European Aviation Safety Agency

Notice of Proposed Amendment 2015-04

Technical and operational requirements for remote tower operations

RMT.0624 — 23.3.2015

EXECUTIVE SUMMARY

This Notice of Proposed Amendment (NPA) addresses a safety issue related to the provision of aerodrome air traffic services when they are provided from a remote tower, commonly known as remote tower operations.

The specific objective of this rulemaking task is to maintain the level of safety in those specific cases where these services are provided from a remote tower, compared to their provision from a conventional tower, as well as to promote the development of a new technology associated to the remote tower concept, thus ensuring a safe implementation.

Therefore, this NPA introduces guidance on the implementation of the remote tower concept for single mode of operation, which is within the scope of the current regulatory framework (Commission Implementing Regulation (EU) No 1035/2011, Commission Regulation (EU) No 139/2014, and Commission Implementing Regulation (EU) No 923/2012), and proposes at the same time 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.

The proposed changes are expected to maintain safety and at the same time improve harmonisation as regards the implementation of the remote tower concept.

Applicability		Process map	
Affected regulations and decisions:	Decision 2015/010/R	Concept Paper:	No
		Terms of Reference:	9.12.2014
		Rulemaking group:	Yes
Affected stakeholders:	Air Navigation Service Providers; aerodrome operators; competent authorities; Air Traffic Management system developers; airspace users.	RIA type:	Full
		Technical consultation during NPA drafting:	No
		Duration of NPA consultation:	6 weeks
Driver/origin:	SESAR; safety; proportionality and cost-effectiveness; technological developments.	Review group:	TBD
		Focussed consultation:	TBD
		Publication date of the Opinion:	n/a
Reference:	Not applicable.	Publication date of the Decision:	2015/Q2

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1. Procedural information

1.1. The rule development procedure

The European Aviation Safety Agency (hereinafter referred to as the 'Agency') 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 Agency's Revised 2014–2017 Rulemaking Programme under RMT.0624.

The text of this NPA has been developed by the Agency, based on the input of the RMT.0624 Rulemaking Group. It is hereby submitted for consultation of all interested parties[3].

The process map on the title page contains the major milestones of this rulemaking activity to date, and provides an outlook of the timescale of the next steps.

1.2. The structure of this NPA and related documents

Chapter 1 of this NPA contains the procedural information related to this task. Chapter 2 (Explanatory Note) explains the core technical content. Chapter 3 contains the proposed guidance regarding the implementation of the remote tower concept. Chapter 4 contains the proposed amendments to the existing AMC/GM to Commission Regulation (EU) 2015/340[4].

1.3. 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/**[5].

The deadline for submission of comments is **4 May 2015.**

1.4. The next steps in the procedure

The Agency will publish the related Comment-Response Document (CRD) 2015-04 concurrently with the Executive Director's Decision containing guidance on the implementation of the remote tower concept and Acceptable Means of Compliance (AMC) and Guidance Material (GM) to Commission Regulation (EU) 2015/340.

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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), as last amended by Commission Regulation (EU) No 6/2013 of 8 January 2013 (OJ L 4, 9.1.2013, p. 34).

2 The Agency is bound to follow a structured rulemaking process as required by Article 52(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as the 'Rulemaking Procedure'. See Management Board Decision concerning the procedure to be applied by the Agency for the issuing of Opinions, Certification Specifications and Guidance Material (Rulemaking Procedure), EASA MB Decision No 01-2012 of 13 March 2012.

3 In accordance with Article 52 of the Basic Regulation and Articles 5(3) and 6 of the Rulemaking Procedure.

4 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).

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

2. Explanatory Note

2.1. Background

The remote tower concept has been studied in the context of the Single European Sky ATM Research (SESAR) project for many years. This concept introduces the possibility to provide aerodrome Air Traffic Services (ATS) to an aerodrome from a remote location, and some European Union Member States, driven by the solution offered by the SESAR project, have started implementing it.

At International Civil Aviation Organization (ICAO) level, the provision of ATS is defined in Annex 11 'Air Traffic Services', Doc 4444 (PANS-ATM), Doc 7030 and Doc 9426; guidance material concerning the provision of 'Aerodrome Flight Information Service (AFIS)' may be found in ICAO Circular 211-AN/128.

As defined in Article 2(32) of Commission Implementing Regulation (EU) No 923/2012[6], as well as in ICAO Annex 11 and Doc 4444 (PANS-ATM), ATS include the following elements:

— flight information service,

— alerting service,

— air traffic advisory service, and

— air traffic control service (area control service, approach control service or aerodrome control service).

Aerodrome control service is provided by licensed Air Traffic Controllers (ATCOs) who 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:

— aircraft flying within the designated area of responsibility of the control tower, including the aerodrome traffic circuits,

— aircraft operating on the manoeuvring area,

— aircraft landing and taking off,

— aircraft and vehicles operating on the manoeuvring area, and

— aircraft on the manoeuvring area and obstructions on that area.

