enablers which may be necessary for service provision. Many of the below listed enablers are also available for conventional towers, however, in the remote tower context they will be affected to various degrees due to the need for data transmission links. Each technical enabler is further described in Section 5.

— visual presentation, replacing, or complementing, the OTW view of a conventional tower (further described in Section 5.2);

— binocular functionality (e.g. a Pan-Tilt-Zoom (PTZ) camera/function, as defined and described in ED-240 [18]), fulfilling/emulating the function of a binocular in a conventional tower (Section 5.3);

— signalling lamp, remotely controlled (Section 5.4);

— aerodrome sound reproduction (Section 5.5);

— communications, i.e. aeronautical mobile service, aeronautical fixed service and surface movement control service (Section 5.6);

— management of aeronautical ground lights (Section 5.9.1);

— management of navigation aids (Section 5.9.2);

— alarm management (Section 5.9.3);

— meteorological information (Section 5.8);

— other ATS systems/functions, as would typically also be available in a conventional tower, but which are <u>not</u> affected by the remote provision of ATS (Section 5.12);

— additional visual 'hot spot/gap filler' cameras (Section 5.2.5);

— the use of infrared or other optical sensors/cameras outside of the visible spectrum (Section 5.2.5);

— dedicated means to facilitate the detection, identification and automatic following of aircraft or vehicles in the visual presentation (e.g. by labels based on surveillance data, complemented by flight plan correlation when available, commonly referred to as 'radar tracking') (Section 5.2.5);

— dedicated means to facilitate the detection and following of moving objects in the visual presentation (e.g. by highlighting/framing such objects based on image processing systems, commonly referred to as 'visual tracking'[18]) (Section 5.2.5);

— system support to help the ATCO/AFISO detect smaller FOD, highlighting the existence of such small objects in the visual presentation (Section 5.2.5);

— other overlaid information in the visual presentation such as; framing and/or designation of runways, taxiways etc., compass directions, meteorological information (Section 5.2.5);

— enhanced functionalities of the binocular functionality, e.g. automatic following of moving objects (Section 5.3).

[18] At the time of publication of this document, EUROCAE working group 'Remote and Virtual Tower' (WG-100) is developing ED-240A, an extension to ED-240 'Minimum Aviation System Performance Specification (MASPS) for Remote Tower Optical Systems' [18], to include remote tower optical target tracking technologies. Expected publication of ED-240A is end 2018. EUROCAE WG-100 currently uses the term 'optical sensor based object augmentation' synonymously with the term 'visual tracking'.

4. Operational context/applications and related recommendations

This section describes the operational context and applications which have been validated to date (by the SESAR JU programme and approved as SESAR solutions) as well as operational context and applications for which remote aerodrome ATS have been approved for operation, together with related recommendations. This would not rule out the possibility for an expansion into other more challenging operational context and applications as further research and development results become available and when more operational experience from implementation is gained. Regardless of the operational context (aerodrome size and complexity, traffic volume/density, the number of simultaneous aerodromes, etc.) described herein, the implementation of remote aerodrome ATS will depend upon a local safety assessment, in accordance with the procedures accepted by the relevant competent authority.

In this section, when discussing the results stemming from the SESAR JU programme, some phrases used by SESAR are frequently referred to and they should be understood as follows;

— 'basic and advanced features' is a division of technical enablers used by SESAR to validate different equipage levels (refer to Appendix 4 for a representative division between basic and advanced features);

— 'low density aerodromes'[19] are described by SESAR as aerodromes with typically a low capacity utilisation, where the prevailing traffic is mostly single aircraft movement operations, rarely reaching or exceeding two simultaneous aircraft movements per aerodrome;

— 'medium density aerodromes'[20] are described by SESAR as being aerodromes with typically a medium capacity utilisation, where simultaneous aircraft movement operations can be expected, frequently experiencing more than one aircraft movement simultaneously per aerodrome.

4.1. Single mode of operation

The remote provision of ATS for a single aerodrome (single mode of operation, see the definition in Section 2 and the overall description in Section 3.2) is, in principle, envisaged to have the potential to be implemented for aerodromes of all sizes and conditions. At the time of publication of this document, research and validations (three so-called SESAR solutions pertaining to the single mode of operation have been published[21]) as well as operational experiences (the single mode of operation is approved in one EASA Member State), support the single mode of operation up to a certain level of aerodrome size and complexity. Nevertheless, the following subsections lists aspects to be considered for the implementation of single mode of operation.

4.1.1. Traffic density under the single mode of operation

The traffic density is a factor for consideration when implementing remote aerodrome ATS (as is the case when building/upgrading a conventional tower). The single mode of operation category is not to be seen as limited to a certain traffic density level.

The traffic density is a factor that will drive the requirements for the visual presentation system and the binocular functionality, as well as the need for technical enablers (technical enablers related to the visual presentation and the binocular presentation as well as other technical enablers). For each

[19] This definition is derived from the SESAR JU programme publications related to remote aerodrome ATS. ICAO Annex 14 [17] defines aerodrome traffic density in a different manner and for different purposes. The definition contained in this document serves exclusively the purposes explained above.

[20] Ibid.

[21] Solution #71: ATC and AFIS service in a single low density aerodrome from a remote CWP,
Solution #12: Single remote tower operations for medium traffic volumes,
Solution #13: Remotely provided air traffic service for contingency situations at aerodromes.

implementation, the safety assessment should consider the traffic density related to the aerodrome when establishing the necessary functionalities of the system.

Validation results from the SESAR JU programme ([19], [20], [25] & [35]) indicate that, in the context of low density aerodromes, the basic features (as described by SESAR, see Appendix 4) are considered to be sufficient. For aerodromes where traffic density exceeds the low density characteristics (as described by SESAR) validation results have shown that the need for advanced features (as described by SESAR, see Appendix 4) may be increased. At the same time it is acknowledged that the quality of the visual presentation is important; with a high quality visual presentation the basic features (as described by SESAR, see Appendix 4) may still be sufficient.

Nevertheless, based on the indications provided by the SESAR validation results and depending on the visual performance quality of the visual presentation, the ATS provider is recommended to consider the advanced features (as described by SESAR, see Appendix 4), especially for medium density aerodromes (as described by SESAR) and beyond. However, if implementing such features, caution should be taken with regard to the potential dependency on information intended to maintain or reach a certain level of situational awareness or capacity. Appropriate fall-back and degraded mode procedures should be developed to handle system degradations.

4.1.2. Characteristics of the aerodrome's layout

The aerodrome layout is a factor for consideration when implementing remote aerodrome ATS (as is the case when building/upgrading a conventional tower). The single mode of operation category is not to be seen as limited to certain specific aerodrome layouts.

The aerodrome layout will drive the requirements for the visual presentation system and the binocular functionality and will affect the setup of the camera installations, e.g. if a single camera tower (possibly complemented with visual 'hot spot/gap filler' cameras) or a distributed camera installation should be implemented. (See chapters 5.2 and 5.3 for further discussions related to this topic.) Also, larger multiple runway aerodromes may negate the need for more than one conventional tower as the aerodrome expands (by introducing cameras and their (visual) presentation into the conventional tower). For each implementation, the safety assessment should consider the characteristics of the aerodrome layout when establishing the necessary functionalities of the system.

The validation exercises conducted in the framework of the SESAR JU programme ([25], [28], [29], [35], [36]) have so far mainly been conducted for aerodromes comprising non-complex layouts (typically one runway, one to three runway entrances per runway[22], one to four aprons), but also for aerodromes comprising more complex aerodrome layouts (e.g. two runways and complex taxiway layout).

4.1.3. Aerodrome switching under single mode of operation

The single mode of operation as described in this document also covers potential operational applications where the ATCO/AFISO switches service provision from one aerodrome to another aerodrome, without providing service to both (or more) at the same time.

4.1.4. Remote tower as backup facility

The remote aerodrome ATS concept could be used to support the ATS contingency arrangements for an aerodrome, as stipulated by ICAO Annex 11 Chapter 2.31[23] [16]. A remote tower could be used as a backup facility in case the conventional tower is not available, either for planned reasons such as

[22] Although here in this context described as increased aerodrome layout complexity, it should be noted that a low number of runway entries/exits can in fact lead to more complex operations. E.g., in case of only one entry/exit per runway, the need for backtracking will increase, leading to longer runway occupancy times.

[23] The first sentence of ICAO Annex 11 Chapter 2.31 is transposed into the EU regulatory framework by ATM/ANS.OR.A.070 of the ATM/ANS Common Requirements Regulation [4], the second sentence is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as ATS IR ATS.OR.135.

maintenance, or for unplanned reasons such as emergency outages. The rationale would be ATS continuity with a high level of retained safety, capacity and flexibility during contingency situations.

When implementing a backup facility based on the remote aerodrome ATS concept, it is recommended to define the required level of HMI commonality with respect to the conventional tower. Similarity to the CWPs and the ATCO/AFISO support tools provided in the conventional tower would reduce both the ATCO/AFISO familiarisation time during the transition into contingency phase as well as the need for recurrent contingency training. The use of new technical enablers should be carefully assessed. Although the introduction of such enablers has the potential to introduce operational benefits, this should be balanced against the disadvantages caused by introducing new tools and equipment which may not be available in the existing conventional tower, as well as by adding complexity to a backup facility (for which robustness would normally be a key factor).

With regard to the visual presentation of a remote tower used as a backup facility for a conventional tower, it would be beneficial to maximise the similarities with the out-the-window view of the conventional tower. On the other hand, the placement of camera(s) feeding the visual presentation will need careful consideration as it would not be advisable to install them on the conventional tower structure (as their purpose is to be used during an event which may have impacted the structure and the electrical/data infrastructure of the conventional tower building).

Another important aspect to consider for a backup implementation is the split of infrastructure (such as for communication, UPS, etc.). Depending on the desired robustness of the backup solution and system, it is recommended to consider and reduce the number of common cause failures as far as practically possible. An appropriate level, depending on a local assessment, should be assessed and defined.

Lastly, it is recommended to define the requirements on traffic complexity (mix of aircraft and vehicles etc.), capacity, duration of service and switchover time for the backup facility.

Contingency operations based on the remote aerodrome ATS concept have been studied in the framework of the SESAR JU programme ([21], [28], [29], [30], [31], [36]) and one related SESAR Solution has been published, see footnote 21 above.

4.2. Multiple mode of operation

The concept for remote provision of ATS for multiple aerodromes (multiple mode of operation) is less mature than the single mode of operation. SESAR has to date published one solution related to the multiple mode of operation[24]. Yet, at the time of publication of this document, no operational implementation of this concept category exists and subsequently no operational experience is available. However, implementation plans comprising the multiple mode of operation exist among Members States, hence operational implementation is likely in the near future (subject to operational approvals of the competent authorities).

The overarching recommendation with regard to multiple mode of operation (when provided by one ATCO/AFISO only) is that it should be used only when the operational circumstances so allows. It is the responsibility of the ATS provider to define the suitable operational circumstances, which require careful considerations, as well as to provide sufficient evidence for an acceptable level of safety (as is always the case).

Some further aspects to consider for the implementation of multiple mode of operation are provided in the subsections below.

[24] Solution #52: Remote tower for two low-density aerodromes.

4.2.1. Number and size of aerodromes in multiple mode of operation

The number and size of aerodromes to be combined in multiple mode of operation needs to be carefully assessed. Furthermore, not only the number of aerodromes, but also the selection of the appropriate combination of aerodromes considering operational aspects (such as traffic levels & complexity, meteorological conditions across the aerodromes, geographical locations, runway orientations, etc.) should be thoroughly considered when providing ATS via the multiple mode of operation category.

The results of the validation exercises performed so far in the framework of the SESAR JU programme ([32], [35], [37]) show that the multiple mode of operation can be applied for the simultaneous provision of ATS to two low density aerodromes (as described by SESAR) by a single ATCO/AFISO. The basic features (as described by SESAR, see Appendix 4) are deemed to be adequate for ATC and AFIS provision at these low density aerodromes, even though the level and flexibility of service provision can be improved through the use of advanced features (as described by SESAR, see Appendix 4). The required equipage would be dependent on e.g. traffic level and complexity (including mixture of aircraft and vehicles) as well as aerodrome layout and complexity, rather than the provision of ATS to multiple aerodromes (as opposed to single aerodromes). Similar to this, even though the SESAR solution targets 'two low density aerodromes', it should be noted that validation results have revealed that the total traffic level and complexity potentially has a greater impact on ATCO/AFISO workload than the number of aerodromes to which services are being provided (e.g. providing service to one aerodrome with a high traffic density and complexity could be more challenging than providing service to two aerodromes with a low traffic utilisation).

4.2.2. Simultaneous aircraft movements on different aerodromes

It is recommended that multiple mode of operation (when provided by one ATCO/AFISO only) is mainly used when certainty exists that, based on the available traffic schedule, the instances of simultaneous aircraft movements on the different aerodromes is minimal. When operational experience is gained or further research/validation results become available, this recommendation may further evolve.

Normal ATCO working practices will allow the levels of simultaneous aircraft movements between aerodromes to be kept manageable, through the use of existing procedures and own judgement (delaying incoming traffic or holding aircraft at one aerodrome on ground while a landing/take-off at the other is handled). However, it should be noted that AFISOs cannot use such procedures. However, some form of advanced planning between the RTM and the wider ATC network may help to smooth the flow, especially for IFR traffic.

The ATS provider should establish procedures to manage capacity peaks or high ATCO/AFISO workload for any other reason. For instance, when and how to open an additional position in the RTM, or when and how to split aerodromes into separate RTMs. All mechanisms implemented should be validated, approved (by the competent authority) and documented in the operations manual (as specified by COMMISSION IMPLEMENTING REGULATION (EU) No 1035/2011 [3] Annex I, Chapter 3.3 'Operations manuals')[25].

Results of the validation exercises performed in the framework of the SESAR JU programme (and available so far) ([32], [35], [37]) indicate that safety can be maintained to the same extent as current operations when remotely providing ATS to two low density aerodromes (as described by SESAR), <u>provided that instances of simultaneous aircraft movements are minimal</u>. Particularly useful guidance on handling simultaneous aircraft movements at different aerodromes is given in the report from the demonstrations/validations performed in Ireland [37].

[25] To be replaced from 2 January 2020 by COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [4], Annex III, Subpart B, ATM/ANS.OR.B035 'Operations manuals'.

4.2.3. Aerodrome switching under multiple mode of operation

The multiple mode of operation as described in this document may include operational applications where the ATCO/AFISO would switch or change service provision for aerodromes on a flexible basis. This may include the following possibilities;

— changing service provision for one (or several) aerodrome(s) to another aerodrome (e.g. if providing service to aerodromes A & B, change service provision to aerodromes A & C);

— adding aerodromes to be provided with service (e.g. if providing service to aerodromes A & B, change service provision to aerodromes A, B & C);

— closing or transferring service provision for one (or several aerodromes) (e.g. if providing service to aerodromes A, B & C, change service to aerodromes A & B).

This may also include the possibility of changing from a single mode of operation to a multiple mode of operation environment, or vice versa, by adding or closing/transferring aerodromes in the RTM (e.g. if providing service to aerodrome A, change service provision to aerodrome A & B, or vice versa).

4.2.4. Service provision in multiple mode of operation

Regarding the type of ATS provision, what has been validated for multiple mode of operation is the combination of aerodromes where the same service type is provided (e.g. ATC+ATC or AFIS+AFIS). Hence, no known experience exists and no related recommendations can be given at this point regarding mixed ATC and AFIS in multiple mode of operation.

4.2.5. Recommended implementation and transition steps

It is likely that multiple mode of operation will be implemented as part of an extension to an already existing single mode of operation implementation. This would facilitate the transition from a one-to-one operating method to a one-to-many operating method by first gaining operational experience of remote aerodrome ATS in a single mode of operation set-up. Therefore, such an approach is recommended. However, depending on the safety evaluation, this may not be a prerequisite for implementation.

4.2.6. Possible developments of multiple mode of operation

Even though, at the time of publication of this document, there is only one SESAR solution published related to multiple mode of operation, future research and validation activities as well as development of technology may potentially extend the possible operational context of multiple mode of operation. Such extensions could be related to the size and complexity of aerodromes as well as to the number of simultaneous aerodromes under multiple mode of operation. In this regard, it can be noted that validation activities comprising three simultaneous aerodromes have already been performed in the framework of the SESAR JU programme (as part of SESAR 1[26]) and that further such validation activities are planned for the continued SESAR activities (of SESAR 2020[27]). The number of simultaneous aerodromes to be provided with ATS from one RTM will ultimately be dependent on a number of factors, such as traffic levels and how the traffic schedule at each aerodrome intersects with the others, meteorological conditions at the aerodromes, technical configuration, support functions, etc. The foundation for such evolution will, however, be dependent on gained operational experiences and trust.

[26] SESAR 1 refers to the first part of the SESAR JU programme, which ran from 2008 to 2016.

[27] SESAR 2020 refers to the second part of the SESAR JU programme, which, building on SESAR 1, was started end 2016 and is planned to last until 2024.

4.3. Common aspects applicable to both single and multiple mode of operation

4.3.1. Airspace and traffic circuit characteristics

The airspace characteristics should be taken into consideration when implementing remote aerodrome ATS. This includes the airspace classification as well as traffic circuits, departure and arrival paths/sectors, VFR entry/exit points, VFR holding points, etc., as need be for the particular aerodrome.

4.3.2. Traffic characteristics

The type and characteristics of air traffic operating at an aerodrome with remote aerodrome ATS as well as the complexity and number of vehicles operating at the manoeuvring area is an important aspect to consider when implementing remote aerodrome ATS. Characteristics such as mix of aircraft, especially when IFR and VFR traffic is combined, and its equipage should also be taken into consideration.

4.3.3. Aerodrome environment

Since each aerodrome is unique and has its own characteristics regarding the surrounding topography, it is important to take into account the specific aspects that may affect the implementation of the concept, as would be the case also when implementing a new conventional tower at an aerodrome. Furthermore, the local wildlife characteristics are also a factor that should be considered for each aerodrome and implementation (e.g. the occurrence of animals/birds on and in the vicinity of the aerodrome and any bird/insect activity potentially affecting/blocking the optical sensors). In addition, aerodromes may be subject to environmental restrictions, which may also influence the implementation of remote aerodrome ATS and should be addressed accordingly.

4.3.4. Local weather characteristics

Local weather/climate factors are another critical aspect to take into account when assessing the impact that the implementation of the concept may have on the aerodrome operations and/or ATS provision. The location of the aerodrome, such as proximity to sea/lake/river, altitude over (or under) mean sea level, proximity to mountains etc., will typically have an effect on meteorological phenomena, which in turn may affect the ATS provision.

For low-visibility conditions, the use of technical enablers such as visual hot spot cameras, could be used to support situational awareness and local low-visibility procedures (as would also be a possibility for conventional tower operations.)

4.3.5. ATCO/AFISO's roles

The ATS provider should identify the particular configuration of the remote tower module and operating methods applied taking into consideration the operational application and the particular needs of the aerodrome(s). Nevertheless, the ATCO's/AFISO's ATS responsibilities should remain the same as if the service would be provided from a conventional tower.

5. Operational and system considerations

This Section addresses the operational and procedural needs and requirements, as well as the system and equipment aspects, to be considered for the implementation of remote aerodrome ATS.

ATCO/AFISO confidence and trust in the system is of vital importance for the implementation of remote aerodrome ATS. The human factors assessment (see Section 6.2) is fundamental to build this confidence and trust.

5.1. Remote aerodrome ATS procedural considerations

This subsection details recommendations identified with regard to procedures related to remote aerodrome ATS. Some of the recommendations are generic to remote aerodrome ATS, and some are specifically related to operations from an RTC.

— Introduction of remote aerodrome ATS should be transparent to airspace users (refer to paragraph 8.2 in Annex I of Regulation 1035/2011[28] [3].

— All formal interfaces with all stakeholders (as specified by COMMISSION IMPLEMENTING REGULATION (EU) No 1035/2011 [3] Annex I, Chapter 3.1)[29]) should be re-evaluated to include items that are unique to remote aerodrome ATS, especially with regard to the communication between the remote ATS unit and the aerodrome. Such formal interfaces should be documented in local agreements. The need for coordination between the ATS unit and the respective aerodrome – and related aspects – is specifically covered in Section 7.