AFIS is the term used to describe the provision of information useful for the safe and efficient conduct of aerodrome traffic. Regarding AFIS, the Aerodrome Flight Information Officer (AFISO) is the person properly trained, competent and duly authorised to provide AFIS. Except for cases when relaying clearance from Air Traffic Control (ATC), AFISOs shall only pass information and warnings to pilots. Pilots are therefore wholly responsible for maintaining proper spacing in conformity with the applicable rules of the air.

The remote tower concept also considers the provision of alerting service, which is defined as the service provided to notify appropriate organisations regarding aircraft in need of search and rescue aid, and assist such organisations as required.

The concept could also bring about a potential increase in safety associated with the use of visual technologies that would allow for some safety enhancements in low-visibility situations (however, currently nothing prevents the use of visual technologies when the service is provided from a

[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 (OJ L 281, 13.10.2012, p. 1).

conventional tower). The fact that there would be the possibility to label objects moving on the aerodrome and its vicinity could also prevent runway incursions.

The provision of aerodrome ATS has been based on one fundamental principle: the direct visual observation of traffic by the ATCO or the AFISO within their area of responsibility, as stated by the ICAO regulatory framework in DOC 4444 'PANS-ATM' and, as guidance material, the ICAO Circular 211-AN/128 and the EUROCONTROL's Manual for AFIS respectively. These documents refer to the need to maintain **visual observation** at all times of all flight operations on and in the vicinity of an aerodrome, as well as of vehicles and personnel on the manoeuvring area. At the same time, the above-mentioned documents provide the possibility of using technologies, such as ATS surveillance systems, when available, in certain conditions. The development and introduction of new technologies make now possible the provision of aerodrome ATS from a remote location, either in the form of AFIS or ATC. This concept also provides the possibility to use a remote facility for contingency purposes. The approach being followed by some stakeholders, as it is also validated by the SESAR project, suggests that the implementation of the concept of remote provision of aerodrome ATS would also allow for safety enhancements as regards operations with aircraft, vehicles and persons operating within the airspace and/or the areas of the aerodrome. The direct visual observation by personnel physically present at the aerodrome will be replaced by cameras and sensors presenting the 'Out-The-Window' (OTW) view, adding information from other sources (when available) such as radar, multilateration or other positioning and surveillance systems providing the positions of moving objects within the aerodrome's movement area and its vicinity. Recent trials and validation activities have demonstrated the viability of the concept.

The increasing number of initiatives taken worldwide to provide remote aerodrome ATS have been duly noted also by ICAO, as indicated in the ICAO Global Air Navigation Plan (Doc 9750) and in the Working Document for the 'Aviation System Block Upgrades' of 28 March 2013 (Section B1-RATS, Remotely Operated Aerodrome Control).

The meaning of 'visual observation' referenced in the relevant ICAO documents is somehow questioned by the aviation community, and the various stakeholders concerned interpret differently its meaning. It is therefore necessary to establish clarity and common understanding on this subject, with the objective of being able to verify the applicability of the established ICAO ATS procedures, or to develop additional requirements and/or guidance which fit with the established ATS provision framework, in particular with the principle of visual observation.

2.2. Overview of the issues to be addressed

2.2.1. Safety assessment methodology

The introduction into service of the remote tower concept cannot be considered only as a pure technical system change. Significant impacts could be envisaged on procedural and personnel aspects (part of the functional system). Additionally, it may affect other stakeholders (aerodrome and its operator, airspace users, etc.). Therefore, it has been considered reasonable to define some provisions regarding particular aspects of the way in which the demonstration of the overall safety assessment should be performed by the ATS providers and aerodrome operators.

2.2.2. Operational context

In principle, nothing prevents the remote tower concept to be implemented at aerodromes of all sizes and conditions. Therefore, it seems reasonable to define the elements that would render an aerodrome suitable for the provision of remote ATS while maintaining safety as if the service was provided locally from the aerodrome. It is therefore proposed that the identified elements be part of the safety assessment for the change so that the particular conditions of the aerodrome are taken into consideration. They can be divided into operational characteristics (such as traffic density, type of

traffic, airspace configuration, etc.) and environmental characteristics (all meteorological conditions, aerodrome surroundings).

At the same time, the remote tower system can be catalogued attending to the functionalities that it may have. Depending on the operational/environmental characteristics of the aerodrome, certain system functionalities may be needed in order to provide ATS effectively while maintaining the required level of safety.

2.2.3. ATS provider's role and performance

Regarding the operation, it seems necessary to analyse the extent to which ATS personnel is impacted by the new visualisation ability and system, taking into consideration the nature of the visual presentation and its associated characteristics (field of view, two-dimensional view with possible loss-of-depth perception, effect of the lighting, compressed image, etc.). The aforementioned elements could require other enhanced visualisation sources to support the implementation of the remote tower concept. This need would have a direct impact on airspace users (e.g. necessity to have transponders on board, etc.).

2.2.4. System aspects

As part of the SESAR project, an initial definition of the remote tower system and of the associated safety requirements has been coined and documented. It will be further developed and consolidated by the ongoing standardisation works (EUROCAE WG-100 'Remote and Virtual Towers') and documented in the respective standards. In addition to these ongoing activities, it has been found reasonable to develop an analysis of the main functionalities of a remote tower system and an initial definition of the associated requirements/objectives, considering the SESAR project's results, the implementation by stakeholders and other aspects in order to facilitate the initial deployment of this technology by the different ATS providers. This should be considered as an initial specification to be further developed in order to duly take into consideration the outcomes of the EUROCAE WG-100, i.e. the Minimum Aviation System Performance Specifications (MASPS), once they are available.