— There might be cases where the ATS provider performs tasks which fall under the responsibility of the aerodrome operator. In case such tasks are to be continued to be performed by the ATS provider, following the introduction of remote aerodrome ATS, specific agreements between the ATS unit and the aerodrome operator should be in place.[30]

— Before initiating service provision, or before assuming responsibility for service provision, the ATCO/AFISO should be able to verify the status of the aerodrome (in terms of traffic, weather situation, etc.) and its related systems and a coordination and transfer of control of operational systems should take place when needed.

— When ATS is provided to several aerodromes from one RTC and those aerodromes could be expected to be used by airspace users as 'alternate aerodromes' for each other, the ATS provider should ensure appropriate measures to avoid a situation where the use of an 'alternate aerodrome' for a particular flight/aerodrome is not jeopardised. Particular care should be taken with regard to an RTC potentially being a single point of failure for aerodromes which otherwise would not be interdependent. (See also Section 9 for more on this aspect.)

— In today's conventional tower operations, operating methods and procedures can sometimes differ between aerodromes due to local variations and practices. When providing service to several aerodromes from an RTC, there is an opportunity to streamline and unify the operating methods and procedures for the aerodromes connected to the same RTC. This is also recommended as it would contribute to the overall improvement of uniformity of ATM services.

— In today's conventional tower operation there is often a lack of standardisation of systems and equipment between different aerodromes. CWPs and human machine interface (HMI) are often different from one conventional tower to another. In order to support flexibility within an RTC regarding aerodrome and RTM allocation as well as to reduce ATCO/AFISO training needs and to

[28] To be replaced from 2 January 2020 by ATM/ATS.OR.A.075 of COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [4], complemented by AMC1 ATM/ATS.OR.A.075(a) in Annex III to EASA ED Decision 2017/001/R [10]

[29] To be replaced from 2 January 2020 by COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [10], Annex III, Subpart B, ATM/ANS.OR.B005(f).

[30] For further details see chapter 7.

contribute to the overall improvement of uniformity of ATM services – when providing service to several aerodromes from an RTC – it is recommended to unify the RTMs within the RTC in terms of HMI and equipment to the extent possible taking into account the different aerodromes for which services are provided.

— When providing service to several aerodromes from an RTC, to support the flexibility of staff and RTM allocation between aerodromes, it is recommended that the RTC enables the transfer of responsibility of ATS for aerodromes between the RTMs within the RTC. If implemented, appropriate procedures for the transferring/merging/splitting of aerodromes between RTMs should be developed and documented. The service provision should be uninterrupted during transfer of responsibility between RTMs.

5.2. Visual presentation

A visual presentation constitutes the core element of remote provision of ATS to aerodromes as it replaces the OTW view of a conventional tower. It provides a presentation enabling the ATCO/AFISO to maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area. A visual presentation system will normally consist of a number of integrated elements, including sensors, data transmission links, data processing systems and situation displays.

The visual presentation may take different forms and designs depending on the specific technical solution. A common design used for implementations to date comprise a wide-angle display that presents a wide field-of-view image (similar to the OTW view obtained from a conventional tower) derived from a central location on the aerodrome (typically a ‘camera tower’ comprising one or several cameras). This design is commonly known as a ‘panorama’ or ‘panoramic’ view. (This ‘panorama’/‘panoramic’ view may also be supported by additional ‘hot spot/gap filler’ cameras as need be.) Another design that has emerged is the so-called ‘video wall’ view, where several sensors from various locations around the aerodrome are stitched together in a combined view, hence presenting different view images from different locations around the aerodrome in a combined manner on this ‘video wall’. This set-up using a distributed camera system may e.g. be fit for use at larger multiple runway aerodromes, to support situational awareness also when distances are large.

Regardless of the chosen technical solution, it is crucial that the visual presentation fulfils the regulatory requirements and the operational needs that exist on the service provision. These regulatory requirements and operational needs are described and discussed in subsection 5.2.1, 5.2.2, 5.2.3 and 5.2.4 below. It is acknowledged that the human vision/eye is very sophisticated and that it is not feasible nor possible to replicate the ATCO/AFISO visual performance obtained from an out-the-window view (refer to EUROCAE ED-240 [18]). This is also not key for the implementation of remote aerodrome ATS, instead what is key is to define specific operational requirements and ensuring that those operational requirements can be supported by the visual presentation system. A process for how to define (as well as how to verify) such requirements is described in EUROCAE ED-240 [18]. Based on the discussion in subsections 5.2.1, 5.2.2 and 5.2.3 below, the ATS provider may use the process described by ED-240 to define the local operational visual performance requirements (termed Detection and Recognition Range Performance (DRRP) requirements by ED-240).

It is recommended that the visual presentation is operationally validated against the perceived total image quality (not only against individual system parameters). Adopting such a validation approach will help to understand the operational benefits and shortcomings of a specific implementation. If short-comings are identified, they could be managed either by improving the technical system or by implementing appropriate operational procedures and mitigation means.

For the purpose of this document, it is assumed that the visual presentation is based on a **visible spectrum sensor-based solution** (where visual cameras capture the image at the aerodrome and the image is relayed to the ATCO's/AFISO's screens), possibly enhanced by optical sensors from the non-visible spectrum, such as thermal, infra-red etc.

As regards the differentiation between ATC provision and AFIS provision with respect to visual presentation, no significant differences that may affect the implementation of remote aerodrome ATS at a certain aerodrome have been identified. Instead, it is rather the traffic density and operational complexity (as opposed to the type of service, ATC/AFIS, provided) that should be considered when defining the exact operational and functional/technical requirements on the visual presentation (and the binocular functionality).

For recommendations related to interoperability, integrity and system availability regarding the visual presentation and the binocular functionality, refer to EUROCAE ED-240 [18].

5.2.1. Primary regulatory requirements

Chapter 7.1.1.2 of ICAO Doc 4444 (PANS-ATM)[31] [14] states that; '*Aerodrome controllers shall maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area. Watch shall be maintained by visual observation, augmented in low visibility conditions by an ATS surveillance system when available.*'

In addition, Part III, Section 2, Chapter 2.1.1 a) of ICAO Doc 9426 (ATS Planning Manual) [15] states that; '*the tower must permit the controller to survey those portions of the aerodrome and its vicinity over which he exercises control*'.

At the same time, Chapter 2.1.2 of the Doc 9426 (ATS Planning Manual) [15] states that; '*The most significant factors contributing to adequate visual surveillance are the siting of the tower and the height of the control tower cab. The optimum tower site will normally be as close as possible to the centre of the manoeuvring part of the aerodrome, provided that at the intended height, the tower structure itself does not become an obstruction or hazard to flight.*' – and Chapter 2.1.3 states that; '*The height of the tower should be such that, …the controller is provided with the visual surveillance previously described. The higher the tower, the more easily this optimum surveillance is attained, but at greater financial cost and with a greater likelihood of penetrating the obstacle limitation surfaces.*' As these guidelines provided by Doc 9426 may be valid in the case of a single centrally located camera tower installation at an aerodrome, they may on the other hand not be relevant in the case of a visual presentation system comprising several camera installations on various locations around the aerodrome.

This provides for an understanding of the overarching regulatory requirements directly affecting the visual presentation and can be formulated as follows:

The visual presentation – subject to the visibility conditions at the aerodrome and its vicinity as well as the topography of the surrounding terrain – **should enable the ATCO/AFISO to survey those portions of the aerodrome and its vicinity over which he/she exercises ATS and should enable the ATCO/AFISO to, within his/her area of responsibility, see:**

— **flight operations (aircraft[32]) in the vicinity of the aerodrome[33];**

— **flight operations (aircraft[32]) on the aerodrome;**

— **vehicles and personnel on the manoeuvring area[34].**

31 Chapter 7.1.1.2 of ICAO Doc 4444 (PANS-ATM) is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as AMC1 ATS.TR.205(c): (b)+(c).

32 Aircraft is defined in Doc 4444 [14] as: *'Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.'*

33 The vicinity of an aerodrome is defined in Doc 4444 [14] as: *'aircraft in, entering or leaving an aerodrome traffic circuit'*.

34 The manoeuvring area is defined in Doc 4444 [14] as: *'that part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons'*.

Note: *Different ATS/ATC roles (e.g. ground, air, apron (if applicable)) may affect the area of interest, therefore, the visual presentation may need to be tailored to support each specific role.*

The above should be seen as applicable in both daylight and darkness conditions (subject to the hours of operation of the ATS unit), however during darkness it is acknowledged that it may be difficult to see objects without their own light source.

5.2.2. Regulatory requirements indirectly related to the visual presentation

In addition to the abovementioned primary/direct regulatory requirements, there are some additional regulatory requirements on the service provision that may be indirectly applicable to the visual presentation (and the binocular functionality). For conventional tower operations, they are per default fulfilled as per the principle 'you see what you see'[35]. However, for the remote aerodrome ATS context, these requirements need to be considered. This chapter lists such relevant provisions of Doc 4444 PANS-ATM as well as Doc 9426 ATS Planning Manual.

ICAO Doc 4444 (PANS-ATM) Chapter 7.4.1.7[36] [14] states that; *'Whenever an abnormal configuration or condition of an aircraft, including conditions such as landing gear not extended or only partly extended, or unusual smoke emissions from any part of the aircraft, is observed by or reported to the aerodrome controller, the aircraft concerned shall be advised without delay.'* Also, ICAO Doc 4444 (PANS-ATM) Chapter 7.1.2.1[37] [14] details the aerodrome control towers responsibility and the circumstances for when to alert rescue and firefighting services.) Hence, it should be considered, as part of the local safety assessment, whether the visual presentation needs to enable the ATCO/AFISO to visually detect/recognise aircraft abnormal configurations or conditions, such as landing gear not or only partly extended or unusual smoke emissions from any part of the aircraft. (As the ICAO provisions states that this could likewise be reported to the aerodrome controller, this needs to be defined on the local implementation level.)

ICAO Doc 4444 (PANS-ATM) Chapter 7.1.1.1[38] [14] states that; *'Aerodrome control towers shall issue information and clearances to aircraft under their control to achieve a safe, orderly and expeditious flow of air traffic on and in the vicinity of an aerodrome with the object of preventing collision(s) between:* ***e)*** *aircraft on the manoeuvring area and obstructions on that area.*' Although ICAO provisions do not particularly state that an ATCO needs to visually see/detect obstructions (the existence of an obstruction could likewise be reported to the ATCO/AFISO), there is an expectation on the service that obstructions (of a certain size, up to a certain distance and subject to the visibility and daylight conditions) can be visually observed/detected by the ATCO/AFISO. Therefore, as part of the local implementation and safety assessment, it should be considered whether and to what extent the visual presentation needs to enable the ATCO/AFISO to visually detect/recognise obstructions on the manoeuvring area. Local operational requirements should be defined, taking into account size and distance of obstructions as well as under which daylight and meteorological conditions the requirements are to be valid.

[35] According to class 3 medical requirements.
[36] ICAO Doc 4444 (PANS-ATM) Chapter 7.4.1.7 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as AMC1 ATS.TR.305(a)(7): (a).
[37] ICAO Doc 4444 (PANS-ATM) Chapter 7.1.2.1 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as AMC1 ATS.TR.400(d).
[38] ICAO Doc 4444 (PANS-ATM) Chapter 7.1.1.1 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as AMC1 ATS.TR.205(c): (a).

ICAO Doc 4444 (PANS-ATM) Chapter 7.4.1.2.2[39] [14] states that *'prior to take-off aircraft shall be advised of:* ***b)*** *significant meteorological conditions[40] in the take-off and climb-out area, except when it is known that the information has already been received by the aircraft.'* Therefore, it should be considered whether the visual presentation needs to enable the ATCO/AFISO to visually observe some significant meteorological conditions in the take-off and climb-out area (subject the type of and distance to the significant weather, the daylight/darkness conditions as well as the meteorological visibility).

ICAO Doc 4444 (PANS-ATM) Chapter 12.3.4[41] [14] 'Phraseologies for use on and in the vicinity of the aerodrome' defines the following means of visual communication with aircraft:

— showing landing lights as a possible means for 'Identification of aircraft' (12.3.4.1[42]);

— moving ailerons (or rudder), rocking wings or flashing landing lights as a possible means for 'acknowledgement by visual means' (12.4.3.2[43]).

As a consequence, an implementer of remote provision of ATS should consider, as part of the local safety assessment, whether and to what extent this should form operational requirements driving the technical requirements of the implementation. As for a conventional tower, the fulfilment of such requirements will be dependent on the distance to the aircraft and on meteorological and daylight/darkness conditions.

5.2.3. Other operational needs

Although not particularly stated in regulations, there would be an expectation on the service provision that the ATCO/AFISO should be able to observe and follow up on changes in weather conditions (e.g. precipitation, showers, fog patches, clouds and e.g. the build-up of cumulonimbus) as would be feasible from a conventional tower. Therefore, the ATS provider may consider, as part of the local implementation and safety assessment, whether and to what extent the visual presentation should support the ATCO/AFISO to observe such weather condition observations.

5.2.4. Functional requirements

In addition to the regulatory requirements described above, factors related more directly to system performance should be considered when moving to a 'remote' environment, as such factors will affect the performance of the visual presentation and subsequently also the operational capabilities of the ATS unit.

The performance and usability of the visual presentation is a complex combination of many such system performance factors. Some factors found to be particularly critical for the ATCO/AFISO ability to perform the ATS are discussed below, but as indicated under Section 5.2.4.5 'Other image quality factors', they are not the only affecting factors. Because of this complexity, as already mentioned under Section 5.2, the visual presentation is recommended to be operationally validated against the perceived total image quality, rather than against specific image quality factors.

[39] ICAO Doc 4444 (PANS-ATM) Chapter 7.4.1.2.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as AMC12 ATS.TR.210(a)(3): (b)(2).

[40] In a note to Chapter 7.4.1.2.2, Doc 4444 [14] describes: *'Significant meteorological conditions in this context include the occurrence or expected occurrence of cumulonimbus or thunderstorm, moderate or severe turbulence, wind shear, hail, moderate or severe icing, severe squall line, freezing precipitation, severe mountain waves, sandstorm, duststorm, blowing snow, tornado or waterspout in the take-off and climb-out area.'*

[41] ICAO Doc 4444 (PANS-ATM) Chapter 12.3.4 is transposed into the EU regulatory framework as 1.4 of AMC1 SERA.14001 General (in Appendix 1 of Annex to ED Decision 2016/023/R 'Acceptable Means of Compliance and Guidance Material to the rules of the air' [11]).

[42] Covered in the EU regulatory framework by 1.4.1 of AMC1 SERA.14001 General [11].

[43] Covered in the EU regulatory framework by 1.4.2 of AMC1 SERA.14001 General [11].

5.2.4.1 Visual presentation setup and layout

The visual presentation should be designed to avoid unnecessary discontinuities or non-uniformities of the presented view. Existing discontinuities and non-uniformities should be clearly indicated so as to avoid misleading impressions of the observed area. For the case of seams/joints in the visual presentation, they should, as far as possible, be avoided at operational 'hot spot' areas such as holding positions, RWY entrance/exits etc. If not possible to avoid, mitigation measures should be considered, such as a hot spot camera providing an unobscured/unbroken view (or a predefined 'quick access' position for the binocular functionality).

This recommendation can be seen as related to the guidelines provided in Chapter 2.1.4 of Doc 9426 (ATS Planning Manual) [15], stating that; *'Vertical supports for the cab roof should be kept to the smallest feasible diameter so as to minimize their obstruction of the controller's view. The supports should also be as few as possible…'.* A difference with regard to the *'vertical supports for the cab roof'* of a conventional tower compared to the frames/joints between cameras/screens in visual presentation, is that the vertical supports are actually blocking the view, whereas the frames/joints in a visual presentation is probably not blocking any part of the view, but rather just separating the images. Even so, it is recommended to minimise the number of seams/joints (e.g. between screens) in the visual presentation, and if existing, to keep them to the smallest feasible width (e.g. by using screens with narrow frames/borders). Also, the risk of potential loss of information between images (e.g. when combining images from different sensors) should be thoroughly assessed as part of the implementation, and if such information loss can be detected, appropriate mitigation means should be introduced. A factor to take into account in this regard is the natural system degradation that may occur over time. E.g., even if there is no occurrence of information loss when the system is new and recently installed, weather and natural wear may affect the equipment and its configuration resulting in a potential loss of information over time. If this is regarded as a potential risk factor for a particular implementation, it is recommended that regular checks are introduced as part of the overall maintenance programme.

5.2.4.2 End-to-end delay/video latency

One critical parameter is the time delay between image/data capture and presentation to the ATCO/AFISO on the visual presentation, the so-called **end-to-end delay** (also known as video latency)**.** The maximum allowable end-to-end delay should be determined by the local safety assessment, with the aim that it should not negatively affect the ATCO's/AFISO's ability to perform the ATS. The exact figure should be derived from operational needs taking into account the local conditions of the operational context.

It is recommended that this value is as low and constant as possible. Long delays will undoubtedly negatively affect the ATCO's/AFISO's situational awareness, with a potential safety impact. The ATS provider should demonstrate that the end-to-end delay does not exceed the established maximum end-to-end delay value.

Note: *EUROCAE ED-240 [18] (REQ 01) stipulates a maximum end-to-end delay of 1 second for the visual presentation.*

Note: *Validation activities performed so far (and known to EASA) have indicated a recommended maximum end-to-end delay to be 1 second (refer to SESAR OSED [23] (REQ-06.09.03-OSED-VC03.1105) & SESAR Technical Specification [24] (REQ-12.04.07-TS-0110.0007)), however, this should be seen in the context of the specific conditions (operational and technical) that were validated and hence should may not be universally fit for purpose. The visual presentation end-to-end delay is therefore recommended to be evaluated and defined for each implementation.*

5.2.4.3 Video update rate

The fidelity of the visual presentation presented to the ATCO/AFISO also depends on the video update rate (also known as 'frame rate'), defined as the number of times per second the visual presentation is updated. The video update rate primarily affects the following operational aspects of the presented image:

— the appearance of moving objects (such as aircraft or vehicles), i.e. if a smooth and regular impression to the human eye is provided;

— the ability to detect acceleration/deceleration/direction changes (i.e. turns) of objects capable of movement;

— the capability to detect and monitor flashing/rotating objects (such as runway guard lights (RGL), aircraft strobe lights, emergency vehicles sirens or rotating propellers/rotors).

The appropriate video update rate should be determined by the safety assessment taking into account the operational context in order to ensure an adequate presentation of moving objects to the ATCO/AFISO and assessing whether there is an operational need to see flashing/rotating objects, e.g. flashing lights.

Note: *For further considerations with regard to video update rate, refer to EUROCAE ED-240 [18] (REQ 03).*

Note: *Validation activities performed so far (and known to EASA) have indicated a recommended video update rate to be 30 frames per second (refer to SESAR OSED [23] (REQ-06.09.03-OSED-VC03.1104) & SESAR Technical Specification [24] (REQ-12.04.07-TS-0110.0006)), however, this should be seen in the context of the specific conditions (operational and technical) that were validated and hence may not be universally fit for purpose. It is also acknowledged that defining a recommended video update rate is complex due to the capabilities and nature of the human eye, the influence of motion blur and due to inherent dependency of many system parameters (e.g. contrast, video compression, bandwidth, codex) (refer to ED-240 [18]). The video update rate is therefore recommended to be evaluated and defined for each implementation*.

5.2.4.4 Difference in daylight/darkness perception

If there is a difference in the perception of daylight/darkness conditions between the visual presentation and the reality, the ATCO/AFISO should have access to information about the current daylight/dusk/darkness/dawn condition at the remote aerodrome as well as the expected time for the transitioning between these phases. Validation experiences have shown that the visual presentation of some technical platforms may present the remote operating environment brighter compared to the real world conditions during dusk and dawn, prolonging the experience of daylight and enabling the ATCO/AFISO to see occurrences which are not possible to see in real life due to darkness conditions. Although this can be seen as a benefit from the situational awareness perspective, it could also be considered as a disadvantage as it may impose new operational risks. It may be difficult for the ATCO/AFISO to judge when darkness has occurred, potentially leading to incorrect service provision, e.g. not detecting when landing lights should be turned on or overestimating pilots' ability to see during dusk/dawn/darkness conditions. If this is the case for a particular implementation, a mitigation should be put in place (which, in its simplest form, could be a basic table of the sunrise/sunset times, but could also be a technical solution that provides and supports the ATCO/AFISO with this kind of information and related decision support).

5.2.4.5 Other image quality factors

In addition to the aforementioned factors, there are also other image quality factors which will affect the quality of the visual presentation, potentially impacting the ATCO/AFISO ability to effectively provide ATS. Such factors may be (but should not be seen as limited to); sensor resolution, display resolution, image uniformity, sharpness, contrast, colour depth, video compression, bandwidth and network related issues, etc.. (For a further elaborated description of such aspects, refer to EUROCAE ED-240 [18].)

5.2.4.6 Environmental protection

Local weather and climate conditions at the aerodrome where the services are provided, lighting conditions, animal interference on cameras/sensors (e.g. insects, birds) etc., may affect and degrade the performance of the visual presentation (and the binocular functionality). In order to avoid negative effects on the ATCO's/AFISO's ability to provide the ATS, the visual presentation system should include (as applicable, depending on the selected technical solution) the means to reduce the impact caused by; animals (e.g. insects, birds), variable light conditions across the field of view, counter-light effects, e.g. glare from direct sunlight, precipitation (e.g. rain, snow, hail), condensation, icing, winds, or any other weather phenomena as applicable to the local conditions at the aerodrome.

5.2.4.7 Failure detection

In order to fulfil ICAO Doc 4444 [14] Chapter 4.14[44] 'Failure or irregularity of systems and equipment' as well as Chapter 7.1.3 'Failure or irregularity of aids and equipment', the remote tower system should enable the ATCO/AFISO to detect any failure or irregularity which could adversely affect the safety or efficiency of flight operations and/or the provision of ATS, such as corrupt, delayed (beyond the defined maximum end-to-end delay value) or frozen image of the visual presentation.

5.2.5. Technical enablers for increased situational awareness

The visual presentation may include tools and functionalities aiming at increasing the ATCO/AFISO situational awareness and enabling the ATCO/AFISO to increase the time spent for 'looking out the windows'.

Such tools/functionalities will typically be of two different types/categories:

— Additional sensors at the aerodrome (and presented to the ATCO/AFISO), that may improve the visual range:

  - Additional visual 'hot spot/gap filler' cameras, enabling the ATCO/AFISO to get a closer view of specific areas of interest as well as improving visual range in low visibility condition – covering distant or obscured parts of the aerodrome or particularly operational critical areas such as holding points for determination of runway clearance.
  - Optical cameras of the non-visible spectrum, such as thermal or infra-red, improving visibility primarily during hours of darkness.

— Digitally overlaid information in the visual presentation, such as:

  - Overlaid symbols and labels associated with and highlighting objects capable of movement and relevant for the service provision, such as aircraft, vehicles, personnel, obstructions or animals/birds on the manoeuvring area and in the vicinity of the aerodrome. (Objects not relevant for the service provision would include e.g. vehicles outside of the aerodrome premises.) Such symbols and labels can be based on:

[44] ICAO Doc 4444 Chapter 4.14 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as ATS IR ATS.OR.140.

  - visual information from optical sensors, i.e. system detection of moving objects (including also non-cooperative targets) in the visual field of view (commonly referred to as 'visual tracking'[45]);
  - surveillance information from ATS surveillance sensors such as radars, ADS-B etc., targeting primarily cooperative targets (commonly referred to as 'radar tracking');
  - or a combination of the two above.
- Overlaid framings/symbols to indicate/highlight specific parts of the aerodrome, such as framing of runways, taxiways etc., in order to enhance the ATCO/AFISO situational awareness, specifically in darkness and during low visibility conditions.
- Overlaid added information relevant to the service provision. Instances of element classes may include:
  - geographic: cardinal/compass directions;
  - meteorological: e.g. wind direction and speed (e.g. instant, 2 min average, 10 min average), QNH, temperature, visibility (e.g. RVR values), object markings to support distance judgement, MET REPORT, METAR, TAF;
  - operational/AIP and service related: runway/taxiway/apron designators, visual reminders such as 'RWY blocked' markings to aid with runway incursion prevention, aerodrome assets/systems status such as lighting, clock, checklists etc.
- System support using a video data processing system to help the ATCO/AFISO detect smaller FOD, highlighting the existence of such small objects in the visual presentation to attract attention (objects which else would be difficult to detect).

Considerations when implementing visual presentation technical enablers

When found beneficial (refer to the guidance given in Sections 4.1.1, 4.1.4 and 4.2.1), the ATS provider may evaluate the possibility of complementing the visual presentation with the tools and functionalities such as the ones described above. The ATS provider should conduct an in-depth evaluation of such technical enablers, including the necessary validation activities and human factors assessment, as part of the corresponding safety assessment of the local implementation.

When implementing additional sensors intended to improve the visual range, care should be taken to mitigate the potential risk induced by ATCOs/AFISOs having a different perception of visibility compared to pilots (e.g. the ATCO/AFISO might 'forget' that the pilot operates in a reduced horizontal visibility if he/she sees the aerodrome clearly).

When implementing overlaid information in the visual presentation, care should be taken about the potential unintended loss of such information and the associated risks that may arise as a consequence. E.g., one risk may arise from introducing a dependency on certain functions/tools to achieve a certain level of situational awareness. Appropriate degraded mode procedures should be developed to handle such situations.

Furthermore, if any digitally overlaid information is implemented in the visual presentation, it is strongly recommended that all such overlaid information is possible to toggle on/off as well as to adjust in light intensity by the ATCO/AFISO. (The reasons e.g. being; avoiding potential blocking of important visual information, avoiding ATCO/AFISO information overload, possibility to adapt to light

[45] At the time of publication of this document, EUROCAE working group 'Remote and Virtual Tower' (WG-100) is developing ED-240A, an extension to ED-240 'Minimum Aviation System Performance Specification (MASPS) for Remote Tower Optical Systems' [18], to include remote tower optical target tracking technologies. Expected publication of ED-240A is end 2018. EUROCAE WG-100 currently uses the term 'optical sensor based object augmentation' synonymously with the term 'visual tracking'.

conditions at the aerodrome (avoiding ATCO/AFISO distraction/dazzling during darkness/night time operations)).

5.3. Binocular functionality

A binocular functionality (e.g. a Pan-Tilt-Zoom camera/function, as defined and described in ED-240 [18]) emulate the function of a binocular in a conventional tower, by allowing the ATCO/AFISO to have a close-up view of a specific location or object. As such, it fulfils ICAO Doc 9426 ATS Planning Manual [15] (PART III, Section 2, Chapter 2 'Specific Requirements for an Aerodrome Control Tower'), listing binoculars as a recommended equipment in an aerodrome control tower.

This functionality is considered additional to the overall visual presentation, enabling the ATCO/AFISO whenever necessary to look at certain objects/occurrences in the area of interest more closely (e.g. engine on fire, landing gear extended, RWY condition/objects on RWY, etc.). The view from the binocular functionality may be presented within the visual presentation display (e.g. as 'picture-in-picture') or on separate screens/displays. When the RTM comprises several separate roles/CWPs (typically for larger aerodromes), the use of independent binocular functionalities and their independent presentation for each role/CWP should be considered (to avoid distraction between the ATCOs/AFISOs).

The binocular functionality should be simple, quick, and easy to use, not considerably increasing the time needed to perform the same/similar tasks as when performed with manually operated binoculars in a conventional tower. As a recommended minimum, the binocular functionality should include a fixed optical zoom feature with a visual indication of the direction of bore sight, but may also feature a moveable/adjustable zoom feature, preferably by the means of optical zoom (as opposed to digital zoom).

In order to increase its usability, the binocular functionality may also include functionalities such as:

— predefined and user-definable positions (automatic functions including zoom, pan-and-tilt and focus) enabling the ATCO/AFISO to quickly jump to frequently recurring areas of interest (e.g. waypoints, thresholds, etc.);

— predefined and user-definable automatic scanning patterns, such as runway sweeps (including the option to pause or stop the scan to be able to check detected objects), supporting the ATCO/AFISO to perform tasks such as scanning the runway;

— automatic following of moving objects (e.g. aircraft, vehicles, personnel, animals), assisting the ATCO/AFISO to follow relevant moving objects of interest;

— optical sensor(s) from the non-visual spectrum, such as infra-red.

The presentation/image provided by the binocular functionality should fulfil the same performance requirements (e.g. end-to-end delay, video update rate) as determined for the visual presentation. The image quality (image sharpness, magnification, contrast, etc.) should be sufficient to support the related ATCO/AFISO tasks.

It is recommended that the ATS provider conducts an evaluation of the operational needs and the requested/needed functionalities of the binocular functionality, as part of the local safety assessment. The required visual performance of the binocular functionality should be defined based on the local operational needs. A process for how to define (as well as how to verify) such visual performance requirements is described in EUROCAE ED-240 [18]. Based on the discussion on primary and indirect regulatory requirements in Sections 5.2.1 and 5.2.2 above, as well as the discussion on 'other operational needs' in Section 5.2.3, the ATS provider may use the process described by ED-240 to define the local operational visual performance requirements (termed Detection and Recognition Range Performance (DRRP) requirements by ED-240). For recommended requirements on control latency and (camera) movement speed performances, refer to EUROCAE ED-240 [18] (REQ 05 to 09)].

If the binocular functionality is planned to be utilised as a mitigation mean for (partial or full) loss of visual presentation, this added dependency should be accounted for when developing availability requirements on the binocular functionality.

***Note:** EUROCAE ED-240 [18] (REQ 02 & REQ 05)] stipulates a maximum end-to-end delay/video latency of 750 milliseconds, to be combined with a control latency of 250 milliseconds, which in sum determines the maximum round-trip delay for the binocular functionality.*

5.4. Signalling lamp

In accordance with ICAO Annex 14 Volume I [17] Chapter 5.1.3[46], the remote tower infrastructure should allow the ATCO/AFISO to communicate via a signalling lamp (e.g. in the case of radiotelephony or data link communication failure).

In order to enable the ATCO/AFISO to communicate via the signalling lamp, it would be required to have remote command capabilities of the signalling lamp from the remote tower. For this purpose, the means of directing the signalling lamp towards the applicable aircraft/vehicle/personnel may be combined with the binocular functionality. The remote tower system should have the means to ensure that the remote command of the signalling lamp is effectively performed and the means for the ATCO/AFISO to detect any potential failure in its functionality. The location (at the aerodrome) should also be published in the AIP, so that pilots know from where to expect the signals.

The remote operation of the signalling lamp might be subject to delays due to communication latency from the remote facility to the aerodrome infrastructure. The maximum allowable delay should be determined by the local safety assessment taking into account the operational context in order to ensure the ATCO's/AFISO's ability to act timely.

5.5. Aerodrome sound

In order to increase situational awareness as well as to create a greater sense of presence (despite potentially not being physically present at the aerodrome), a functionality that captures the surrounding aerodrome sound and relays it to the ATCO/AFISO could be introduced. Such functionality has shown to be valuable particularly for smaller aerodromes where sound could play an important role in the ATCO's/AFISO's job, attracting his/her attention to arising occurrences. It can also increase situational awareness during low visibility conditions as well as during emergency situations and it may also support weather perception. Hence, an aerodrome sound reproduction functionality could be an important and valuable stimulus for building up the total ATCO/AFISO situational awareness.

On the other hand, today's practice at many conventional towers is to minimise or even suppress surrounding aerodrome sound by sound insulating the tower cab/building. This may e.g. be the case for larger aerodromes with a high traffic density or for aerodromes where the traffic constitutes particularly loud aircraft operations such as military jet fighters. Therefore, the need for an aerodrome sound reproduction functionality should be assessed as part of the local safety assessment, taking into account the particulates of the operational context.

If implemented, the volume should be adjustable and possible to turn off by the ATCO/AFISO. This possibility would support the needs of individual ATCOs/AFISOs to minimise disturbing background noise when/if needed.

Further to this, a maximum allowable end-to-end delay for the aerodrome sound should be determined by the local safety assessment, taking into account the corresponding end-to-end delay of the visual presentation and a possible synchronisation with the same.

[46] ICAO Annex 14 Volume I Chapter 5.1.3 is transposed into the EU regulatory framework as CS ADR-DSN.K.500 (of the Annex to ED Decision 2016/027/R [12] 'Issuing Certification Specifications and Guidance Material for Aerodrome Design (CS ADR-DSN – Issue 3)'.

5.6. Communications

The communication for the 'aeronautical mobile service', 'aeronautical fixed service' and 'surface movement control service' may in the remote tower context be affected as described in the text below.

The remote tower infrastructure should enable the ATCO/AFISO to establish voice/data link communication detailed below.

— **Aeronautical mobile service** (air–ground communications) in the area of responsibility, in accordance with ICAO Annex 11 [16] Chapter 6.1[47].

— **Aeronautical Fixed Service** (ground–ground communications) in the area of responsibility, in accordance with ICAO Annex 11 [16] Chapter 6.2[48].

According to ICAO Annex 11 Chapter 6.2, an aerodrome control tower '*shall be connected to; the flight information centre, the area control centre and the approach control unit* and *shall have facilities for communications with the associated air traffic services reporting office, when separately established, and to the following units providing a service within* the *area of responsibility; appropriate military units, rescue and emergency services (including ambulance, fire, etc.), the meteorological office serving the unit concerned, the aeronautical telecommunications station serving the unit concerned, the unit providing apron management service, when separately established.*

In addition to the communication with the units and entities prescribed by ICAO Annex 11 Chapter 6.2 (as listed above), the remote tower infrastructure should also enable the ATCO/AFISO to establish voice/data link communication with aerodrome personnel and/or any other entities as need be for the coordination and communication between the remote ATS unit and the aerodrome (and as documented in local agreements, see Sections 5.1 and 7).

— **Surface movement control service** (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled[49] aerodromes) in the area of responsibility, in accordance with ICAO Annex 11 [16] Chapter 6.3[50].

'Aeronautical mobile service' and 'surface movement control service' are typically established through the local radio equipment at the aerodrome. For remote aerodrome ATS, the RTC/RTM might need a dedicated connection (e.g. through WAN) to the local radio equipment at the aerodrome. This remote command of the aerodrome radio equipment might be subject to delays due to communication link latency. The maximum allowable delay should be determined by the safety assessment taking into account the operational context in order to ensure timely communication between the ATCO/AFISO and aircraft as well as vehicles.

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[47] ICAO Annex 11 Chapter 6.1 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.400(a), GM1 ATS.OR.405, ATS IR ATS.OR.400(c), ATS IR ATS.OR.460(a)(1), ATS IR ATS.OR.410(a), GM1 ATS.OR.410(a), ATS IR ATS.OR.415, AMC1 ATS.OR.415, GM1 ATS.OR.415, ATS IR ATS.OR.420(a), ATS IR ATS.4R.420(b), ATS IR ATS.OR.425(a), ATS IR ATS.OR.425(b).

[48] ICAO Annex 11 Chapter 6.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.430(a), GM1 ATS.OR.430(a), ATS IR ATS.OR.435(a)(1), ATS IR ATS.OR.435(a)(2), ATS IR ATS.OR.435(a)(3), ATS IR ATS.OR.435(a)(4), ATS IR ATS.OR.435(b)(1), ATS IR ATS.OR.435(b)(2), ATS IR ATS.OR.435(b)(3), ATS IR ATS.OR.435(c)(1), ATS IR ATS.OR.435(c)(2), ATS IR ATS.OR.435(c)(3), GM1 ATS.OR.435(a);(b), ATS IR ATS.OR.435(c)(4), ATS IR ATS.OR.435(c)(5), ATS.OR.460(a)(2), ATS IR ATS.OR.440(a), ATS IR ATS.OR.440(a), ATS IR ATS.OR.440(b), ATS IR ATS.TR.440(c), ATS IR ATS.OR.440(c), ATS IR ATS.OR.440(d), GM1 ATS.OR.440(d), ATS IR ATS.OR.440(e), ATS IR ATS.OR.440(f), ATS IR ATS.OR.440(g), ATS IR ATS.OR.460(a)(3), ATS IR ATS.OR.445.

[49] This could also be applicable for AFIS aerodromes.

[50] ICAO Annex 11 Chapter 6.3 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.450(a), ATS IR ATS.OR.450(b) and (c), ATS IR ATS.OR.460(a)(4).

Also, for backup or emergency radio systems (refer to ICAO Doc 4444 [14] Chapter 8.3.1), a dedicated and independent backup connection between the aerodrome and the remote facility will be required. Standard fall-back solutions, such as handheld radios used in a conventional tower, may not be applicable in the remote tower scenario due to coverage limitations.

5.7. Voice and data recording

ICAO Annex 11 [16] Chapter 6 specifies recording requirements for aeronautical mobile service (air-ground communications) (Chapters 6.1.1.3[51] & 6.1.1.4[52]), aeronautical fixed service (ground-ground communications) (Chapters 6.2.2.3.3[53], 6.2.2.3.7[54] & 6.2.2.3.8[55]), surface movement control service (Chapters 6.3.1.2[56] & 6.3.1.3[57]) and aeronautical radio navigation service (Chapter 6.4.1[58]).

For the particular case of remote aerodrome ATS, the recording functionality should be extended to include systems data that is specific to remote tower operations, such as the visual presentation data, the binocular functionality data and the aerodromes sound data. As a minimum, the data presented to the ATCO/AFISO (i.e. the processed data presented to and used by the ATCO/AFISO as support in her/his decision making, including both the view of the aerodrome and its vicinity as well as any overlaid data/information/decision support), should be recorded and retained to support an effective accident and incident investigation. In addition, the sensor data (i.e. the raw data recorded by the sensors) may also be recorded to further support accident and incident investigation. It should be noted that integrity issues may result from the recording and retention of optical/video/sound data from public spaces (which could be the case for an aerodrome, depending on the national legislation). Such integrity and privacy issues are different from state to state depending on national integrity and surveillance legislation. The exact requirements for the recording and retention of this data (e.g. what data to be recorded and the time/number of days that the data is to be retained) should therefore be determined and specified by the competent authority, taking into account the aspects described herein.

5.8. Meteorological information

The presentation of meteorological information to the ATCO/AFISO may in the remote tower context be affected by the need for additional data transmission links.

The remote tower infrastructure should support and provide:

— presentation of meteorological information in accordance with ICAO Annex 11 [16] Chapter 7.1.4[59] and ICAO Doc 4444 [14] Chapter 7.4.1.2[60]*)*;

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[51] ICAO Annex 11 Chapter 6.1.1.3 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as;ATS IR ATS.OR.400(c).

[52] ICAO Annex 11 Chapter 6.1.1.4 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS.OR.460(a)(1).

[53] ICAO Annex 11 Chapter 6.2.2.3.3 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.435(c)(3).

[54] ICAO Annex 11 Chapter 6.2.2.3.7 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as;ATS IR ATS.OR.435(c)(5).

[55] ICAO Annex 11 Chapter 6.2.2.3.8 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.460(a)(2).

[56] ICAO Annex 11 Chapter 6.3.1.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.450(b) and (c).

[57] ICAO Annex 11 Chapter 6.3.1.3 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.460(a)(4).

[58] ICAO Annex 11 Chapter 6.4.1 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.455, ATS IR ATS.OR.460(a)(5).

[59] ICAO Annex 11 Chapter 7.1.4 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS.OR.515.

[60] ICAO Doc 4444 Chapter 7.4.1.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; AMC12 ATS.TR.210(a)(3) & GM1 to AMC12 ATS.TR.210(a)(3).

— access to relevant meteorological information in accordance with requirement MET.OR.242(a) of commission implementing regulation (EU) 2017/373 [4].