Additionally, guidance is proposed about the split of the remote tower system into constituents. This guidance might be used by ATS providers when required to demonstrate compliance with the interoperability Regulation[7], which shall be based on the Declaration of Suitability for Use (DSU) by the manufacturers due to the current lack of Community Specifications (CSs). The split of the system into constituents should be consistent with the assumptions and approach taken by the EUROCAE WG-100 in order to ensure a seamless transition from a DSU-based compliance to a Declaration Of Conformity (DOC)-based compliance, once the standards (and associated CSs) are available.

Finally, compared with a conventional tower, the introduction of the remote tower concept may increase the likelihood of increasing the existing security risks and, potentially, some additional security risks may be identified. For this reason, specific provisions should be developed to increase the awareness about such additional risks (with respect to the current operations) resulting from the distributed nature of the new system and the potential impact on the ATCO/AFISO visual observation.

2.2.5. Abnormal situations and contingency procedures

The remote tower concept presents also some new safety-related elements that need to be carefully analysed and, where necessary, mitigated. One of the key concerns is the reliability of the system and the potential creation of abnormal situations, since a system failure (degraded mode, hardware malfunction, etc.) might create a situation where the ATCO or AFISO would suddenly not be able to

[7] 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).

maintain visual observation of and/or communication with aircraft under their responsibility. For these reasons, new contingency procedures and associated working methods will be required.

2.2.6. Transition plan

As part of the introduction into service of the remote tower concept, the ATS provider, in coordination with the aerodrome operator concerned, should establish a transition plan in such a way that ATS are moved from the local conventional tower to the remote facility. This transition plan should define the different phases to be followed (and the associated transition criteria), allowing in any case the fall-back procedure of ATS being provided from the local conventional tower in case of unexpected events or problems. Then, the capability of providing ATS from the local tower should be kept during the entire transition process, which shall include a period of time (to be defined by the ATS provider) during which the possibility of falling back on the conventional tower exists in case it is needed. The transition plan should be subject to safety assessment.

2.2.7. ATCOs'/AFISOs' qualifications and training

Regarding the aspects of the qualifications and training of the ATS personnel responsible for the provision of ATS from remote towers, it is important to first differentiate between ATCOs and AFISOs, since the regulatory framework currently applicable to this personnel is different. No common European Union (EU) licensing scheme exists for AFISOs, and the approach to their qualifications is also different compared to ATCOs.

As far as ATCOs are concerned, the Agency collected already the views of its stakeholders via NPA 2012-18 on the 'Licensing and medical certification of air traffic controllers'[8] with the aim to identify how such operating methods could be best handled from the regulatory point of view. Four questions were put forward for discussion, which generated valuable feedback for the follow-up of the said NPA and created some basis also for the present one.

The questions made through NPA 2012-18 were related to several aspects regarding the remote tower concept, focussing on both the administrative element (necessity for a new rating endorsement and unit endorsements associated to the remote operation) and the training objectives (harmonisation and duration).

Despite the diverse nature of the comments and responses received, and the fact that a considerable number of commentators stated that the concept of remote towers was (at that point in time) not mature enough, generally the input received proved valuable for the Agency.

More than three years after the publication of NPA 2012-18 and the related questionnaire, the Agency is currently still sharing the opinion that given the yet early status of such projects and the limited amount of available data, there is no justification for strong regulatory intervention. However, based on existing practices and experience, some guidance should be elaborated which could serve as a basis for the future projects of interested stakeholders.

The responses to the questionnaire showed that the majority of stakeholders is clearly in favour of requiring every aerodrome, for which the traffic is controlled by a remote tower, to be covered by its own unit endorsement. This view is in line with the current definition of unit endorsement, according to which unit endorsement means the authorisation entered on and forming part of a licence, indicating the ICAO location indicator and the sector, group of sectors or working positions where the licence holder is competent to work at. The unit endorsement authorises the licence holder to provide ATC services for a specific sector, group of sectors and/or working positions. To enhance clarity, the Agency now proposes to add a new GM to ATCO.B.020(a) clarifying the scope of the unit endorsement's privileges with regard to remotely controlled aerodromes.

[8] http://www.easa.europa.eu/document-library/notices-of-proposed-amendments/npa-2012-18

As regards integrating the privileges of providing aerodrome control service from a remote location into a rating endorsement and thus creating the basis for mutual recognition in this domain, the Agency is still of the opinion that there is neither a need nor a valid basis yet for such action. The privileges of the Tower Rating (TWR) endorsement are based on common training requirements that are placed at Implementing Rule (IR) level and this commonality creates the basis for the EU-wide recognition of that qualification. The remote tower concept is currently in such early stages and the initiatives are so diverse that the Agency sees no added value in creating detailed, one-size-fits-all requirements. Moreover, due to the very specific local technologies and operating methods, the Agency does not yet see a real need to support the establishment of a generic remote tower qualification by regulatory means. Should the technology used become more harmonised and widespread, this option can of course be analysed anew.