5.9. Management of aerodrome assets

5.9.1. Aeronautical ground lights

The remote tower infrastructure should enable the ATCO/AFISO to operate and monitor aeronautical ground lights, in accordance with ICAO Doc 4444 [14] Chapter 7.15[61]. (Such lights comprise e.g.; approach lighting, runway lighting, stopway lighting, taxiway lighting, stop bars, obstacle lighting.)

The implementation of this function should provide the means to ensure that this remote operation is effectively performed.

Furthermore, ICAO Annex 14 Volume I [17] chapter 8.3.2[62] stipulates that *'Where lighting systems are used for aircraft control purposes, such systems shall be monitored automatically so as to provide an indication of any fault which may affect the control functions. This information shall be automatically relayed to the air traffic services unit.'.* The remote tower infrastructure should support such automatic information relay, according to the recommendations given chapter 8.3 of ICAO Annex 14 Volume I, whenever necessary subject to the needs of the particular aerodrome.

5.9.2. Management of navigation aids

According to ICAO Annex 11 Chapter 7.3[63] [16], the *ATS units shall be kept currently informed of the operational status of radio navigation services and visual aids essential for take-off, departure, approach and landing procedures within their area of responsibility and of those radio navigation services and visual aids essential for surface movement*. In the remote tower system, the information about the status of these radio navigation services and visual aids should be collected and presented to the ATCO/AFISO. The remote tower should ensure that the integrity of this information is preserved throughout this process. If the ATS unit is tasked to also operate any such radio navigation services or visual aids, the remote tower infrastructure should offer the means to ensure that its operation can be effectively performed, and should also offer the means for the ATCO/AFISO to detect any potential failure in this operation. This information and operation may require the use of a data network (e.g. WAN).

5.9.3. Alerting service and alarm management

ICAO Doc 4444 Chapter 7.1.2.2[64] [14] stipulates that *'Procedures concerning the alerting of the rescue and fire fighting services shall be contained in local instructions. Such instructions shall specify the type of information to be provided to the rescue and fire fighting services, including..'.* If such procedures include e.g. the monitoring and triggering of accident, incident and distress alarms, the remote tower infrastructure should support the need to remotely manage the corresponding alarms as applicable to the aerodrome.

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[61] ICAO Doc 4444 Chapter 7.15 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS.TR.155, AMC1 ATS.TR.155, GM1 to AMC1 ATS.TR.155.

[62] ICAO Annex 14 Volume I Chapter 8.3.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ADR-DSN.S.890 (of the Annex to ED Decision 2016/027/R 'Issuing Certification Specifications and Guidance Material for Aerodrome Design (CS ADR-DSN – Issue 3)').

[63] ICAO Annex 11 Chapter 7.3 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS IR ATS.OR.525(a), ATS IR ATS.OR.525(b), GM1 ATS.OR.525.

[64] ICAO Doc 4444 Chapter 7.1.2.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as follows; the first sentence considered transposed as ATS IR in ATS.TR.4001 by the introduction of 'in accordance with local instructions' in point (d), the second sentence is transposed as AMC2 ATS.TR.400(d).

Additionally, to support ICAO Doc 4444 chapter 7.1.2.1[65] [14], the remote tower system should ensure that relevant aerodrome service/personnel can contact the ATCO/AFISO, in order to inform them whenever: '*a) an aircraft accident has occurred on or in the vicinity of the aerodrome*'; or '*b)*' when *'..the safety of an aircraft…may have or has been impaired';* or *'d) when otherwise deemed necessary or desirable'.* (See also Sections 5.1 and 5.6.)

5.9.4. Management of other aerodrome assets

Even though not specifically regulated, the remote tower infrastructure may need to consider the monitoring and manoeuvring of (other) aerodrome related assets such as; vehicle traffic lights, gates or bars, arresting cables/barriers or runoff nets, activation of anti-bird guns/systems, etc., according to the specific needs of the particular aerodrome. As the monitoring and manoeuvring of such assets are not ATS tasks, their implementation and related procedures should be specified in local agreements between the aerodrome and the ATS unit.

5.10. RTC/RTM–aerodrome communication aspects

Remote aerodrome ATS relies on data communications as a critical enabler. E.g. the visual presentation, aeronautical mobile service and surface movement control service voice communication, as well as monitoring and manoeuvring of systems/equipment on the aerodrome (e.g. camera management, aerodrome lights and navigation/landing systems) rely on the communication link between the remote facility and the aerodrome.

It is therefore essential that the ATS provider takes the communication network into account when designing the technical architecture, including the identification of **redundancy needs**. When the ATS provider relies on third-party providers (e.g. network or telecom service providers), it should ensure that the appropriate safety requirements are incorporated into the Service Level Agreements (SLAs) with such third-party providers, and that the quality assurance processes can verify that such services are provided in accordance with the applicable requirements, standards and procedures.

5.11. Technical supervision

Remote aerodrome ATS is based on a distributed infrastructure comprising system components on the aerodrome as well as in the remote tower facility, which may be located away from the aerodrome. The infrastructure also includes data communication connecting the involved sites. The ATS provision is dependent on a high level of availability of the technical system.

The system and its constituents should include monitoring functions that continuously monitors the technical status and provide:

— **Presentation of the technical status:** Indication of system availability by acquiring, synthesising and displaying the technical and functional status of the system and its constituents.

— **Failure detection:** Generate alarms and warnings when failures have been detected.

— **Support for analysis of the detected failure:** Classify the severity of the failure and make recorded technical data related to the failure available.

— **Proposed actions and help function:** Propose appropriate failure correction actions based on the available data.

— **Log technical data:** Record data related to the failures for post processing in support of safety procedures, system development and history of events.

[65] ICAO Doc 4444 chapter 7.1.2.1 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; AMC1 ATS.TR.400(d).

The technical supervision role can be implemented in different ways depending on the local situation. The role can be part of the normal maintenance organisation at the aerodrome; or a dedicated function at the remote facility; or a mixture of both as long as one function has responsibility for the total system functionality.

The system monitoring function should automatically analyse the failures, classify them and, based on the severity, present information to the technical supervisory function. The technical supervisory function should have access to all information. The information presented related to the failure can be on different detailed levels. In the ATCO/AFISO positions, only information directly related to the operational function should be presented. Advice and 'help information' could be generated by the system automatically or be provided through other means like 'check lists' etc. In case of severe failures impacting the operational service provided when the ATCO/AFISO is monitoring the system, the solution could be for the ATCO/AFISO to call for the technical supervisory specialist or close down the service.

5.12. Other ATS systems/functions

This subsection lists systems/functions which are needed for the ATS provision, but which are not necessarily affected or changed due to the service being provided remotely. Hence, no specific guidelines are provided for these functions with regard to the remote service provision.

These systems or functions, that should be available to the ATCO/AFISO, are:

— presentation of ATS surveillance system(s), (e.g. air situation display(s) or surface movement control display(s)), when available for the particular aerodrome (ref ICAO Doc 4444 [14] Chapter 7.1.1.2[66]);

— handling of air traffic service messages (in accordance with ICAO Doc 4444 [14] Chapter 11)[67];

— presentation and updating of flight plan and control data (in accordance with ICAO Doc 4444 [14] Chapter 4.13[68]*;*
Note*: When an RTC enables transfer of responsibility of ATS for aerodromes between RTMs within the RTC, it is recommended that an electronic system is used for the presentation and updating of flight plan and control data.*

— presentation of the correct time (in the format of hours, minutes and seconds in UTC) (ref ICAO Doc 4444 [14] Chapter 7.4.1.2[69])*;*

— the ATCO/AFISO should be provided with all relevant operational data (e.g. AIP information, NOTAMs, Manual of operations etc.) required for conducting the ATS tasks.

5.13. Working environment

A dedicated analysis of the working environment and ergonomics of the facilities used for remote aerodromes ATS should be conducted by the ATS provider, as this is as an essential aspect for a successful ATS provision and e.g. for the ATCO/AFISO overall system trust. A good working environment will help to reduce the risks for fatigue, stress, mental illness, mental strain etc. A poor working environment on the other hand, will negatively affect the ATCO/AFISO ability to perform

[66] ICAO Doc 4444 Chapter 7.1.1.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; AMC1 ATS.TR.205(c).

[67] With regard to the use of ICAO aerodrome location indicators in case of remote aerodrome ATS, each aerodrome/ATS unit will keep its designated location indicator and the relevant ATS messages should be rerouted accordingly.

[68] ICAO Doc 4444 Chapter 4.13 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; ATS.TR.210(b), AMC1 ATS.OR.145(a), ATS IR ATS.OR.145(a), GM3 ATS.OR.145(a), GM1 ATS.OR.145(a), ATS IR ATS.OR.460(a)(6), ATS IR ATS.OR.140.

[69] ICAO Doc 4444 Chapter 7.4.1.2 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; AMC12 ATS.TR.210(a)(3), GM1 to AMC12 ATS.TR.210(a)(3).

his/her job, and might, in the long run, negatively affect the safety of ATS provision. Some recommendations regarding aspects that may be specifically related to the working environment in remote aerodrome ATS are given below.

The physical working environment (noise, temperature, lighting etc.) should be in accordance with national regulations for normal office establishments.

It is recommended that the working environment permits daylight conditions equal/similar to ordinary office establishments. One justification for this (apart from an overall good working environment and well-being) would be that ATCOs/AFISOs, used to working in conventional towers, are accustomed to daylight conditions. (A comparison can be made to modern ACCs which typically are designed to allow for daylight conditions.)

It should be possible to adjust the lighting conditions in the RTC/RTM in order to adapt to the daylight conditions at the (possibly remote) aerodrome(s). E.g. during hours of darkness at the aerodrome(s), the lighting conditions in the RTM/RTC will probably need to be darker (compared to during hours of daylight at the aerodrome(s)). If several RTMs are co-located in an RTC, it is recommended that it is possible to control/adjust the light conditions individually for each RTM, as the daylight conditions may differ between the aerodromes connected to different RTMs.

With regard to the lighting conditions in the RTM, particular care should be taken with regard to the visual presentation and e.g. the difference in light between screens and the background. If this aspect is not properly treated as part of the implementation, this may create eye strain as well as reduce the usefulness of the visual presentation for the ATCO/AFISO.

The CWP should be designed according to state-of-the-art ergonomic design principles and should allow for a degree of flexibility for user adaption. Aspects to consider may e.g. be; number of input and output devices limited to a minimum, adaption for left/right handed persons, height adjustable worktables, etc.

5.14. Additional considerations for multiple mode of operation

5.14.1. Procedural considerations in multiple mode of operation

5.14.1.1 Handling of abnormal and emergency situations in multiple mode of operation

The ATS provider should put in place procedures and contingency plans that clearly define how to deal with unexpected events, such as an emergency situation at one of the aerodromes significantly increasing the ATCO/AFISO workload and affecting her/his capability to continue to provide ATS to all aerodromes under responsibility. Such procedures and situations should be adequately and recurrently trained.

Such procedures may stipulate that the ATCO/AFISO, in order to be able to manage the abnormal situation, could e.g. perform one of the following actions, but not be limited to:

— temporarily delay or stop traffic at the other aerodrome(s);

— isolate the abnormal/emergency situation on a RTM dealing with only this issue;

— request another ATCO/AFISO to support her/him, in order to be able to continue the provision of ATS for all aerodromes under responsibility of the same RTM.
Note: This would not be specific to multiple mode of operation, as this method may be (and is) used also for single mode of operation and conventional towers.

Note: An RTC Supervisor may support the ATCO/AFISO to apply these procedures.

5.14.1.2 Communication procedural aspects in multiple mode of operation

The ATS provider should conduct an in-depth evaluation of the communication aspects of any multiple mode of operation implementation, as part of the local safety assessment. The related operational procedures should be designed and established and the necessary system support should be defined accordingly.

The validations performed in the framework of the SESAR JU programme ([32], [35], [37]) have examined different ways of handling communication in a multiple mode of operation context, i.e. in dealing with frequencies/radio traffic for several aerodromes at the same time as well as dealing with an increased number of e.g. telephone lines to other ATS units and entities (compared to single mode of operation). With regard to the radio communication aspect, based on the validation results, some preferences can be noted, as discussed below.

For aerodrome mobile service (air–ground communications) two obvious possibilities exist. Either the respective aerodrome frequencies are handled **separately** or **cross-coupled** (as e.g. commonly used when combining sectors in an ACC). If treated **separately**, the ATCO/AFISO would be able to hear all transmissions for all aerodromes, however, the pilots would only hear the aircraft transmissions related to their 'own' aerodrome. The ATCO/AFISO may respond/transmit to aerodromes separately or may choose to respond/transmit to all aerodromes under their responsibility. One benefit of this method would be a reduced risk for pilot confusion, as a result of lowered risk to misinterpret transmissions on frequencies of other aerodromes. On the other hand, pilots may try to transmit on the frequency when the ATCO/AFISO is occupied with radio traffic at another aerodrome, as they will not necessarily hear transmissions of the other aerodrome(s). If **cross-coupling** the different aerodrome frequencies, pilots (as well as the ATCO/AFISO) would hear all transmissions related to all aerodromes under the responsibility of the ATCO/AFISO. The benefit of this method would be that pilots at all times would be aware of the ATCO/AFISO occupancy and the risk for simultaneous transmissions (affecting the ATCO/AFISO) would be reduced. On the other hand, confusion may arise from pilots hearing transmission(s) at other aerodromes. Based on the SESAR JU programme validation results ([32], [35], [37]), the preferred method seems to be frequency cross-coupling across the aerodromes.

Some specific recommendations can be given with regard to aerodrome mobile service:

— When performing multiple mode of operation and when there is a possibility of confusion due to aerodromes having the same or similar runway designators, and if transmissions are not performed to individual aerodromes, the inclusion of aerodrome names in clearances/radio transmissions should be considered as a standard procedure.

— In addition, the ATS provider may also consider, as part of the local safety assessment, the inclusion of aerodrome names/ATS unit call sign for all transmissions (i.e. not only for the first contact) between pilots and ATCOs/AFISOs in multiple mode of operation. If this procedure is to be implemented, it should be published in the AIP for the particular aerodrome, together with any other specific communication methods as deemed necessary.

For surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled[70] aerodromes), based on the SESAR JU programme validation results ([32], [35], [37]), the preference seems to be to keep the frequencies of different aerodromes separate. A recommendation in this regard can also be made:

— For aerodromes provided with (or to potentially be provided with) multiple mode of operation, it is recommended to consider the introduction of different call sign/number series for the vehicles at the respective aerodrome. (E.g. vehicles at aerodrome A to use a call sign/number series starting with 'A' or '1', vehicles at aerodrome B to use a call sign/number series starting with 'B' or

[70] This could also be applicable for AFIS aerodromes.

'2', etc.). This could be a simple way to support and facilitate the ATCO/AFISO recognition of vehicle radio calls from different aerodromes as well as to avoid misinterpretations of clearances/transmissions.

5.14.2. CWP/RTM design considerations in multiple mode of operation

When performing multiple mode of operation, the ATCO/AFISO should be provided with all systems and data/information required (to perform the ATS) for all aerodromes under their responsibility.

Furthermore, the system design should support the ATCO/AFSIO to distinguish to which aerodrome any single set of displays and functionalities are linked.

The technical system should support and reduce ATCO/AFISO workload by system integration to the level where the ATCO/AFISO can focus on task performance in the new working environment.

5.14.3. Communication technical aspects in multiple mode of operation

<u>Aeronautical mobile service (air–ground communications)</u>

When performing multiple mode of operation, the communication system should enable the ATCO/AFISO to:

— listen to all aeronautical mobile service communication frequencies for all aerodromes being served; and

— to transmit either to 'all aerodromes' being served or to 'individual aerodromes'.

The communication system should also enable aeronautical mobile service transmissions to be retransmitted/relayed between all aerodromes (often referred to as frequency cross-coupling) being served by one RTM (or being served by a conventional tower providing remote aerodrome ATS to one or more aerodromes simultaneously with the local ATS provision (refer to the operational application example in Section 3.3)).

<u>Aeronautical Fixed Service (ground–ground communications)</u>

When performing multiple mode of operation, the aeronautical fixed service should be extended to cover communications with all units relevant for all aerodromes being served.

<u>Surface movement control service (communications for the control of vehicles other than aircraft on manoeuvring areas at controlled[71] aerodromes)</u>

When performing multiple mode of operation, the communication system should enable the ATCO/AFISO to:

— listen to all surface movement control service communication frequencies for all aerodromes being served; and

— to transmit to individual aerodromes for the surface movement control service communication frequencies.

5.14.4. Visual presentation in multiple mode of operation

The provision of ATS to more than one aerodrome simultaneously would be made possible by visual presentation(s) that allow for the constant monitoring of each aerodrome, enabling ATCO/AFISOs to '*maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as*

[71] This could also be applicable for AFIS aerodromes.

vehicles and personnel on the manoeuvring area'[72]. The visual presentation(s) should display each aerodrome simultaneously. To allow ATCO/AFISO to fulfil the duty of continuous watch, the delay to see any part of the area of interest on any aerodrome being under the responsibility of the ATCO/AFISO should not be higher than the delay it would take in a conventional tower (e.g. by turning around to see behind, or to use binoculars), or indeed not higher than the delay experienced in a single mode of operation set-up.

The placement of cameras/sensors at an aerodrome in order to obtain the most suitable view of the aerodrome and its vicinity is dependent on various factors such as; aerodrome layout and runway orientation(s), layout of aerodrome traffic circuit(s), the sun's position on the horizon, availability of technical infrastructure etc., as is the case also when determining the placement of a new conventional tower. In case of multiple mode of operation, the ATS provider may want to consider also an additional aspect, not related to the local conditions of the aerodrome, but related to the interdependencies between the aerodromes to be combined in multiple mode of operation. E.g., a generic placement of camera towers (if applicable) relative to the runway directions and relative to cardinal/compass directions on all aerodromes may be beneficial for the ATCO/AFISO situational awareness when providing ATS to several aerodromes simultaneously.

It is essential that the ATCO/AFISO is, at all times, able to distinguish between the aerodromes.

Note 1: *Validation activities and human factors assessments performed in the framework of the SESAR JU programme (refer to [32] & [34]) indicates that the distinguishing between aerodromes may be supported by introducing overlaid (digital) information in the visual presentation, marking and identifying the respective aerodrome. This may be particularly helpful during darkness, low visibility conditions and when the daylight/meteorological conditions are similar at different aerodromes.*

Note 2: *Validation activities and human factors assessments performed in the framework of the SESAR JU programme further indicates that the introduction of other overlaid (digital) information in the visual presentation, such as 'visual' and/or 'radar tracking', runway/taxiway/apron markings and denominations, compass directions, meteorological information, aerodrome assets/systems status, may support the ATCO/AFISO situational awareness in the multiple mode of operation environment and may also increase heads-up time. If implementing any such overlaid information, care needs to be taken with regard to the possible added dependency on such digital information for the service provision and the potential risks induced by its malfunctioning (see more in Section 5.2.5).*

5.14.5. Aerodrome sound in multiple mode of operation

The validation activities and the human factors assessment performed in the framework of the SESAR JU programme have indicated that aerodrome sound may be particularly useful in a multiple mode of operation setup, aiding ATCOs/AFISOs attention to occurrences at the different aerodromes.

If implemented, it is recommended that the aerodrome sound playbacks are linked in a directional manner according to the visual presentation of aerodromes, as this was found to be a contributing factor to optimal situational awareness.

For multiple mode of operation, if aerodrome sound is implemented, the volume should be adjustable and possible to turn off by the ATCO/AFISO individually for each aerodrome. (As for single mode of operation, this possibility would support the needs of individual ATCOs/AFISOs and would enable to minimise disturbing background noise when/if needed.)

5.14.6. Other ATS systems/functions in multiple mode of operation

In multiple mode of operation, in order to help reduce the ATCO/AFISO overall workload, it is recommended that coordination and transfer of control (the latter only applicable for ATC) of a flight

[72] Chapter 7.1.1.2 of ICAO Doc 4444 (PANS-ATM) [14]

to/from other ATS units (in accordance with ICAO Doc 4444 [14] Chapter 10[73]) is supported by system means enabling automated coordination.

5.14.7. Work environment in multiple mode of operation

It is recommended that the number of input devices to control the same functions for different aerodromes are as few as possible, as this will help to support the possibility to perform tasks in an efficient manner in a multiple mode of operation environment.

The lighting conditions in the RTM should support the possibility of different daylight/darkness conditions at the different aerodromes connected to a RTM in a multiple-mode-of-operation environment.

[73] ICAO Doc 4444 Chapter 10 is proposed for transposition into the EU regulatory framework by NPA 2016-09 [13] as; GM1 ATS.TR.230, GM2 ATS.TR.230, AMC1 ATS.TR.230, AMC2 ATS.TR.230, AMC3 ATS.TR.230, GM1 to AMC2 ATS.TR.230, GM2 to AMC2 ATS.TR.230, GM1 to AMC3 ATS.TR.230, GM2 to AMC3 ATS.TR.230, GM1 ATS.OR.150(b), GM1 ATS.TR.300(c)(2), GM2 ATS.TR.300(c)(2), ATS IR ATS.OR.430(b), AMC2 ATS.TR.105(b).

6. Management of change

6.1. Safety assessment methodology

Implementation of remote aerodrome ATS is a change to the functional system and, as such, it does not require any specific safety assessment methodology. The applicable safety assessment requirements are laid down in Commission Implementing Regulations (EU) Nos 1034/2011[2] (oversight) and 1035/2011 [3] (service provision)[74]. Nevertheless, the particularities of the concept of remote aerodrome ATS require the need to take into account some specific considerations in the safety assessment. The objective of this entire document is to provide ATS providers and competent authorities with such considerations.

In order to facilitate the safety assessment, Appendix 1 of this document summarises (in a non-exhaustive list, to be considered as reference only) the elements which are deemed to be the main elements for consideration when implementation remote aerodrome ATS. The list in Appendix 1 may be used as a check list by the ATS provider and the competent authority, but should be adjusted as necessary taking into account the local implementation aspects of the operational context and the particularities of the selected technical solution. When initiating the safety review process, it could be beneficial and useful to agree on a tailored check list in coordination between the ATS provider and the competent authority.

In addition to the guidance provided in the other sections of this document, the following subsections (6.1.1 and 6.1.2) provides some additional considerations and guidance related more directly to the safety assessment. It is also highlighted that the results of the human factors and security assessments (see Chapter 6.2 and 6.4) form important inputs to the safety assessment.

6.1.1. Dependencies and interfaces

The implementation of remote aerodrome ATS is a change to the functional system that may impact one or several entities, persons or organisation (e.g. Communication Navigation Surveillance (CNS) providers, adjacent ATS providers). Those entities, persons or organisation affected by the introduction of the remote tower concept would be, at least, the aerodrome operator(s) and the aircraft operators.

In reference to Commission Implementing Regulation (EU) No 1035/2011 [3], Annex II, recital 3.2.1(c)[75], these dependencies shall be taken into account by the ATS provider when conducting the safety assessment.

The way in which the technical systems of a remote tower implementation will interact may be different from that of a conventional tower. For example, as discussed in Chapters 3 and 4, technical systems may be located at different distant geographical locations (such as at the aerodrome and at the remote location/facility), interacting with each other as well as with external entities on both sides. Such interaction would require consideration during the safety assessment.

6.1.2. Identification of hazards

As stipulated by Commission Implementing Regulation (EU) No 1035/2011[3], Annex II, Sections 3.2.1 and 3.2.4[76], the ATS provider shall perform a hazard identification.

[74] Regulations 1034/2011 and 1035/2011 are to be replaced from 2 January 2020 by COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [4], complemented by EASA ED Decision 2017/001/R [10] issuing Acceptable Means of Compliance and Guidance Material to Commission Implementing Regulation (EU) 2017/373.

[75] With regard to the interaction and dependencies with other entities, persons or organisations, as of 2 January 2020 this is to be covered by ATM/ANS.OR.A.045 and ATS.OR.205 of Commission Implementing Regulation (EU) 2017/373 [4], complemented by EASA ED Decision 2017/001/R [10], especially Annex III, AMC1 and GM1 ATM/ANS.OR.A.045(a)(3), AMC1 and GM1 to GM4 ATM/ANS.OR.A.045(e), GM1 ATM/ANS.OR.A.045(e)(2) and GM1 ATM/ANS.OR.A.045(f).

The generic safety assessments performed in the framework of the SESAR JU programme ([26], [30], [33]) have derived a list of operational hazards in relation to the provision of aerodrome ATS. As such, they may not be related to remote aerodrome ATS only, but also to the provision of ATS from a conventional tower. Nevertheless, the implementation of remote aerodrome ATS may affect the causes or the probability of occurrence of those hazards. In order to facilitate the safety assessment to be performed when introducing remote aerodrome ATS, the identified operational hazards from the SESAR safety work are presented in Table 2 (Appendix 2) for ATC provision and in Table 3 (Appendix 3) for AFIS provision. These hazards may be considered as an initial input by the ATS provider, but needs to be adapted appropriately taking into account the local conditions and the operational application and context of the particular implementation and the addition of potential system hazards. The adapted list of hazards can then be used by the ATS provider for the development of safety requirements, by using its own safety assessment methodology as accepted by the corresponding competent authority.

[76] To be replaced from 2 January 2020 by COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [4], Annex IV, ATS.OR.200(2) and ATS.OR.205(b)(1), complemented by EASA ED Decision 2017/001/R [10], especially Annex IV, AMC1 and AMC2 ATS.OR.205(b)(1) and GM1 ATS.OR.205(b)(1).

6.2. Human factors assessment

The introduction into service of the remote aerodrome ATS has direct human factors implications as it may influence the capability of the ATCO/AFISO to accomplish their allocated tasks in a safe and efficient manner. The implementation of mitigation of human factors aspects themselves may further impact the humans operating the services.

Some sections in this document already state the need for a human factors assessment. This section addresses in more detail human factors aspects that should be considered for the implementation of remote aerodrome ATS. The assessment is recommended to be performed independently but should in any case be presented with the details as part of Regulation 1035/2011 [3] Annex II, 3.2.1(c)[77].

Human factors assessment is not about assessing the technical performance itself, but the suitability of technical components in an ATCO/AFISO's task context allowing her/him to successfully accomplish the ATS task.

Human factors assessment should be based on a state-of-the-art process that covers the relevant human factors areas affected by the change. It concerns:

— HMI and system;

— working environment;

— procedures and working methods;

— organisation and human-human interaction;

— transition factors (competencies, training, acceptance).

It also should cover, in a proportionate manner, those actors (ATCO, AFISO, ATSEP, MET officers, etc.) affected by the change. The human factors assessment should also support decisions on safety nets and functionalities to safely achieve the level of service intended and in an acceptable manner for the actors involved.

The assessment of human factors aspects should be carried out through e.g. simulations[78], passive, active and advanced shadow mode validations[79], as appropriate for the proposed implementation, using the final functional system to ensure that human performance is not negatively impacted. Simulations as well as shadow mode validations are considered to be useful to find inconsistencies in the equipment and procedures.

6.2.1. Remote aerodrome ATS related human factors elements/aspects

The aspects listed in this section are applicable when implementing remote aerodrome ATS, regardless of single or multiple mode of operation. For multiple mode operation, particular care and considerations should be taken with regard to the interaction between aerodromes and the increased complexity when providing multiple mode of operation.

The concept includes existing standards and anticipates the introduction of future standards and applications of the technology associated with image presentation, which encompasses several

[77] To be replaced from 2 January 2020 by ATS.OR.205(a)(1) of COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [4].

[78] In this context the term simulation should be understood as; familiarisation with the new equipment and the tools. The simulations could also be used to develop the procedures for using the equipment and tools.

[79] Shadow mode validations are referred to the validation technique in which the new system is given live feeds in the operational environment and runs in parallel to the operational system. In passive shadow mode, the new system will be non-interfering and will not play an active part in the ATM system. In active shadow mode, the new system can be provided to a user in parallel with the current system and thereby play a more active role in actual operations. In advanced shadow mode the new system will be put in active operation with the old system run in parallel as a fall back. Hence – in the context of remote aerodrome ATS validations – for passive and active shadow modes, the ATS will still be provided from the conventional tower (shadowed from the remote tower to various degrees), whereas for advanced shadow mode the ATS will be provided from the remote tower (shadowed from the conventional tower.)

aspects. Before implementing the technology, the ATS provider should perform human factors assessments including the following technical elements:

— screen layout;

— field of view (vertical and horizontal degree angle, speed and smoothness of panning);

— use and impact of colours;

— image quality factors (contrast, brightness, sharpness, focus, dynamic range, resolution, jitter and motion blur, etc.) for the area of interest;

— compression and distortion of reality;

— availability and usability of binocular function;

— avoidance of blind areas and, if unavoidable, their location and their mitigation;

— reliability of the visual presentation;

— availability of the visual presentation;

— integrity of the visual presentation;

— accuracy of the visual presentation;

— end to end delays between image and sound (if implemented) capture and their presentation;

— discrepancy or synchronisation between visual presentation, aerodrome sound (if implemented) and voice communication;

— appearance and mitigation of image freezing issues;

— physical and mental fatigue induction (e.g. eye fatigue);

— other types of fatigue induced (e.g. occupational fatigue);

— capability of the system to provide smooth, regular and operationally acceptable visual presentation of moving/flashing/rotating objects to the human eye;

— quality of the visual presentation to allow the ATCO/AFISO to judge the distance between objects;

— procedures in case of image integrity failure;

— functions to manage and avoid overlapping information;

— system monitoring capabilities; and

— maintenance procedures.

At least, the following human factors elements should be taken into consideration as a consequence of the replacement of direct visual observation with visual presentation systems:

— ATCO/AFISO ability to '*maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area*'[80];

— ATCO/AFISO situational awareness;

— ATCO/AFISO perception;

— ATCO/AFISO workload;

— ATCO/AFISO fatigue and boredom;

[80] Chapter 7.1.1.2 of ICAO Doc 4444 (PANS-ATM) [14]

— impact of augmented reality;

— effect of time delays on visual presentation in all situations, with special attention to emergency situations (e.g. runway incursions);

— potential confusion over the different views that an ATCO/AFISO could suffer from having images originated from different cameras with different locations and angles of view on the manoeuvring area (e.g. positioning cameras on both sides of a runway);

— differences in brightness between ground and sky in the screen views;

— differences in brightness between reality and the presented view;

— partial obstruction of visual detection during sunrise or sunset;

— contrast of screens with the background;

— colour balance with different daylight configurations;

— combining video images from different sources;

— screens arrangement (e.g. number of screens, angles of screens, edges of screens, multiple views);

— capability of the cameras to capture and transmit blinking beacon images in all circumstances;

— specific local conditions affecting the visibility (e.g. deficiencies in image capture due to seawater splash);

— if made available, aerodrome ambient sound;

— acoustic characteristics of the control room (RTM/RTC);

— camera angles and screen orientation in relation to aerodrome layouts and in relation to the different legs of the aerodrome traffic circuit, as well as emergency and missed approach procedures;

— integrated flight data label information (if available), both with static information and with dynamic information, and measures to prevent the label from shadowing visual information as well as measures to prevent frequent and sudden moves of those labels;

— binocular functionality and the possibility to follow moving objects, either automatically (rotation, tilt to the desired elevation angle and focus at the indicated distance, if available) or through a manual pan-and-tilt/zoom function;

— visual tracking[81] functionality (if available).

Apart from the above-mentioned elements, some <u>other aspects</u> not related to the replacement of direct visual observation need to be considered in the human factors assessment. At least the following aspects should be reflected:

— local procedures to manage movement of vehicles, aircraft and persons on the manoeuvring area;

— local procedures on the coordination of aerodrome ATS unit and approach control (APP) services, and/or area control and flight information services (ACC/FIC) as applicable, whether merged or not in the same location;

[81] At the time of publication of this document, EUROCAE working group ‘Remote and Virtual Tower’ (WG-100) is developing ED-240A, an extension to ED-240 ‘Minimum Aviation System Performance Specification (MASPS) for Remote Tower Optical Systems’ [18], to include remote tower optical target tracking technologies. Expected publication of ED-240A is end 2018. EUROCAE WG-100 currently uses the term ‘optical sensor based object augmentation’ synonymously with the term ‘visual tracking’.

— local procedures for operations during low-cloud situations, low visibility or similar;

— local procedures to handle limitations and conditions (e.g. number of simultaneous aircraft and/or vehicle movements at one aerodrome for a specific time), if applicable;

— specific training elements related to local aerodrome characteristics (e.g. unit endorsement requirements);

— effect of limitations on operation (if any) and prioritisation of traffic;

— effect of the types of airspace surrounding the aerodrome concerned particularly when establishing a new ATS unit;

— effect on the possibility to detect and recognise aircraft, their equipment, flight patterns and behaviour of flights;

— specific local requirements needed for safety reasons, such as:

- extended spacing;
- ground equipment (e.g. radar);
- on-board equipment (e.g. transponder, ADS-B);
- specific camera configuration (e.g. hot spot coverage);
- specific additional camera equipment e.g. adaptable housing and ancillary equipment (e.g. automatic cleaning system for the windows, sun filters) to protect and mitigate effects caused by sunshine, weather and animal activities);
- specific screen requirements (e.g. automatic adjustable contrast to mitigate daylight variations);

— for the case when ATCOs/AFISOs will switch service provision between aerodromes under the same shift (may be applicable to the single mode of application as well as to the multiple mode of application, see Sections 4.1.3 and 4.2.3), it is recommended for ATS providers to:

- carefully consider the consequences on fatigue and mental availability and define mitigation measures as suitable;
- adequately manage the operational difficulties; such as publication of service availability, defining the correct moment for switching (e.g. will the switch be delayed if traffic is delayed, if so, how will airspace users be informed about it on both aerodromes).

6.2.2. Additional human factors elements/aspects related to multiple mode of operation

In reference to the introductory paragraph of Section 6.2.1, when considering the implementation of the multiple mode of operation, the elements listed in this section should be assessed with particular care.

Technology elements:

— availability of the visual presentations for all aerodromes under the responsibility of the AFISO/ATCO;

— screen layouts;

— field of view (vertical and horizontal degree angle, speed and smoothness of panning) of each aerodrome;

— image quality factors (contrast, brightness, sharpness, focus, dynamic range, resolution, etc.) for the areas of interest in relation to the different aerodromes;

— supervisory and maintenance tools for ATSEPs for handling multiple mode of operation;

— input commands for each aerodrome (binocular functionalities, signalling lamps, equipment control etc.).

<u>Human factors elements</u>:

— ATCO/AFISO ability to '*maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area*'[82] for all aerodromes under responsibility;

— distributed attention;

— potential confusion over the different views that an ATCO/AFISO could suffer from having images originated from different cameras with different locations and angles of view on the manoeuvring area (e.g. positioning cameras on both sides of a runway) of the different aerodromes;

— potential confusion of voice communication (for pilots, vehicle drivers, ATCO/AFIOs, e.g. origination of call, frequency of voice communication transmission and retransmissions, simultaneous calls, voice station denominator (remote or conventional), interface design);

— differentiation between the different aerodromes (metrological conditions);

— arrangement of screens for the visual presentation and screens for other ATS systems/functions (e.g. amount of screens and their functions, angles of screens);

— if applicable, aerodrome sound origin.

<u>Other aspects</u>:

— increase in complexity of procedures due to multiple mode of operation, particularly with simultaneous aircraft movements and events (abnormal situations, emergencies, degradations, spacing between aircraft movements at different aerodromes, different interface arrangements with aerodromes);

— operational procedures related to the multiple mode of operation such as splitting, merging and prioritising;

— specific training elements related to multiple operations (unit endorsement requirements; individual human factors limitations);

— potential impact on simultaneous operations on the ground or in the air;

— specific requirements needed for safety reasons, such as:

- extended spacing and other operational procedures;
- specific camera configuration (e.g. to minimise contrast between aerodromes);
- specific screen requirements (e.g. automatic adjustable contrast to mitigate daylight variations between aerodromes);

— ATS supervisory function;

— coordination processes with ATSEP(s) in charge of the ATCOs/AFISOs' tools.

[82] Chapter 7.1.1.2 of ICAO Doc 4444 (PANS-ATM) [14]

6.3. Transition/implementation plan

The ATS provider should, in coordination with the aerodrome operator and other affected stakeholders as need be, establish a transition/implementation plan, as appropriate, for the introduction into service of remote aerodrome ATS, regardless if migrating service from a conventional tower or if setting up a new ATS unit. The transition/implementation plan should be documented and included in the safety assessment.

6.3.1. Transitioning from a conventional tower to a remote tower

For the case when the service is migrated from a conventional tower to a remote tower, a transition plan should be developed and should define the different phases to be followed (and the associated transition criteria), including fall-back procedures for how to revert the ATS to the conventional tower in case of unexpected events or problems. The capability of providing ATS from the conventional tower should be maintained during all transition phases, plus an additional period (to be defined by the ATS provider) following the successful migration, for contingency reasons. The transition plan may consider the following states:

— Conventional tower control: While in this state, ATS will be provided from the conventional tower.

— Transferring control: In this state, ATS will still be provided from the conventional tower, but the necessary data will also be rerouted to the remote tower for shadow mode operations/transfer-of-control initiation.

— Remote tower control: In this state, the responsibility for providing ATS will lie with the remote tower personnel.

The transition between states may be performed through a handover process between the conventional tower and the remote tower. This handover process should only start once the remote tower is ready to assume responsibility for the ATS. The handover protocol may be split as follows:

— While maintaining the provision of ATS from the conventional tower (conventional tower control state), the remote tower ATCO/AFISO calls the conventional tower in order to declare their ability to assume responsibility for ATS.

— Acknowledgement of this request by the conventional tower will trigger the transition to the 'transferring control' state.

— When all the necessary information is transferred and when all the required technical operations are completed in order to allow the remote tower system to work properly, the remote ATCO's/AFIO's acceptance of the responsibility will trigger the transition to the 'remote tower control' state. The conventional tower office will then inform all the other actors involved (i.e. local emergency personnel, aerodrome services, adjacent and relevant ATS units, etc.) of the successful completion of transfer of responsibility.

The remote tower functional system should be designed in such a way that these states (or equivalent ones) and the associated transitions are feasible. Additionally, the possibility to return to the 'conventional tower control' state from the 'remote tower control' state should be maintained throughout the transition process, and should be also maintained for some time after the successful transition for contingency reasons.

6.3.2. Setting up a new ATS unit

When the introduction into service of remote aerodrome ATS is performed at an aerodrome where no conventional tower exists (and therefore no associated ATS is provided), a implementation plan for the implementation of the new ATS unit should be developed, taking into consideration the different elements contained in this document and the specific conditions of the target aerodrome.

6.3.3. Common aspects for a transition/implementation plan

Regardless if migrating from a conventional tower or if setting up a new ATS unit at an aerodrome, the aspects below should be covered by the transition/implementation plan.

Airspace users, relevant ATS units (e.g. those in charge of adjacent sectors), and respective aerodrome units should be notified without undue delay when ATS is provided from the remote tower, or when ATS from the remote tower is planned to be terminated. This notification process should be applied through the aeronautical products and services (e.g. Notice to Airmen (NOTAM)), see Section 9.

When the introduction into service of the remote aerodrome ATS is completed, the following requirements should be met:

— ATCO/AFISO (or the responsible person designated by the ATS provider) providing ATS from a remote tower should apply the relevant remote tower start-up procedure before providing the ATS. This start-up procedure should include the confirmation of the remote tower's capability to provide the ATS.

— Personnel at the aerodrome should be informed by the ATCO/AFISO (or by the responsible person designated by the ATS provider) when the remote provision of ATS is to be initiated and terminated.

— Prior to a planned termination, the ATCO/AFISO should ensure that ATS can be appropriately (safely) terminated.

— Prior to an unplanned termination, the ATCO/AFISO should, as far as possible, ensure that ATS is appropriately (safely) terminated.

— ATCO/AFISO should inform all traffic under their responsibility in case the provision of ATS is unplanned terminated.