As regards harmonisation of the training objectives for remote towers across the EU, most commentators stressed the importance of site-specific training associated with the unit endorsement. Based on these grounds, the Agency is now proposing high-level performance objectives as well as training subjects and objectives to be integrated into the unit training course. The leading principle of the proposal is to ensure that the use of specific equipment does not negatively impact/affect airspace users and the level of service compared to the aerodrome control provided locally from a conventional tower. The training subject encompasses the details of the remote tower operation including the operating environment, the associated human factors, and the specific abnormal situations.

In order to assist in the establishment of the appropriate unit training plans, the Agency proposes a new GM to ATCO.D.055(a) with the aim to clarify that for the purpose of the unit training plan a Remote Tower Centre (RTC) may be considered as one ATC unit.

Since the unit endorsement course is meant for student ATCOs or ATCOs from another unit, the Agency proposes to set out the same very high-level performance and training objectives for the conversion training, in the form of additional GM, which will cover changes in the operational environment. Turning a conventional tower into a remotely operated tower is certainly a change in the operational environment which requires the appropriate training of the affected ATCOs.

In conclusion, no modification of the ATCO licensing scheme laid down in Commission Regulation (EU) 2015/340 is required for those ATCOs who provide aerodrome control service from a remote tower. The Agency's proposal focusses on the establishment of high-level guidance as regards training and qualifications of such personnel, that can be imparted locally, as conversion or unit training, without putting additional administrative burden on competent authorities.

Regarding the qualifications and training scheme for AFISOs, for which there is a lack of common regulatory framework, the training should also take into consideration the differences related to the ATS provided from remote towers. In any case, no regulatory change is proposed in this regard.

2.2.8. Aerodrome aspects

Aerodrome design and operation should not be considered separately. On the contrary, a clear and strong systemic interdependence exists between aerodromes and other organisations providing services at an aerodrome, while both sides contribute to the safe and efficient functioning of the overall air transportation system.

This systemic interdependence is particularly true for the case of aerodrome and ATS. This interdependence is present in all phases, from the initial design phase of an aerodrome[9] until its commissioning, and continues to be present during its operation. Examples of such interdependencies

[9] As an example, the need for visibility from the aerodrome control tower may affect its location and this may, in turn, affect the design of the aerodrome and vice versa. See also ICAO Doc 9157 'Aerodrome Design Manual', Part 2 'Taxiways, Aprons and Holding Bays', Section 1.1.6.

are: the development of common procedures for the operation of the aerodrome in low-visibility conditions, the development of standard taxiing routes that satisfy the need for expeditious and safe traffic flow at the aerodrome while respecting the limitations emanating from the aerodrome's infrastructure design, the involvement of the ATS provider in the aerodrome's emergency plan, the operation of certain parts of the aerodrome's infrastructure (e.g. aerodrome visual aids systems) by the ATS personnel, etc.

The proper implementation of an organisation's Safety Management System (SMS) has as prerequisite the necessary 'system description' in order to properly identify interfaces and interdependencies between organisations and finally the potential hazards that may be posed to the system or may be generated by the system itself. In the case of aerodromes, the 'aerodrome system' includes ATS[10].

Based on this assumption, an aerodrome operator should not assess only the impact of the changes stemming directly from the aerodrome and its operation; it should also assess the impact that a change to other elements of the 'aerodrome system' might have on the aerodrome and on the safety of its own services. Such an assessment is necessary even if the changes to such elements are not driven by the aerodrome operator itself, or even if the organisation that is driving the change (e.g. ATS provider) has already assessed the impact of such a change (from its own standpoint). Moreover, such an assessment does not aim to the mere satisfaction of the relevant legal requirements, but aims also to satisfy the substantial methodological and safety needs that arise from a variety of factors, such as: potentially diverging criteria used for the safety assessment, approaching a certain issue from different angles and interests, lack of expertise in a given area, etc. In this regard, a properly coordinated assessment of such changes seems to be the most appropriate way forward.

The implementation of the remote tower concept at an aerodrome, which may equally be initiated by the aerodrome operator itself either because the aerodrome operator is also the ATS provider or merely due to financial or other reasons, may also affect the aerodrome and its operation.

This impact may have various forms, always depending on the complexity and the characteristics of the aerodrome and its operation, varying from the need to review and amend the existing aerodrome operating procedures contained in the aerodrome manual to the development and implementation of specific training for the aerodrome personnel in order to address totally new duties resulting from the remote provision of ATS, or enhance the existing ones. As a result, an agreed timeline with the ATS provider, and with the relevant competent authorities too, regarding the implementation of the remote ATS concept is also necessary.

In any case, it is understood that the areas that will be mainly affected by the implementation of the remote ATS concept — and therefore need to be taken particularly into account during the safety assessment process — are the following.