6.4. Information and cyber security

As stated in Regulation 1035/2011[3], Annex I, point 4[83], air navigation service providers provider – and therefore also ATS providers – *shall establish a security management system to ensure*; (a) *the security of their facilities and personnel so as to prevent unlawful interference with the provision of (air navigation) services*; and (b) *the security of operational data they receive or produce or otherwise employ, so that access to it is restricted only to those authorised.*

Remote aerodrome ATS relies on IT infrastructure for data exchange to support, amongst others: visual presentation, communications (in particular aeronautical mobile service and surface movement control service) and management of aerodrome equipment/systems/assets, which may make it vulnerable to potential security threats to computer systems or the data exchanged.

Risks may be posed due to unavailability of such data (denial of service) or unauthorised modification (data tampering) with limited ATCO/AFISO capability to detect potential integrity problems in the information presented at the RTM.

Consequently, the introduction of remote aerodrome ATS may affect the security risk assessment and these security vulnerabilities may have an impact on safety. For this reason, these security vulnerabilities may add new causes to the existing safety hazards (e.g. possible corruption of navigation aids information, loss of visual presentation data) or may add new hazards (e.g. complete loss of the provision of ATS). Based on these considerations, the ATS provider shall (in reference to Regulations 1035/2011 and 2017/373, see above) conduct a dedicated security risk analysis and take the necessary measures to protect its systems and constituents against information and cyber security threats. The results of this security risk analysis should be considered as input to the safety assessment.

In this context, security threat is defined as any circumstance or event with the potential to adversely impact on the operation, systems and/or constituents due to human action (accidental, casual, or intentionally or unintentionally mistaken) resulting from unauthorised access, use, disclosure, denial, disruption, modification, or destruction of information and/or information system interfaces. It should be noted that this may also include malware and the effects of external systems on dependent systems.

[83] To be replaced from 2 January 2020 by COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [4], Annex III, ATM/ANS.OR.D.010.

6.5. Contingency planning

As stipulated by point 8.2 in Annex I of Regulation (EU) No 1035/2011[84] [3], a service provider – and therefore also the ATS provider – shall have in place contingency plans for all the services it provides in the case of events which result in significant degradation or interruption of its operations.

With regard to remote aerodrome ATS, the contingency procedures should be adapted/designed to the specific local conditions, taking into consideration elements such as:

— the use of signal lights and emergency flares;

— alerting in case of failure conditions;

— impact on the service provision in case of major failure;

— the management of existing traffic in the scenario of major or complete failure.

In case the ATS provision is affected by a system degradation, the remote tower system should be able to fulfil the following requirements:

— Remote aerodrome ATS should be terminated in case of inadequate capability of the remote tower system elements to provide the service.

— Airspace users, relevant and adjacent ATS units, and respective aerodrome services units should be notified without undue delay in case the ATS cannot be provided (unplanned termination of the ATS provision due to system failures). For these cases, the remote aerodrome ATS should be appropriately (safely) terminated.

The following items represent examples of degraded mode situations for which contingency procedures should be applied:

— Events related to visual presentation and binocular functionality, including:

- unreliable visual presentation, e.g. 'blank screen', frozen presentation, or end-to-end delay above the maximum value allowed;
- degraded mode, e.g. partial or full loss of visual presentation, loss/degradation of binocular functionality.

— Events related to other system aspects, including:

- loss/degradation of communication (i.e. aeronautical mobile service, aeronautical fixed service and surface movement control service);
- loss/degradation of signal light gun;
- loss/degradation of meteorological information;
- loss/degradation of information and/or management of aeronautical ground lights;
- loss/degradation of information and/or management of navigation aids;
- loss/degradation of alarm management;
- loss/degradation of aerodrome audio/ambient sound (if available);
- loss/degradation of other systems such as ATS surveillance information, flight plan and control data, etc.

For the events listed above, not only each specific element in isolation should be considered but also the impact in case of combined failures and how they interact.

[84] To be replaced from 2 January 2020 by ATM/ATS.OR.A.070 of COMMISSION IMPLEMENTING REGULATION (EU) 2017/373 [4], complemented by GM1 ATM/ATS.OR.A.070 in Annex III to EASA ED Decision 2017/001/R [10].

In case of multiple mode of operation, contingency procedures should take into account the effect of degraded mode situations for all aerodromes connected to one RTM and how failures may interfere between the aerodromes. The following cases of use may then be considered in the perspective of multiple mode of operation from an RTM:

— failure of one or several systems for one aerodrome;

— failure of one or several systems for more than one aerodrome but less than all connected aerodromes (this use case is only applicable in case of more than two connected aerodromes);

— failure of one or several systems for all connected aerodromes.

6.6. Remote tower system constituents

In relation to the demonstration of compliance with respect to the interoperability Regulation[85], the split of the technical system into constituents falls under the responsibility of the ATM/ANS service provider, in agreement with the respective competent authority. The split may depend on several factors, such as the availability of community specifications for certain parts of the system and even how the contractual arrangements between the service provider and the constituent manufacturers are established.

Based on the considerations above, some recommendations are put forward on how the remote aerodrome ATS system may be split into constituents.

Based on the high-level remote aerodrome ATS functionalities presented in Section 5, the remote tower system constituents may be grouped as follows:

— visual presentation, binocular functionality and aerodrome sound related functionalities;

— voice/data-communication-related functionalities (i.e. aeronautical mobile service, aeronautical fixed service and surface movement control service);

— manoeuvring and monitoring related functionalities (e.g. signal light gun, management of aerodrome equipment/systems such as aeronautical ground lights and navigation aids, alarm management, technical supervision).

The aforementioned functional grouping has been selected as the basis for the proposed split, identifying a constituent as responsible for the implementation of each of these categories. Nevertheless, these recommendations are based on two main assumptions:

— that the system (physical) architecture ensures independence from each of the constituents; and

— that the interface specification among them is based on existing standards.

For a particular technical solution, the validity of these assumptions should be assessed by the ATS provider. It is also important to analyse the ATM/ANS service for which a constituent should be considered as this may also affect the possible split of the system into constituents.

The main question would be whether the visual presentation and aerodrome sound parts are to be considered as constituents in the ATS domain or as a combination of ATS constituents and CNS (surveillance) constituents, or, in other words, if the visualisation means (cameras) and aerodrome sound means (microphones) can be considered as ATS surveillance equipment. With regard to that, the definition of 'ATS surveillance system' of ICAO Doc 4444 [14] is recalled:

*'**ATS surveillance system.** A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.*

Note.— A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.'

The image captured by the cameras/optical sensors is used to replace the 'out of the window view' with a 'visual presentation'. It is not intended for provision of ATS surveillance services, nor does it provide the necessary means and information for that purpose. (E.g. the precise distance between two aircraft in flight cannot be provided.) It would be used primarily for the 'detection' and 'recognition' of aircraft (as well as for other objects and purposes, e.g. vehicles, personnel, obstructions, animals, occurrences at the aerodrome, weather follow up, etc.) and normally not used for the 'identification' of aircraft for the purpose of ATS surveillance services provision.

[85] Regulation (EC) No 552/2004 [8] 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).

The aerodrome surrounding sound captured by the microphones is used as a means to increase the general ATCO/AFISO situational awareness, but is not used for the 'identification' of aircraft for the purpose of ATS surveillance services provision.

Following this analysis, it has been concluded that the ground infrastructure at the aerodrome for capturing images and surrounding sound should be considered as ATS constituents (or part of it).

The following table summarises the results of both analyses that constitute the recommended way of organising the allocation of the system's constituents.

Table 1: Remote tower system constituents

Constituent	Allocated functions	ATM/ANS service
Visual presentation, binocular functionality & aerodrome sound	Visual presentation Binocular functionality Aerodrome sound reproduction Data recording of the associated data	ATS
Voice/data communication	Aeronautical mobile service Aeronautical fixed service Surface movement control service Voice and data recording of the associated communication frequencies/data.	CNS
Manoeuvring and monitoring	Management of signal light gun Management of aerodrome lights Management of alarms Management of navigation aids Technical supervision	ATS

The following is noted:

— EUROCAE has published ED-240 [18], a Minimum Aviation System Performance Specification (MASPS) for Remote Tower Optical Systems.

— The denominations of the constituents are included for illustrative purposes only.

— The ATS provider may split further these constituents (e.g. splitting between equipment at the aerodrome and at the remote tower/RTC), which would require the definition of the interface specifications (standards) among the identified new constituents.

— The ATS provider may consider the possibility of including additional constituents or additional functionalities to the identified ones.

— The ATS provider may consider adding other functions to the identified constituents provided that they are consistent with the ATM/ANS service (ATS or CNS) provided.

— The ATS provider may consider merging visual presentation, aerodrome sound reproduction and manoeuvring and monitoring, as they belong to the same domain.

7. Aerodrome related aspects

According to ICAO Annex 14 certain aerodromes need to be certified, in accordance with an appropriate regulatory framework. At EU level, Regulation 139/2014 [7] applies to the aerodromes that meet the criteria prescribed in Regulation 216/2008 [1]. EASA Member States are also expected to adopt an appropriate regulatory framework that applies to the aerodromes that fall outside the scope of Regulation 139/2014 [7].

During aerodrome planning, design and certification activities, it is imperative that, among others, ATS aspects are properly and adequately identified and addressed.

Remote aerodrome ATS enables the possibility to provide aerodrome ATS from locations other than the aerodrome itself.

An advantage of providing the aerodrome ATS from the aerodrome itself (be it either from a 'conventional tower' or from a 'remote tower') is the possibility of direct personal contact with the aerodrome operator, which can be beneficial particularly during special events/accidents or incidents.

For remote aerodrome ATS, and specifically so if the remote tower is located away from the aerodrome, it is particularly important to ensure appropriate coordination between the competent authorities, the ATS provider, and the aerodrome operator, throughout the implementation as well as during the actual ATS provision.

With regard to aerodromes, and irrespective of the regulatory framework that an aerodrome falls under, the following aspects should be taken into consideration to meet this objective.

7.1. Certification

7.1.1. Documentation to be provided by the aerodrome applicant at the initial aerodrome certification

The documentation for the initial certification of the aerodrome should include information regarding the provision of ATM/ANS at the aerodrome, including:

— the type of ATS provided (ATC services and/or AFIS);

— the way ATS is provided:

- from a conventional tower (ATS unit established at the aerodrome); or
- from a remote tower (ATS unit established at the aerodrome or off-site (away from) the aerodrome); or
- a combination of the above (in alternation from a conventional tower and a remote tower);

— CNS;

— MET.

When remote aerodrome ATS is provided, the submitted documentation (apart from the necessary arrangements between the aerodrome operator and the ATS provider) should clearly identify:

— the location of the ATS unit;

— communication means to be used between the ATS unit and all relevant aerodrome units;

— the tasks that will be needed to be carried out locally at the aerodrome in order to enable and support the remote aerodrome ATS;

— the organisation that will carry out these tasks locally; and

— the communication procedures established for special occurrences/events, emergency landings or diversions including reporting procedures.

The submitted drawings showing the design of the aerodrome should contain information regarding:

— the kind of facilities, installations and equipment to be established at the aerodrome or in its vicinity (e.g. cameras, sensors, etc.) to enable and support the remote aerodrome ATS; and

— their location.

Information concerning the planned overall height of the above-mentioned facilities, installations and equipment should also be provided.

Moreover, information should be provided regarding the technical solutions employed for:

— the operation/control/monitoring of the aerodrome's lighting systems and their individual elements, as appropriate;

— the communication systems between the ATS unit and the relevant aerodrome units (e.g. rescue and firefighting services (RFFS) station, apron management services unit as appropriate, persons or vehicles operating on the manoeuvring or movement area (if apron management services are also provided by the ATS unit);

— the operation of the alerting system for RFFS purposes;

— the operation of the signalling lamp;

— the provision of light and pyrotechnic signals to aerodrome traffic[86]; and

— any other aerodrome equipment/system which would have to be used by the ATS personnel.

7.1.2. Aerodrome manual

In case of remote aerodrome ATS, the aerodrome manual should additionally contain relevant information including, but not limited to:

— provision of relevant information to the Aeronautical Information Service (AIS) for publication in the AIP;

— procedures for the transition of ATS provided from a conventional tower to ATS provided from a remote tower, and vice versa, if applicable;

— procedures for the day-to-day coordination (day- and night-time), including the necessary exchange of information, between the aerodrome operator and the ATS provider, as appropriate;

— procedures for the participation of ATS personnel in the aerodrome's safety committees, including the Local Runway Safety Team, and the implementation of the local safety programmes, including joint training and aerodrome familiarisation with other relevant personnel;

— procedures to facilitate site awareness of remote aerodrome ATS personnel (ATCOs/AFISOs), including e.g. the frequency and the agenda for on-site familiarization visits;

— procedures for low visibility/extreme weather situations;

[86] In EASA Member States, see Commission Implementing Regulation (EU) No 923/2012 [6] (SERA.3301, Appendix 1).

— information about the location of facilities (maps, charts), installations and equipment enabling and supporting the remote aerodrome ATS, within and, if applicable, outside the aerodrome's boundaries;

— operating, maintenance (including emergency maintenance) repair and service instructions, troubleshooting and inspection procedures of facilities, installations and equipment enabling and supporting the remote aerodrome ATS;

— procedures for meteorological observation and provision;

— procedures for apron management services provision;

— procedures and measures for the protection of facilities, installations and equipment enabling and supporting the remote aerodrome ATS, control of activities, and ground maintenance in the vicinity of these installations; procedures for safeguarding such facilities, installations and equipment against acts of unlawful interference;

— procedures for the use of light and pyrotechnic signals to aerodrome traffic; and

— procedures for initiating a NOTAM declaring the aerodrome closed in the event of failure of facilities, installations and equipment enabling and supporting the remote aerodrome ATS.

7.1.3. Local agreement between aerodrome and ATM/ANS providers

A local agreement between the aerodrome operator and the ATS provider defining responsibilities and addressing coordination needs and means should be in place. In case of remote aerodrome ATS this agreement should additionally cover the elements contained in Section 7.1.2.

7.2. Operational aspects

7.2.1. Coordination between the aerodrome operator and the ATM/ANS providers in the event of system failure

In the event of failure of any of the facilities, installations and equipment enabling and supporting remote aerodrome ATS (locally or remotely), timely coordination between the aerodrome operator and the ATS unit should take place about the cause and impact of the failure on the operations and NOTAMs should be issued, as necessary.

7.2.2. Aerodrome safeguarding

In case of remote aerodrome ATS, the aerodrome operator should ensure that:

— the risk of sources of non-visible radiation, or the presence of moving (or fixed) objects which may interfere with, or adversely affect, the performance of applicable facilities, installations and equipment enabling and supporting the remote aerodrome ATS is assessed and mitigated;

— appropriate security procedures are established and implemented for the protection of such facilities, installations and equipment;

— appropriate security and/or preventive actions according to cyber threats during the transition of aeronautical data and information are in place (including the provision of redundancy measures);

— only authorized people have access to the facility and/or related equipment and data.

7.2.3. Maintenance of the remote tower system facilities

Where remote aerodrome ATS is provided, the maintenance programme of the remote tower systems at the aerodrome should cover the maintenance needs of the facilities, installations and equipment, including electrical systems, which enable and support the remote aerodrome ATS. Such arrangements should also specify the maintenance responsibilities of the involved organisations.

A preventive maintenance programme should be established and implemented. Such a programme should contain information related to scheduled maintenance work in order to prevent a failure or degradation of such facilities, installations and equipment.

The preventive maintenance programme should be based on the maintenance instructions of the manufacturer of the respective facility, installation and equipment, as appropriate, and should contain all the necessary information for its timely and correct implementation, including but not limited to:

— the type of inspections/checks to be carried out (e.g. visual inspection, cleaning of equipment, equipment stability/alignment, calibration, etc.) for each facility, installation and equipment, taking also into account factors such as their location and meteorological phenomena;

— the frequency of inspections/checks for each facility, installation and equipment;

— the tools and equipment required for each type of inspection/check; and

— the periodic replacement of parts of equipment that may be required.

Arrangements should be in place to ensure that timely corrective maintenance action is taken to ensure safety and regularity of services. Such arrangements should cover the cases of maintenance needs that are:

— identified either during preventive maintenance activities; or

— raised at any other time (e.g. due to equipment malfunction or failure).

7.2.4. Management of the change to remote aerodrome ATS — Aerodrome operator[87]

At aerodromes where ATS is provided from a conventional tower and the introduction of remote aerodrome ATS is planned, or at aerodromes where no ATS is provided but is planned to be introduced via the introduction of remote aerodromes ATS, due care and time should be taken for the adequate preparation of the transition/implementation plan before the change/introduction is introduced.

Due to the significance of the change, a competent authority approval may be required. Therefore, the aerodrome operator and the ATS provider should communicate intentions and plans to the appropriate competent authority in due time before the planned introduction of the new operating concept in order to avoid unnecessary delays.

As part of the aerodrome operator's processes and procedures for managing safety, including changes, a safety assessment, including human factors aspects, should be submitted by the aerodrome operator to its competent authority prior to the introduction of the change. This assessment should be properly coordinated with the ATS provider and all other interfacing organisations that may be affected by the change.

Although each aerodrome's unique characteristics (based on its complexity, types of operations, organisational arrangements, etc.) may have an effect on both the content and the outcome of the safety assessment, it is expected that this process should at least include the following areas:

— Tasks that are currently performed by the ATS provider and which may need to be performed by the aerodrome operator. This may include:

[87] Refer to COMMISSION REGULATION (EU) No 139/2014 [7], ADR.OR.B.040 Changes

- tasks that fall under the responsibility of the aerodrome operator but had been performed by the ATS provider based on existing local arrangements (e.g. runway surface condition assessment or apron management service) and which may need to be performed by the aerodrome operator; and
- tasks which fall under the responsibility of the ATS provider and which are planned to be performed by the aerodrome operator, based on existing or new local arrangements. Such tasks may include but may not be limited to:
  - maintenance of facilities, installations and equipment necessary for the remote aerodrome ATS;
  - meteorological observations;
  - provision of pyrotechnic signals to aerodrome traffic.
- tasks which were, and will continue to be, performed by the aerodrome operator, but which may be affected by the introduction of the change in that they may need to be enhanced in order to cover additional areas. Such tasks may include but may not be limited to:
  - regular inspections conducted by the aerodrome operator;
  - safeguarding and protection of facilities, installations and equipment necessary for the remote aerodrome ATS (e.g. obstacles, interference from various sources, etc.);
  - security procedures for the protection of facilities, installations and equipment necessary for the remote aerodrome ATS.

— Need for review, update and timely implementation of the training requirements for aerodrome personnel, as a result of task reassignment/enhancement, but also amendment of the aerodrome procedures.

— Technical solutions applied:

- remotely for the implementation of the remote aerodrome ATS, such as:
  - operation/control of the aerodrome’s lighting systems and their individual elements, as appropriate;
  - operation/control of the visual presentation system elements located at the aerodrome, as appropriate;
  - communication systems between the remote ATS unit and the relevant aerodrome units (e.g. RFFS station, apron management services unit), persons or vehicles operating on the manoeuvring or movement area (if apron management services are also provided by the remote ATS unit);
  - operation of the alerting system for RFFS purposes;
- at the aerodrome in order to support the implementation of the remote aerodrome ATS, such as:
  - provision of power supply to the facilities, installations and equipment for providing and supporting ATS remotely;
  - location/installation of cameras;
  - any other data processing equipment (servers, computers, etc.).

7.2.5. Power supply at aerodromes

Apart from the applicable power supply infrastructure requirements, aerodromes provided with remote aerodromes ATS, should also meet the power supply measures listed below.

7.2.5.1 Electrical power supply systems for the remote aerodrome ATS

— Cameras and related facilities enabling and supporting the remote aerodrome ATS and located at an aerodrome, should be provided with adequate primary power supply.

— Cameras and related facilities enabling and supporting the remote aerodrome ATS and located at an aerodrome, should be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply. Electric power supply connections to such cameras and related facilities should be so arranged that they are automatically connected to the secondary power supply when the primary power supply fails.

— The power supply for cameras and related facilities mentioned above should be continuous/uninterrupted.