Possible reassignment of tasks between the ATS provider and the aerodrome operator

Such reassignment may be the result of tasks which although they fall under the responsibility of the aerodrome operator, had been performed by the ATS provider (e.g. runway surface condition assessment), or tasks which might not be performed by the ATS provider anymore and are therefore best reassigned to the aerodrome operator (e.g. meteorological observation on a permanent or ad hoc basis, or maintenance of facilities used for remote ATS provision, etc.), not only because it may already have appropriately qualified personnel available, but also in order to maintain the financial benefits stemming from the implementation of the concept of remote ATS provision.

[10] See ICAO Doc 9859 'Safety Management Manual', Second Edition, Appendix 1 to Chapter 7 'System Description Of An Aerodrome'.

Tasks which, due to their nature, are aerodrome-related but which will need to be modified/enhanced in order to satisfy newly created needs arising from the implementation of the concept of remote ATS provision

As an example, the equipment and facilities that will be located at the aerodrome, and potentially in its immediate vicinity, to support the remote provision of ATS will need to be safeguarded from various activities that may impact on their proper functioning, and therefore safety (e.g. obstacles, interferences), but also from an aviation security perspective[11]. This may be done as part of similar activities, already required to be conducted by the aerodrome personnel, aiming to safeguard other equipment serving communication, surveillance and navigation systems.

Review, update and implementation of the training requirements

Task reassignment, but also changes in the applicable procedures, may create the need to establish new or revisit existing training standards and other elements related to the development and implementation of the relevant aerodrome training programme (e.g. training content, syllabi, instructors'/assessors' qualifications, etc.).

Review and update of the relevant aerodrome documentation, including the aerodrome manual

Such an update should cover the outcome of any task reassignment in terms of necessary operating procedures, but also the result of the assessment of the current allocation of roles and responsibilities of persons and/or organisations in certain functions. For example, an aerodrome emergency plan may need to be amended because the roles/responsibilities that had been allocated to the ATS unit may not be possible to be implemented anymore as a result of the remote location of the ATS unit. Finally, the documentation review and update should also cover the result of the assessment of the appropriateness and effectiveness of the aerodrome's Advanced Surface Movement Guidance & Control System (A-SMGCS) under the proposed concept of remote ATS provision.

Technical solutions adopted for the remote operation of the aerodrome systems

For example, if the ATS provider will also be involved in the remote provision of apron management services, the aerodrome operator, being responsible for ensuring the safety on the apron through the provision of apron management services, should assess the potential impact of this change.

A similar approach is expected to be applied to all the aerodrome systems used by the ATS provider in the context of remote ATS provision (e.g. aerodrome lighting systems, monitoring systems) or other aerodrome systems necessary to be used by the ATS provider for other purposes (e.g. alerting systems for aerodrome Rescue and Firefighting Services (RFFS)). This approach should also cover the relevant communication systems needed for the safe operation of the aerodrome (e.g. communication between RFFS station and remote ATS unit).

2.2.9. Airspace user aspects

The different developments regarding the implementation of the remote tower concept are built upon the assumption that airspace users should by no means be negatively impacted. However, this condition might not be totally satisfied as in some cases, due to the visual presentation conditions and characteristics of the system and the necessity to ensure visual observation, the concept will require the assessment of the need to have lights on when entering airspace under the responsibility of the remote control tower. In line with that, if the characteristics of the scenario present some additional functionalities (e.g. surveillance) to support aircraft identification, that would have a direct impact on

[11] See ICAO Doc 9734 'Oversight Manual', Part C 'The Establishment and Management of a State's Aviation Security Oversight System', Section 2.2.3.

the aircraft equipment (need to have surveillance equipment on board) and might require the establishment of Transponder Mandatory Zones (TMZ).

2.2.10. Remote tower operations

As regards the operational scheme, the remote tower concept could present different modes of operation. However, the scope of the Guidance Material contained in this NPA is to address the single mode of operation which is defined as the provision of ATS from a Remote Tower Module (RTM) for only one aerodrome at a time. Under this mode of operation, there can be several units managed by different ATCO or AFISO from one remote location, usually referred to as RTC.

Based on the complexity and characteristics of each of the aforementioned situations, it seems reasonable to introduce the concept with a phased approach, where the first phase would be the single mode of operation and then other modes may possibly follow (together with a set of additional requirements/standards, when needed), in order to gain the necessary experience with the new technology and working concept that would ensure optimisation of operations and safety as far as its future development is concerned.

2.2.11. Regulatory framework analysis

The purpose of this NPA is to be used as a reference by the stakeholders for the implementation of the remote tower concept in operations and the performance of the safety assessment following a change in the ATM functional system.

It is important to note that due to the fact that the concept affects several regulations of a different nature (e.g. Regulation (EU) No 1035/2011, Regulation (EU) 2015/340), it was necessary to elaborate and structure this document in such a way that it reflects and complements the content and the structure of the aforementioned rules (see Section 2.5.).

Remote towers as a change to the functional system

In accordance with the regulatory framework in force, and with its ongoing developments, the implementation of remote aerodrome ATS provision shall be treated as a **change to the ATM/ANS functional system (systems, personnel and procedures),** for which the appropriate safety assessment shall be developed. It is proposed that such change be managed taking also into consideration the specific aspects contained in this document. The material developed includes a minimum list of factors/elements to be considered by the ATS providers when introducing remote aerodrome ATS provision into service. It should be complemented as necessary (e.g. local aspects, particularities of the selected solution) to demonstrate that the remote provision of ATS for an aerodrome is as safe as the ATS provided locally (from a conventional tower) in equivalent conditions of traffic (in terms of capacity and movements) and operational environment.

Compliance with ICAO and EU regulations

The implementation of the remote tower concept and the provision of ATS from a remote tower shall comply with the ICAO and EU regulations.

2.2.12. Aeronautical Information Publication (AIP)

As a consequence of the remote tower concept implementation, some of the elements subject to publication will need to be amended through the Aeronautical Information Service (AIS) in the corresponding documents (e.g. charts, aerodrome general aspects, etc.).

2.3. 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 Chapter 2 of this NPA.

The specific objective is to ensure that ATS provided from a remote location meet the applicable ICAO requirements and ensure at least the same level of safety as when provided from a conventional tower. The visual reproduction and the system support shall enable visualisation and environmental reproduction of the areas of responsibility of the ATS provider at least equivalent to those provided from a control tower.

In order to meet this objective, this NPA proposes a phased approach and means of regulatory compliance and guidance material issued by the Agency to facilitate the safety assessment, implementation and operational approval of the remote tower concept, taking into consideration the following:

— This proposal forms the first phase of the work for single mode of operation and is based on research, development and validation activities conducted so far within the SESAR project.

— Further work will be conducted by the Agency in order to:

- address future developments concerning the remote tower concept; and
- align with future regulatory measures concerning ATS provision.

This work will be closely linked with EUROCAE WG-100, whose aim is to develop an industry standard on technical aspects of the remote tower concept.

The Agency will aim to recognise this standard as part of the means of compliance with the presumption of regulatory compliance.

2.4. Summary of the Regulatory Impact Assessment (RIA) of the options

Based on the issues and the objective identified in Section 2.3., the following two options have been assessed:

— Option 0 (the baseline option): no regulatory action or any kind of guidance whatsoever;

— Option 1: Draft guidance on remote tower aspects and AMC/GM for ATCOs/AFISOs.

In addition to the questions made through NPA 2012-18 referred to in Section 2.2.7., the Agency addressed a questionnaire to its stakeholders and consultative bodies (Rulemaking Advisory Group (RAG) and ATM/ANS RAG/Thematic Advisory Groups (TAGs) and Safety Standards Consultative Committee (SSCC)) on 30 January 2015 to obtain feedback on the remote tower concept implementation projects in the EU Member States and to identify any potential issues caused by the current regulatory framework.

Despite the low response rate (28 answers), some indications can be derived and used to support the assessment of Option 0 and Option 1. A summary of all the answers is contained in Appendix 5.

Option 0: Baseline option

The **current** regulatory framework is considered to be sufficiently **adequate** to address the implementation of remote aerodrome ATS provision for single mode of operation provided that it is supplemented by guidance and proportionate rules.

Due to the various particular aspects identified (such as specific items related to the safety assessment and its methodology, contingency procedures in case of failure, security of the image and voice

exchanged between pilot and ATCO, interfaces with aerodrome operators, system equipment aspects, etc.) together with the fact that not all stakeholders will be aware of the different experiences and feedback from recent implementation and validation activities, the baseline option, i.e. no regulatory action, would raise some implementation concerns.

Option 1: Draft guidance on remote tower aspects and AMC/GM for ATCOs/AFISOs

The option to develop guidance, as per Chapter 3 and Chapter 4, is the answer to the issues identified in the baseline option. The main aspects of this option are the following:

— it is limited to the application of the remote tower concept for single mode of operation;

— it entails limited and proportionate regulatory action with guidance on the application of the remote tower concept and specific AMC/GM for ATCOs;

— this guidance highlights the specific aspects of the remote tower concept to be considered based on the current regulatory framework, with special attention to (see Chapter 3):

- safety assessment methodology;
- system aspects;
- abnormal situations and contingency procedures;
- aerodrome;
- possible impact on airspace users; and
- AIP.

— the draft AMC/GM for ATCOs specify:

- the way the concept should be applied in relation to the unit endorsement scheme;
- some generic provisions on the training to be delivered, in the context of the unit training plan and the unit competence scheme contained in Chapter 4.

As a conclusion, Option 1 proposes guidance on the specific aspects of the remote tower concept to be considered when using the current EU rules. The draft regulations in Option 1 for ATCO leave all the flexibility to ATS providers to implement the proposed AMC and GM. Option 1 can really be considered useful for the approval and implementation of the remote tower concept in the EU without overregulating.

2.5. Overview of the proposed amendments

As stated in Section 2.3., the objective of this NPA is to facilitate the implementation (through the elaboration of the corresponding safety assessment of the change(s) to the functional system) and the operational approval of the implementation of the remote tower concept. For that purpose, and taking into consideration the regulatory framework at the time of publication of this NPA, the NPA has been structured in such a way that two different regulatory approaches are followed. The first one, contained in Chapter 3, proposes guidance for the implementation of the remote tower operations, covering different aspects (safety assessment, aerodrome aspects, impact on airspace users, and AIP). The second one (Chapter 4) provides specific AMC and GM to Commission Regulation (EU) 2015/340.