7.2.6. Cameras at aerodromes

For aerodromes (provided) with remote aerodrome ATS and where the respective ATS unit is also responsible for the provision of apron management services, cameras should be in place and so located as to provide the ATS unit with an unobstructed view of the apron(s) (under the responsibility of that ATS unit).

8. Possible impact on airspace users

In principle, and as confirmed by recent operational experience and validation activities, remote aerodrome ATS should not negatively impact airspace users. In any case, the ATS provider should analyse any possible impacts on airspace users when conducting the safety assessment and propose appropriate mitigation measures, if needed. Particular care needs to be taken in case of multiple mode of operation, where the operations at different aerodromes may become interdependent.

Airspace users are informed through the aeronautical products and services, see Section 9.

9. Aeronautical information products and services

The ATS provider should together with the aerodrome operator perform an analysis of the aeronautical information, including products and services, affected by the introduction of remote aerodrome ATS and ensure that relevant aeronautical information is included in the appropriate products and services.

In particular the following items have been identified to be considered in the analysis:

— Information that should be included in the appropriate sections of the AIP (Aeronautical Information Publication):

- Indication that remote aerodrome ATS is provided (in AIP AD 2.23 'Additional Information', for each relevant aerodrome).
- Location of signalling lamp (in AIP AD 2.23 'Additional Information' by e.g. the phrase *'Signalling lamp positioned at [geographical fix]'* + a clear indication of the signalling lamp location in the aerodrome chart, for each relevant aerodrome).
- Any specific communication methods as deemed necessary in case of multiple mode of operation (see Section 5.14.1.2), such as e.g. the inclusion of aerodrome names/ATS unit call sign for all transmissions (i.e. not only for the first contact) between pilots and ATCOs/AFISOs (in AIP AD 2.23 'Additional Information', for each relevant aerodrome).
- Any relevant actions required by the airspace users following an emergency/abnormal situation and possible contingency measures by the ATS provider in case of disruptions, if applicable (in AIP AD 2.22 'Flight Procedures').
- Interdependencies of service availability or indication of aerodromes not suitable for diversion from the aerodrome (for airspace users not to plan an aerodrome as alternate when serviced by the same RTC), if deemed applicable (see also Section 5.1 for more on this aspect) (in AIP AD 2.23 'Additional Information', for each affected aerodrome).

— Information on implementation plans and milestones may be published in AIC (Aeronautical Information Circular). E.g.:

- dates and scope of Validation exercises;
- planned date of operation.

10. Qualification and training considerations

10.1. Qualification and training of ATCOs

The specific AMC and GM concerning the qualification and training of ATCOs providing remote aerodrome ATS are proposed under Section 3.2. of this NPA. These AMC and GM will be complementary to the requirements established in Regulation 2015/340 [5].

10.2. Qualification and training of AFISOs

With regard to the qualification and training of personnel providing Aerodrome Flight Information Service (AFISOs), it should be noted that at the time of publication of this document, the EU legislation does not include a detailed regulatory framework. However, point 5 of Annex 1 in Regulation 1035/2011[88] [3] stipulates that an air navigation service provider – and therefore also the AFIS provider – shall employ appropriately skilled personnel to ensure the provision of air navigation services in a safe, efficient, continuous and sustainable manner. In this context, the air navigation service provider shall establish policies for the recruitment and training of personnel. It is left to the Member States to define the appropriate regulatory means to meet this requirement in accordance with the local AFIS provision. To facilitate the development of AFISO training in the case of remote aerodrome ATS, the aforementioned AMC and GM for the training and qualification of ATCOs can be considered in order to derive training plans and requirements that are appropriate to the local environment.

10.3. Qualification and training of ATSEPs

Air Traffic Safety Electronics Personnel (ATSEP) involved in the operation and maintenance of equipment, facilities and installations enabling and supporting the remote aerodrome ATS, should be adequately trained, qualified and competent to perform their duties in accordance with the requirements laid down in Commission Implementing Regulation (EU) No 1035/2011 [3] (Annex II, point 3.3[89]) and in Commission Regulation (EU) No 139/2014 [7] (ADR.OR.D.015 and ADR.OR.D.017), as appropriate.

[88] To be replaced from 2 January 2020 by paragraph (a)(7) of ATM/ANS.OR.B.005 of Commission Implementing Regulation (EU) No 2017/373 [4].

[89] To be replaced from 2 January 2020 by Commission Implementing Regulation (EU) No 2017/373 (Annex XIII) [4].

11. References

11.1. Referenced EU Regulations

[1] Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC

[2] Commission Implementing Regulation (EU) No 1034/2011 of 17 October 2011 on safety oversight in air traffic management and air navigation services and amending Regulation (EU) No 691/2010

[3] Commission Implementing Regulation (EU) No 1035/2011 of 17 October 2011 laying down common requirements for the provision of air navigation services and amending Regulations (EC) No 482/2008 and (EU) No 691/2010

[4] Commission Implementing Regulation (EU) 2017/373 of 1 March 2017 laying down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight, repealing Regulation (EC) No 482/2008, Implementing Regulations (EU) No 1034/2011, (EU) No 1035/2011 and (EU) 2016/1377 and amending Regulation (EU) No 677/2011

[5] Commission Regulation (EU) 2015/340 of 20 February 2015 laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council, amending Commission Implementing Regulation (EU) No 923/2012 and repealing Commission Regulation (EU) No 805/2011

[6] Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Implementing Regulation (EU) No 1035/2011 and Regulations (EC) No 1265/2007, (EC) No 1794/2006, (EC) No 730/2006, (EC) No 1033/2006 and (EU) No 255/2010

[7] Commission Implementing Regulation (EU) No 139/2014 of 12 February 2014 laying down requirements and administrative procedures related to aerodromes pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council

[8] 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)

11.2. Referenced EASA ED Decisions/NPAs

[9] EASA Executive Director Decision 2015/014/R of 3 July 2015 adopting Guidance Material on the implementation of the remote tower concept for single mode of operation

[10] Executive Director Decision 2017/001/R of 8 March 2017 issuing Acceptable Means of Compliance and Guidance Material to Commission Implementing Regulation (EU) 2017/373

[11] Executive Director Decision 2016/023/R of 13 October 2016, ‘AMC and GM to the rules of the air — Amendment 1’, amending the Acceptable Means of Compliance and Guidance Material to Commission Implementing Regulation (EU) No 923/2012

[12] Executive Director Decision 2016/027/R of 8 December 2016, 'CS ADR-DSN — Issue 3, Issuing Certification Specifications and Guidance Material for Aerodrome Design (CS ADR-DSN)

[13] EASA NPA 2016-09 'Requirements for air traffic services'

11.3. Referenced ICAO provisions/publications

[14] ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management' (PANS-ATM), Sixteenth Edition, 2016

[15] ICAO Doc 9426 'Air Traffic Services Planning Manual', First (provisional) edition, 1984

[16] ICAO Annex 11 'Air Traffic Services', Fourteenth Edition, July 2016

[17] ICAO Annex 14 'Aerodromes – Volume I, Aerodrome Design and Operations', Seventh Edition, July 2016

11.4. Referenced technical standards

[18] EUROCAE ED-240, 'Minimum Aviation System Performance Specification (MASPS) for Remote Tower Optical Systems', September 2016

11.5. Referenced SESAR JU deliverables/publications

[19] SESAR Solution #71, ATC and AFIS service in a single low density aerodrome from a remote CWP, Contextual Note

[20] SESAR Solution #12, Single remote tower operations for medium traffic volumes, Contextual Note

[21] SESAR Solution #13, Remotely-provided air traffic services for contingency situations at aerodromes, Contextual Note

[22] SESAR Solution #52, Remotely Provided Air Traffic Services for Two Low Density Aerodromes, Contextual Note

[23] OSED for Remote Provision of ATS to Aerodromes, SESAR JU Deliverable D94, Edition 00.07.01, 2016-07-15

[24] Remote Tower Technical Specifications, SESAR JU Deliverable D09, Edition 01.00.00, 2016-03-07

[25] Remotely Provided Air Traffic Service for Single Aerodrome VALR *(**Remark**: VALR=Validation report)*, SESAR JU Deliverable D08-02, Edition 00.05.02, 2014-05-01

[26] OFA06.03.01 Remote Tower - Safety Assessment Report for Single Remote Tower, SESAR JU Deliverable D108, Edition 00.02.01, 2016-07-26

[27] HP Assessment Report for Single Remote TWR, SESAR JU Deliverable D109, Edition 00.02.01, 2016-07-26

[28] Contingency TWR Trial 1 & 2 Validation Report, SESAR JU Deliverable D12, Edition 00.03.01, 2015-11-02

[29] Contingency Tower V3 – VALR *(**Remark**: VALR=Validation report)* VP-752, SESAR JU Deliverable D107, Edition 00.01.01, 2016-05-15

[30] 6.8.4 SAR (Remark: SAR=Safety *Assessment Report)* Contingency Tower - Final Update, SESAR JU Deliverable D110, Edition 00.02.01, 2016-08-22

[31] Human Performance Assessment - Contingency Tower, SESAR JU Deliverable D111, Edition 00.02.01, 2016-07-22

[32] Remotely Provided Air Traffic Service for Two Low Density Aerodromes Validation Report, SESAR JU Deliverable D13, Edition 00.04.01, 2015-11-23

[33] OFA06.03.01 Remote Tower - Safety Assessment Report for Multiple Remote Tower, SESAR JU Deliverable D32, Edition 00.01.01, 2015-11-18

[34] Remotely provided Air Traffic Services for two low density aerodromes Appendix F: HP Assessment Report, SESAR JU Deliverable D28, Edition 00.01.01, 2015-09-01

[35] Demonstration Report RTO *(**Remark:** Demonstrations performed in Germany, the Netherlands and Sweden)*, SESAR JU Project LSD 02.05, Edition 00.02.00, 2016-10-28

[36] Demonstration Report *(**Remark**: Demonstrations performed in Budapest)*, SESAR JU Project LSD 02.10, Edition 01.00.20, 2016-12-15

[37] Remote Towers Demonstration Report *(**Remark:** Demonstrations performed in Ireland)*, SESAR JU Project LSD 02.04, Edition 00.02.00, 2016-10-24

11.6. Other referenced publications

[38] European Operational Concept Validation Methodology – E-OCVM Version 3.0, February 2010

12. Appendices

12.1. Appendix 1: Checklist for the implementation of remote aerodrome ATS

Based on the content of this document, the following elements are listed (for reference purposes only) in order to summarise some aspects deemed to be important for consideration when implementing remote aerodrome ATS and for the related safety assessment.

— Assessment on configuration of technical enablers, based on operational context, needs and requirements and support from safety, security, and human factors assessments (see e.g. Sections 3.5, 5.2.5, 5.3, 5.5).

— Development of operational visual performance requirements on the visual presentation and the binocular functionality, based on direct and indirect regulatory requirements as well as other operational needs (see Sections 5.2.1, 5.2.2 and 5.2.3).

— Development of functional requirements on the visual presentation and the binocular functionality, supporting the above-mentioned operational visual performance requirements (see Sections 5.2.4 and 5.3).

— Siting assessment of location and number of cameras at the aerodrome to meet view and operational visual performance requirements (see Sections 5.2 and 7.2.6).

— Development of voice and data recording requirements for new system elements, for the purpose of supporting accident and incident investigations (see Section 5.7).

— Identification of redundancy needs for the technical architecture, particularly with regard to the communication link between the remote facility and the aerodrome (see Section 5.10).

— Assessment of impact on interfaces/interdependencies with external stakeholders/ /entities/persons/organisation and analysis of the necessary coordination processes and procedures (see Sections 5.1, 6.1.1 and 7).

— Assessment of impact on existing and new tasks and the need for possible for reassignment of tasks, with particular reference to;

- ATS tasks (see Section 5),
- aerodrome operator tasks (see Sections 5.1, 5.9.4 and 7),
- MET related tasks (see Section 5.8),
- AIS related tasks (see Section 9), and
- maintenance tasks (see Section 5.11 and 7.2.3).

— Human factors assessment, including working environment and ergonomics analysis (see Sections 6.2, 5.13 and 5.14.7).

— Security risk assessment (see Sections 6.4 and 7.2.2).

— Split of the remote aerodrome ATS technical system into constituents in accordance to the interoperability Regulation (see Section 6.6)

— Transition/implementation plan developed by the ATS provider and the aerodrome operator (see Section 6.3)

— Development of a contingency plan and related procedures, including also the need for coordination between the ATS provider, the aerodrome operator, and any other involved stakeholder (see Sections 6.5 and 7.2.1).

— Review and update of the aerodrome documentation (see Section 7.1).

— Review and documentation of roles and responsibilities assigned to the ATS provider and the aerodrome operator (see Section 7.1.3).

— Coordination between the ATS provider and the aerodrome operator in relation to safety assessment process and methodology (see Sections 6.1 and 7.2.4).

— Review and update of the training requirements for ATS provider's and aerodrome operator's personnel (see Sections 7 and 10).

— Analysis of possible impact on operational procedures and/or airspace users (see Sections 4, 5, 7 and 8).

— Analysis of aeronautical information products and services and proposed modifications (see Section 9).

12.2. Appendix 2: List of operational hazards for ATC services

Table 2 below lists the operational hazards and the operational effects for the ATC services, based on the results of the SESAR safety work, performed in the framework of the SESAR JU programme. They are valid in the in the context of single mode of operation as well as multiple mode of operation. However, it should be noted that the operational hazards were developed for the specific operational applications and context that was studied and using the specific methodology as described in the SESAR safety assessment reports [26], [30] and [33]. Therefore, if using this list as initial input, it needs to be adapted as necessary, taking into account the local conditions and the operational application and context of the particular implementation as well as the addition of potential system hazards.

Table 2: List of operational hazards (SESAR safety assessment — ATC case)

ID	Description	Operational effects
OH-01	Remote ATC incorrectly coordinates with other ATS Unit with respect to inbound/outbound traffic.	A potential conflict can be induced Imminent infringement
OH-02	Remote ATC incorrectly manages the entry of a flight into traffic circuit.	A potential conflict can be induced Imminent infringement
OH-03	Remote ATC incorrectly manages arriving aircraft.	A potential conflict can be induced Imminent infringement
OH-04	Remote ATC incorrectly manages departing aircraft.	A potential conflict can be induced Imminent infringement
OH-05	Remote ATC fails to provide appropriate separation to traffic in the vicinity of the aerodrome.	Imminent infringement
OH-06	Remote ATC fails to provide appropriate separation to traffic with respect to restricted areas.	Tactical conflict
OH-07	Remote ATC incorrectly manages missed approach situation.	Imminent infringement
OH-08	Remote ATC does not detect in time conflicts/ potential collision between aircraft in the vicinity of the aerodrome.	Imminent collision
OH-09	Remote ATC does not detect in time restricted area infringements.	Tactical conflict
OH-10	Remote ATC fails to provide appropriate instruction to resolve a conflict between traffic in the vicinity of the aerodrome.	Imminent collision
OH-11	Remote ATC fails to provide appropriate instruction to resolve an airspace infringement.	Tactical conflict
OH-12	Remote ATC fails to provide appropriate information to departing aircraft for the start-up.	Tactical taxiway conflict generated
OH-13	Remote ATC fails to enable push-back/towing operations to appropriate aircraft.	Tactical taxiway conflict generated
OH-14	Remote ATC provides inadequate taxiing	Encounter with aircraft, vehicle or

ID	Description	Operational effects
	instruction to aircraft on the manoeuvring area.	obstacle
OH-15	Remote ATC provides inadequate taxiing instruction to vehicle on the manoeuvring area.	Encounter with aircraft, vehicle or obstacle
OH-16	Remote ATC does not detect in time potential conflict on the manoeuvring area.	Imminent collision
OH-17	Remote ATC fails to provide appropriate instruction to resolve conflicts on the manoeuvring area.	Imminent collision
OH-18	Remote ATC fails to provide (appropriate) navigation support to aircraft and vehicle on the manoeuvring area.	Tactical taxiway conflict generated
OH-19	Remote ATC incorrectly manages runway entry for a departing aircraft (occupied runway).	Runway conflict
OH-20	Remote ATC incorrectly manages runway exit for a landing aircraft.	Runway conflict
OH-21	Remote ATC incorrectly manages runway crossing (occupied runway) for a vehicle or an aircraft.	Runway conflict
OH-22	Remote ATC fails to properly support departing and landing aircraft (with respect to visual aids).	Runway conflict
OH-23	Remote ATC incorrectly manages vehicle-related tasks on the runway.	Runway conflict
OH-24	Remote ATC incorrectly manages aircraft take-off (occupied runway).	Runway conflict
OH-25	Remote ATC incorrectly manages aircraft landing (occupied runway).	Runway conflict
OH-26	Remote ATC fails to detect in time runway incursions (aircraft or vehicles).	Runway penetration
OH-27	Remote ATC fails to provide appropriate instruction to resolve runway incursion and prevent potential collision on the runway.	Runway penetration
OH-28	Remote ATC fails to detect in time a flight towards terrain in the vicinity of the aerodrome.	Imminent Controlled Flight Into Terrain (CFIT)
OH-29	Remote ATC fails to provide appropriate support to pilot in a CFIT situation.	Imminent CFIT
OH-30	Remote ATC fails to establish sufficient wake-turbulence spacing between aircraft.	Turbulence in front of the aircraft at a distance less than the separation minima
OH-31	Remote ATC fails to properly support landing/ take-off operations with respect to weather conditions.	Potential landing accident/runway excursion
OH-32	Remote ATC fails to properly support landing/ take-off operations with respect to runway conditions and potential foreign object debris.	Potential landing accident/runway excursion

ID	Description	Operational effects
OH-33	Remote ATC fails to properly support departing and arriving aircraft on the runway with respect to non-visual aids.	Potential landing accident/runway excursion
OH-34	Remote ATC fails to detect in time an intrusion inside landing-air protection area.	Potential landing accident/runway excursion
OH-35	Remote ATC fails to provide appropriate ATC services with respect to operational environment conditions on the aerodrome and its vicinity.	This hazard is already covered by more detailed hazards already identified above, potentially inducing conflicts in the vicinity of the aerodrome or on the manoeuvring area due to inappropriate understanding of the operational environment conditions. This hazard is related to all other hazards EXCEPT: OH-01, OH-08, OH-09, OH-13, OH-16, OH-26, OH-28, OH-34.
OH-36	ATC resources are incorrectly managed in the RTC for the remote provision of ATC services.	In case controller has to manage more traffic than expected, the controller workload could be negatively impacted and so the capability to provide ATC services. This hazard is to be considered as part of ALL the other hazards in which controller errors are a potential cause.
OH-37	Remote ATC fails to provide appropriate ATC services due to inappropriate capability of the remote tower system.	This hazard is already considered as part of ALL other hazards already identified above in which equipment failure/errors are potential causes, potentially inducing conflicts in the vicinity of the aerodrome or on the manoeuvre area.

12.3. Appendix 3: List of operational hazards for AFIS

Table 3 below lists the operational hazards based on the results of the SESAR safety work, performed in the framework of the SESAR JU programme, that may be considered by the ATS provider for AFIS. They are valid in the in the context of single mode of operation as well as multiple mode of operation. However, it should be noted that the operational hazards were developed for the specific operational applications and context that was studied and using the specific methodology as described in the SESAR safety assessment reports [26] and [33]. The SESAR safety work focussed on the ATC case, assuming that the most constraining results specifying the concept of remote aerodrome ATS would be derived from ATC services. Therefore, if using this list as an initial input, it needs to be adapted as necessary taking into account the local conditions and the operational application and context of the particular implementation as well as the addition of potential system hazards.