3. Proposed guidance on the implementation of the remote tower concept

This NPA introduces guidance on the implementation of the remote tower concept which is within the scope of the current regulatory framework.

3.1. Definitions

For the purpose of this document, the following definitions shall apply:

1. 'Aerodrome conventional tower' means a facility located at an aerodrome from which ATS can be provided to aerodrome traffic through the maintenance of direct visual observation of the area of responsibility of the aerodrome.
2. 'Aerodrome remote tower' means a facility from which ATS can be provided to aerodrome traffic through real-time visual presentation of the elements contained in its area of responsibility (airfield and vicinity) together with other elements that may support the operation.
3. 'Aviation undertaking' means an entity, person or organisation, other than an air navigation service provider, that is affected by or affects a service delivered by a service provider.
4. 'Direct visual observation' means observation through direct eyesight of objects situated within the line of sight of the observer (through 'out-the-window view' means), possibly enhanced by external elements (e.g. binoculars).
5. 'Movement' means the operation of an aircraft for take-off or landing.
6. 'Operational context' means the operational characteristics that define the situation where the remote tower concept is to be implemented.
7. 'Single mode of operation' means the provision of ATS from a Remote Tower Module (RTM) for only one aerodrome at a time.
8. 'Out-the-window view' means a view equivalent, in terms of visual coverage, to the one available at the corresponding conventional tower, when available.

   In the absence of a conventional tower, or when other locations deemed more beneficial, the 'out-the-window' view shall mean an unobstructed view of all the areas of responsibility of the ATCO/AFISO.

3.2. Safety assessment of the changes to the functional system

3.2.1. Identification of the change

The solutions which are available for the remote tower system are not based on a unique system configuration but on a set of basic functionalities which can be enhanced with additional functions with the aim to improve the situational awareness of the ATCO/AFISO. This would require ATS providers to perform an initial analysis of the set of functionalities which would be required for the particular change.

The remote tower functionalities can be classified in two different categories:

— **Basic equipage:** This category represents the minimum equipage of technical enablers which are necessary for the operation of the remote tower at a single aerodrome. It comprises the following functionalities:

- visual presentation,
- binocular functionality,

- voice/data communication,
- management of assets (aerodrome lights, alarm management, status of navigation aids, etc.).

The above-mentioned technical enablers are specific[12] to the remote tower concept, which means they are either new or modified in some way to be adapted to the remote provision of ATS. Aerodrome sound reproduction should also be available if the outcomes of the safety assessment and the human performance assessment require so.

— **Enhanced equipage:** In addition to the functionalities included in the basic equipage, enhanced equipage includes some additional options intended to further improve the situational awareness and conflict detection capabilities of the ATCO/AFISO. They may include:

- Use of infrared cameras.
- Dedicated means to facilitate the detection, recognition, identification (e.g. based on surveillance data or on flight plan correlation) and tracking (e.g. labels directly in the visual presentation) of aircraft.
- Dedicated means to facilitate the detection and tracking (e.g. labels directly in the visual presentation) of vehicles on the manoeuvring area.
- Dedicated means to facilitate the detection and tracking of obstructions/foreign objects on the manoeuvring area (e.g. personnel or animals).
- Functionalities to facilitate judging the aircraft's position or altitude (depth of vision for the operator).
- Presentation to the ATCO/AFISO of additional overlaid information (visual overlays). The type of overlaid information may include (some of the elements are the result of other advanced visualisation features):
    - information associated with a specific element or target in the visual field, aiding or facilitating detection, recognition, identification and ranging;
    - information indicating or highlighting specific parts of the aerodrome (such as runways, taxiways) in order to enhance the ATCO's/AFISO's situational awareness, specifically in darkness and low-visibility conditions;
    - information related to the general area of interest or area of responsibility in order to assist the ATCO/AFISO and minimise 'head down' time;
    - information to assist the ATCO/AFISO (e.g. as regards current wind and RVR values, and status of aerodrome systems such as runway and approach lighting).

The ATS provider should take into account that the analyses and validation exercises, performed in the frame of the SESAR project, have shown that for certain operational contexts (see Section 3.2.3.) the functionalities presented in the **basic equipage may be sufficient** to provide the same level of safety as in the current operations (local conventional tower), subject to the confirmation by the corresponding safety assessment of the local implementation.

Nevertheless, in case that the operational context of the target aerodrome exceeds that referred above, the ATS provider should evaluate the possibility of complementing the basic equipage with additional functionalities (enhanced) in order to ensure an appropriate level of mitigation of the operational risks. In this case, the ATS provider should conduct an in-depth evaluation of the selected

[12] They may be complemented with other functionalities (e.g. electronic flight strips), but they are not included in the list as far as they are not strictly necessary for the remote tower concept and they could also be available in a local conventional tower.

enhanced functionalities, including the necessary validation activities and human performance assessment, in addition to the corresponding safety assessment of the local implementation.