Table 3: Initial list of operational hazards (SESAR safety assessment — AFIS case)

ID	Description
OH-AFIS-01	Remote AFIS fails to properly select runway-in-use.
OH-AFIS-02	Remote AFIS fails to identify potential 'conflicts' in the vicinity of the aerodrome.
OH-AFIS-03	Remote AFIS fails to provide appropriate traffic information (including local traffic) to relevant traffic: — direction of flight or traffic concerned; — type of wake-turbulence category; — level of traffic and potential changes; — relative bearing (12-h clock indication); — other relevant information.
OH-AFIS-04	Remote AFIS fails to provide appropriate information concerning the availability of the runway for departing/arriving traffic.
OH-AFIS-05	Remote AFIS fails to provide appropriate traffic position information on the manoeuvring area.
OH-AFIS-06	Remote AFIS fails to provide appropriate wake-turbulence- and jet-blast-related information.
OH-AFIS-07	Remote AFIS fails to provide appropriate essential information on aerodrome conditions (surface conditions, maintenance works, obstacles, birds, lighting system failure, etc.) to departing and arriving traffic: — conditions on the manoeuvring area; — conditions on the parking area.
OH-AFIS-08	Remote AFIS fails to provide appropriate start-up instructions to departing traffic.
OH-AFIS-09	Remote AFIS fails to provide appropriate meteorological information to departing and arriving traffic.
OH-AFIS-10	Remote AFIS fails to manoeuvre the visual signals to indicate to traffic that aerodrome is not safe.
OH-AFIS-11	Remote AFIS incorrectly coordinates with ATC for arriving traffic.

ID	Description
OH-AFIS-12	Remote AFIS incorrectly coordinates with ATC for departing traffic.
OH-AFIS-13	Remote AFIS fails to provide appropriate information on local traffic to assist taxiing operations.
OH-AFIS-14	Remote AFIS incorrectly provides authorisation to persons/vehicles to enter into the manoeuvring area.
OH-AFIS-15	Remote AFIS fails to provide light signals to vehicles and personnel on the manoeuvring area (when adequate or in case of radio communication failure).
OH-AFIS-16	Remote AFIS fails to provide appropriate relevant information on local traffic and aerodrome conditions to assist the flight crew in deciding when to take off.
OH-AFIS-17	Remote AFIS fails to provide appropriate relevant information on local traffic and aerodrome conditions to assist the flight crew in deciding whether to land or go around.
OH-AFIS-18	Remote AFIS fails to detect a runway incursion or the existence of any obstruction (including animals) on or in close proximity to the take-off/landing area.
OH-AFIS-19	Remote AFIS fails to operate aeronautical ground lights: — manoeuvring lighting; — taxiway area lighting.
OH-AFIS-20	Remote AFIS fails to monitor visual aids status.

12.4. Appendix 4: SESAR division of basic and advanced features

The documentation of the SESAR JU programme often refers to a division of technical enablers into 'basic' and 'advanced features', when presenting the results of the various validations and solutions. Depending of the particularities of each validation and each SESAR solution, this division between 'basic' and 'advanced' sometimes differs slightly between the SESAR deliverables. For the purpose of this document, a screening of the various technical set-ups regarding the division of 'basic' versus 'advanced', as described for the various SESAR Solutions ([19], [20], [21], [22]) and their related SESAR validations ([25], [28], [29], [32]), has been made and based on that a representative division is presented below. When this document is discussing the results and validations of the SESAR JU programme and referring to 'basic' and 'advanced' equipage, the division presented below is assumed:

— **Basic features:**

- visual presentation, replacing the OTW view of a conventional tower;
- binocular functionality (e.g. a Pan-Tilt-Zoom (PTZ) camera/function, as defined and described in ED-240 [18]), fulfilling the function of a binocular in a conventional tower.

— **Advanced features:**

- additional visual 'hot spot' cameras;
- the use of infrared or other optical sensors/cameras outside of the visible spectrum;
- binocular functionality automatic following of moving objects (commonly referred to as 'PTZ tracking');
- dedicated means to facilitate the detection, identification and automatic following of aircraft or vehicles in the visual presentation (e.g. by labels based on surveillance data, complemented by flight plan correlation when available, commonly referred to as 'radar tracking');
- dedicated means to facilitate the detection and following of moving objects in the visual presentation (e.g. by highlighting/framing such objects based on image processing systems, commonly referred to as 'visual tracking'[90]);
- other overlaid information in the visual presentation such as; framing and/or designation of runways, taxiways, etc., compass directions, meteorological information;
- ATS surveillance (air and/or ground radar presentation).

[90] At the time of publication of this document, EUROCAE working group 'Remote and Virtual Tower' (WG-100) is developing ED-240A, an extension to ED-240 'Minimum Aviation System Performance Specification (MASPS) for Remote Tower Optical Systems' [18], to include remote tower optical target tracking technologies. Expected publication of ED-240A is end 2018. This group currently uses the term 'optical sensor based object augmentation' synonymously with the term 'visual tracking'.

12.5. Appendix 5: List of acronyms

ACC	Area Control Centre
AD	Aerodrome
ADS-B	Automatic Dependent Surveillance – Broadcast
AFIS	Aerodrome Flight Information Service
AFISO	Aerodrome Flight Information Service Officer
AIC	Aeronautical Information Circular
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
AMC	Acceptable Means of Compliance
ANS	Air Navigation Service
APP	Approach Control
ATC	Air Traffic Control (in this document mostly used to specifically target 'aerodrome control service')
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSEP	Air Traffic Safety Electronics Personnel
CFIT	Controlled Flight Into Terrain
CN	Contextual Note
CNS	Communication Navigation Surveillance
CWP	Controller Working Position
EASA	European Aviation Safety Agency
EC	European Commission
ED Decision	Executive Director Decision
E-OCVM	European Operational Concept Validation Methodology
EU	European Union
EUROCAE	European Organisation for Civil Aviation Equipment
FIC	Flight Information Centre
FOD	Foreign Object Debris
GM	Guidance Material
HMI	Human Machine Interface
ICAO	International Civil Aviation Organization
ID	Identifier
IFR	Instrument Flight Rules
IR	Implementing Rule
IT	Information Technology
MASPS	Minimum Aviation System Performance Standards
MET	Meteorological
METAR	Meteorological Terminal Aviation Routine Weather Report
NOTAM	Notice to Airmen
NPA	Notice of Proposed Amendment
OH	Operational Hazard
OSED	Operational Services and Environment Description

OTW	Out-The-Window
PANS-ATM	Procedures for Navigation Services – Air Traffic Management
PSR	Primary Surveillance Radar
PTZ	Pan-Tilt-Zoom
QNH	Q code indicating atmospheric pressure adjusted to sea level
RFFS	Rescue and Firefighting Services
RGL	Runway Guard Lights
RTC	Remote Tower Centre
RTM	Remote Tower Module
RWY	Runway
SAR	Safety Assessment Report
SERA	Standardised European Rules of the Air
SESAR	Single European Sky ATM Research
SESAR JU	Single European Sky ATM Research Joint Undertaking
SSR	Secondary Surveillance Radar
TAF	Terminal Aerodrome Forecast
UPS	Uninterruptible Power Supply
VALR	Validation Report
VFR	Visual Flight Rules
WAN	Wide Area Network

3.2 Draft acceptable means of compliance and guidance material (Draft EASA decision)

Draft resulting text

Regarding the EU ATCO regulatory framework, the amendments to the existing AMC/GM[91] associated to Commission Regulation (EU) 2015/340 are proposed below.

Rationale

With the proposal contained below, the AMC and GM that where introduced by Annex I of ED Decision 2015/015/R are partly amended and updated. In addition, new GM is proposed to cater for the extended scope of this NPA, such as the concept of multiple mode of operation.

The regulatory level for the ATCO licensing aspects of remote aerodrome ATS was concluded already as indicated in NPA 2015-04[92] (refer to Section 2.2.7 of said NPA). EASA considers that the assumptions leading to the result from the assessment in that NPA have not changed.

Regarding the qualification and training of ATS personnel in general, it is highlighted that the regulatory framework for AFISOs (as well as ATSEPs) is different from the ATCO regulatory framework. Currently no common European Union (EU) licensing scheme exists for AFISOs and the approach to their qualification is also different compared to ATCOs. Qualification and training aspects for AFISOs (and ATSEPs) is discussed in Chapter 10 of the 'Guidelines on Remote Aerodrome Air Traffic Services', contained in this NPA. Apart from that, no other regulatory actions are proposed.

[91] Decision 2015/010/R of the Executive Director of the Agency of 13 March 2015 adopting Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) 2015/340 and Decision 2015/015/R of the Executive Director of the Agency of 3 July 2015 amending Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) 2015/340.

[92] https://www.easa.europa.eu/document-library/notices-of-proposed-amendment/npa-2015-04

The text of the amendment is arranged to show deleted text, new or amended text as shown below:

— deleted text is ~~struck through~~;

— new or amended text is highlighted in grey.

AMC1 ATCO.B.020(a) Unit endorsements

GENERAL

When aerodrome control service is provided ~~from a remote location~~ by 'remote aerodrome ATS' (defined in EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2[93]), each aerodrome for which the service is provided should constitute its own unit endorsement.

GM1 to AMC1 ATCO.B.020(a) Unit endorsements

There might be cases where, for a given aerodrome, air traffic control service is provided from a 'conventional tower' (defined in EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) during certain time periods and from a 'remote tower' (defined in EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) at other times. In such cases, the unit endorsement(s) should indicate the working position(s) (conventional and/or remote tower) from which the licence holder is authorised to provide the service.

When this is done for shorter/limited time periods, e.g. during a validation or for transitional purposes, different unit endorsements for conventional and remote tower may not be considered necessary.

GM1 ATCO.D.055(a) Unit training plan

— UNIT TRAINING PLAN FOR A REMOTE TOWER CENTRE

~~ATC UNIT FOR AERODROME CONTROL FROM A REMOTE TOWER~~

For the purpose of establishing a unit training plan, a 'Remote Tower Centre' (RTC) (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) may be considered as one Air Traffic Control (ATC) unit.

The unit training plan of a RTC should include the list of the unit endorsement courses for all aerodromes which the RTC is providing service to.

GM3 ATCO.D.060(c) Unit endorsement course

TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING REMOTE AERODROME ATS

The unit endorsement course should enable air traffic controllers providing 'remote aerodrome ATS' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) to acquire knowledge of the concept of remote aerodrome ATS and of the characteristics of the operating environment, to appreciate the necessity to consider the specific human factors influence on the remote aerodrome ATS as well as to recognise specific abnormal situations and to manage their impact.

This could be achieved by addressing e.g. the following items:

— Introduction to remote aerodrome ATS;

[93] See: [link to EASA Remote Towers webpage to be added once the ED Decision is published]

- Concept of remote aerodrome ATS (described in Chapters 3 and 4 of the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), e.g. 'remote tower modules' (RTMs) (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), 'remote tower centre' (RTC) (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), technical enablers used for remote aerodrome ATS (described in Chapters 3.5 and 5 of the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), operational applications (described in Chapters 3 and 4 of the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2).

— Operating environment;

- Configuration of the RTM and RTC (if applicable);
- 'Visual presentation' (defined and described in Sections 2 and 5.2 of the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) at the RTM, e.g.;
  - layout and orientation;
  - technical capabilities and limitations of a 'visual presentation system' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), e.g. impact of weather conditions on site the aerodrome, end-to-end delay, frame rate, any differences in light conditions between the aerodrome and the visual presentation, 'dead' pixels, any overlaid information and any site specific equipment such as sun filters;
- Set-up and characteristics of the local equipment at the aerodrome, e.g. location of cameras, signalling lamp etc.;
- Familiarisation with the physical aerodrome(s) environment and the different local stakeholders via study visit(s).

— Human factors aspects;

- Human factors influence on remote aerodrome ATS;
- Factors that can generate fatigue in 'remote tower' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) environment (e.g. eye strain caused by the performance of the visual presentation or by contrast in lighting against the background, artificial light and/or lack of daylight in the RTM) and preventing and mitigating strategies on fatigue.

— Procedures for degraded modes, e.g.;

- Complete or partial loss of the visual presentation;
- Corrupt, delayed or frozen image;
- Loss or degradation of the 'binocular functionality' (described in Chapter 5.3 of the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2).

~~PERFORMANCE OBJECTIVES FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL SERVICE FROM A REMOTE TOWER~~

~~The performance objectives for air traffic controllers providing aerodrome control service from a remote tower should ensure, through the use of a Remote Tower Module (RTM), that applicants apply ATC procedures in a manner that airspace users are not negatively impacted/affected, providing at least the same level of safety as from a conventional tower.~~

GM4 ATCO.D.060(c) Unit endorsement course

MULTIPLE MODE OF OPERATION

When performing 'multiple mode of operation' (defined in Sections 2, 3 and 4 of the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), in addition to GM3 ATCO.D.060(c), the following items should also be considered:

— Use of communication facilities (e.g. aeronautical mobile service, aeronautical fixed service and surface movement control service) for simultaneous provision of ATS in geographically separated areas of responsibility;

— Applicable procedures for traffic management, such as traffic prioritisation, enabling multiple mode of operation;

— Procedures for prioritising between aerodromes;

— Procedures for the transferring/merging/splitting of aerodromes in a RTM (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2);

— Different weather conditions at different aerodromes;

— Human limitations with regard to the simultaneous handling of more than one aerodrome and distribution of attention.

~~TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL SERVICE FROM A REMOTE TOWER~~

~~For air traffic controllers providing aerodrome control service from a remote tower, the following subjects, subject objectives, topics and subtopics should be integrated into the unit endorsement course:~~

~~Subject 1: REMOTE TOWER OPERATION~~

~~— The subject objective is:~~
~~Learners shall acquire knowledge of the concept of remote tower operations, the characteristics of the operating environment, as well as the functions and limitations of the equipment.~~

~~**TOPIC RTO 1 INTRODUCTION TO REMOTE TOWER OPERATION**~~
~~Subtopic RTO 1.1 — Operational applications~~
~~Subtopic RTO 1.2 — Remote Tower Modules (RTMs), Remote Tower Centre (RTC)~~
~~Subtopic RTO 1.3 — Advanced Visual Features (AVFs) — Technologies, if available, to enhance visual presentation~~

~~**TOPIC RTO 2 OPERATING ENVIRONMENT**~~
~~Subtopic RTO 2.1 — Configuration of the RTM~~
~~Subtopic RTO 2.2 — Visual presentation at the RTM, e.g. layout of the visual presentation, end-to-end delay, orientation, differences in light conditions between the aerodrome and the Out-The-Window (OTW) visual presentation, use of filters, recognition of 'dead' pixels~~
~~Subtopic RTO 2.3 — Operating methods~~
~~Subtopic RTO 2.4 — Set-up and characteristics of the local equipment, including the location of the cameras~~
~~Subtopic RTO 2.5 — Familiarisation with the physical aerodrome environment and the different stakeholders via study visit(s)~~
~~Subtopic RTO 2.6 — Weather conditions' impact on the equipment and on the visual presentation~~

~~Subject 2: HUMAN FACTORS~~

~~The subject objective is:~~
~~Learners shall appreciate the necessity to consider the specific human factors influence on the remote provision of aerodrome control service.~~

~~Subject 3: ABNORMAL SITUATIONS~~

~~The subject objective is:~~
~~Learners shall recognise specific abnormal situations and manage their impact.~~

~~**TOPIC ABN 1 LOSS OF VISUAL PRESENTATION**~~
~~Subtopic ABN 1.1 — Complete loss of visual presentation, e.g. 'blank screens' or frozen presentation~~
~~Subtopic ABN 1.2 — Visual presentation not being current~~

~~**TOPIC ABN 2 DEGRADED MODES OF VISUAL PRESENTATION**~~
~~Subtopic ABN 2.1 — Partial loss of visual presentation (e.g. loss of a screen(s) or camera failure)~~
~~Subtopic ABN 2.2 — Loss or degradation of the labelling system, if available~~
~~Subtopic ABN 2.3 — Loss or degradation of the zooming functionality and signalling lamp~~

GM1 ATCO.D.080(b) Refresher training

REFRESHER TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING REMOTE AERODROME ATS

~~TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL SERVICE FROM A REMOTE TOWER~~

For air traffic controllers holding a unit endorsements for 'remote aerodrome ATS' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) ~~providing aerodrome control service from a remote tower~~, the refresher training should include familiarisation with the physical aerodrome environment and the different stakeholders via study visit(s).

GM1 ATCO.D.085 Conversion training

CONVERSION TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING REMOTE AERODROME ATS

~~TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL SERVICE FROM A REMOTE TOWER~~

In case of a transition ~~When converting~~ from a 'conventional tower' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) to a 'remote tower' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), the conversion training for air traffic controllers providing 'remote aerodrome ATS' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) ~~aerodrome control service from a remote tower~~ should at least include the items listed ~~subjects, subject objectives, topics and subtopics as specified~~ in GM3 ~~GM4~~ ATCO.D.060(c).

In case of a transition ~~When converting~~ from a remote tower to a conventional tower, the training organisation should consider possible additional training needs, if appropriate, required by the change of operational environment.

In case of a transition from 'single mode of operation' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2) to 'multiple mode of operation' (defined in the EASA Guidelines on Remote Aerodrome Air Traffic Services — Issue 2), the conversion training for air traffic controllers should at least include the items listed in GM4 ATCO.D.060(c).

4. Impact assessment (IA)

Considering that the proposals in this NPA contains mainly guidelines, as well as some amendments on AMC/GM for the related ATCO Licensing provisions, to facilitate safe and harmonised implementations of remote aerodrome ATS provision, EASA has not conducted a detailed impact assessment. The Options were limited as already indicated in NPA 2015-04[94] (refer to Section 2.4 of said NPA). EASA considers that the assumptions leading to the results from the assessment in that NPA have not changed.

[94] https://www.easa.europa.eu/document-library/notices-of-proposed-amendment/npa-2015-04

5. Proposed actions to support implementation

EASA intends to launch a support to implementation action under the existing EASA advisory bodies (ATM/ANS and ADR TeB and ATM/ANS and ADR TeC), with a view to exchange best practises for the implementation of the remote tower project as well as their oversight. The forum will provide a platform for questions and exchange of experiences. This support to implementation action may contain, or may be supported by, one or more of the below listed methods:

— Focused communication for advisory body meeting(s):

  (ATM/ANS and ADR TeB and ATM/ANS and ADR TeC).

— Establishment of specific forum under the Agency's advisory bodies:

  (ANSPs, ADR operators, industry, Competent Authority).

— Dedicated thematic workshops/sessions:

  (ANSPs, ADR operators, industry, Competent Authority).

— Series of thematic events organised on the regional/national principle:

  (ANSPs, ADR operators, industry, Competent Authority).

— Combination of the above selected means:

  (ANSPs, ADR operators, industry, Competent Authority).

6. References

6.1 Related regulations

- Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1)
- Commission Implementing Regulation (EU) No 1034/2011 of 17 October 2011 on safety oversight in air traffic management and air navigation services and amending Regulation (EU) No 691/2010 (OJ L 271, 18.10.2011, p. 15)
- Commission Implementing Regulation (EU) No 1035/2011 of 17 October 2011 laying down common requirements for the provision of air navigation services and amending Regulations (EC) No 482/2008 and (EU) No 691/2010 (OJ L 271, 18.10.2011, p. 23)
- Commission Implementing Regulation (EU) 2017/373 of 1 March 2017 laying down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight, repealing Regulation (EC) No 482/2008, Implementing Regulations (EU) No 1034/2011, (EU) No 1035/2011 and (EU) 2016/1377 and amending Regulation (EU) No 677/2011 (OJ L 62, 8.3.2017, p.1)
- Commission Regulation (EU) 2015/340 of 20 February 2015 laying down technical requirements and administrative procedures relating to air traffic controllers' licences and certificates pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council, amending Commission Implementing Regulation (EU) No 923/2012 and repealing Commission Regulation (EU) No 805/2011 (OJ L 63, 6.3.2015, p. 1)
- Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Implementing Regulation (EU) No 1035/2011 and Regulations (EC) No 1265/2007, (EC) No 1794/2006, (EC) No 730/2006, (EC) No 1033/2006 and (EU) No 255/2010 (OJ L 281, 13.10.2012, p. 1)
- Commission Implementing Regulation (EU) No 139/2014 of 12 February 2014 laying down requirements and administrative procedures related to aerodromes pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 44, 14.2.2014, p. 1)
- 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) (OJ L 96, 31.3.2004, p. 26)

6.2 Affected decisions

- EASA Executive Director Decision 2015/014/R of 3 July 2015 adopting Guidance Material on the implementation of the remote tower concept for single mode of operation
- EASA Executive Director Decision 2015/010/R of 13 March 2015, adopting Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) 2015/340