3.2.2. Safety assessment methodology

The remote tower concept, as a change to the functional system, does not require any specific safety assessment methodology. The available procedures, which are part of the SMS and their compliance with Commission Implementing Regulation (EU) No 1035/2011 has been demonstrated, may be used for the safety assessment. Nevertheless, the particularities of the remote tower concept, as technological change, may require the need to take into account some specific considerations in the application of such accepted procedures. The objective of the developed material is to provide ATS providers and competent authorities with such considerations. In order to facilitate the process of approval, Appendix 4 summarises (as a non-exhaustive list and to be considered just as reference) the overall elements deemed necessary for the remote tower concept implementation.

Furthermore, and while following a methodology-independent approach, the present guidance takes into account the main elements of the safety work performed in the frame of the SESAR project and how this available experience can be incorporated by the ATS providers into their respective safety assessment processes for the introduction into service of the remote tower concept. The identified elements are those for which, based on the SESAR safety work, some particular emphasis may be required to be put on in relation to the remote tower aspects. They are considered to be generally applicable although they should be completed as necessary by the ATS providers by taking into account local implementation aspects or particularities of the selected solution. Also, this guidance should be used as complementary information to the existing safety-related information (e.g. hazards baseline, existing mitigations) available to ATS providers for the introduction into service of changes affecting ATS.

3.2.2.1. Scope, boundaries, interfaces and operational environment characterisation

The environment for the remote provision of ATS is extended compared with the local conventional tower so far as it is necessary also to consider that the remote facility's as well as the aerodrome's operating environment is significantly changed.

These aspects should be taken into account when determining the properties of the operational environment as well as the scope, boundaries and interfaces of the technical systems. The technical systems are going to be located at two different places, at the aerodrome and at the RTC, interacting with each other but also with external entities at both sides. The way in which the technical systems will interact may be different from that of the local tower (e.g. at least this would be done through a Wide Area Network (WAN)), something that may introduce some new situations which would require some consideration during the safety analysis. Then, the operational characteristics, roles and responsibilities as well as the technical characteristics may be different for each environment, so a separate characterisation should be done for each of the environments, i.e. for aerodromes and RTCs.

The aerodrome's operational context may be characterised in terms of (see Section 3.2.3.):

— type of services (e.g. ATC or AFIS);

— airspace-related aspects (e.g. airspace classification, CTR, Aerodrome Traffic Zone (ATZ), Terminal Manoeuvring Area (TMA), type of flight procedures);

— aerodrome layout complexity (e.g. number of Runways (RWYs), number of Taxiways (TWYs) and runway entries, number and location of aprons);

— traffic information (e.g. number of movements per day, number of simultaneous movements, type of traffic, aircraft fleet mix);

— environmental conditions at the aerodrome.

The aerodrome's technical environment may be characterised through the description of the existing communication, navigation and surveillance systems available at the aerodrome plus the available safety nets. They do not necessarily change as a result of providing ATS remotely. This technical characterisation does not include the installation of the remote tower equipment at the aerodrome and it should be considered as part of the safety assessment.

The RTC's operational and technical environment should include the detailed characterisation, as necessary for the safety assessment, of the technical infrastructure of the RTC and RTMs plus the way in which the operation is intended, and also the changes at the aerodrome site.

3.2.2.2. Interdependencies and assumptions

The introduction into service of the remote tower concept is a change to the functional system that may impact on one or several aviation undertakings, as it may introduce changes to the way that they receive the ATS or the operational context in which these services are provided to them, or to the way in which the aviation undertakings are operating. The aviation undertakings potentially affected by the introduction into service of the remote tower concept would include, at least, the aerodrome operator and the aircraft operators.

Also, the change may also affect other service providers (e.g. Communication Navigation Surveillance (CNS) providers, adjacent ATS providers) other than the ATS provider proposing the change.

These interdependencies with other service providers and with aviation undertakings should be taken into account by the ATS provider when performing the safety assessment. In particular, the ATS provider should determine:

— the dependencies with each other and, where feasible, with the affected aviation undertakings; and

— the assumptions and risk mitigations that relate to more than one service provider or aviation undertaking.

As regards aviation undertakings (e.g. aerodrome operator, aircraft operators), the ATS provider should seek their participation when assumptions and risk mitigations used in the safety assessment are shared with those aviation undertakings concerned.

Nevertheless, for the aerodrome operator, it is strongly recommended that this involvement be extended towards a coordinated assessment to ensure consistency between their respective safety assessments. These coordinated means should allow as much as possible:

— joint identification of the scope of their responsibilities with regard to the particular implementation, and in particular their safety responsibilities;

— joint identification of the dependencies;

— joint identification of the hazards/effects associated with the change in the common context;

— common understanding of the consequences in the shared operational context and chains of causes/consequences;

— agreement on the assumptions for the change that affect each party and those assumptions that jointly relate to them;

— mutual agreement on the mitigation of risks each party is supposed to implement and those mitigations of risks that require joint implementation.

In case where a particular implementation is found to have interdependencies with other Air Navigation Service Providers (ANSPs), they should be involved in the safety assessment of the ATS

provider and the necessary coordination means should also be established with the aim of having agreed and aligned assumptions and mitigations in their respective safety assessments.

3.2.2.3. Safety criteria

Keeping in mind that the main driver for the implementation of the remote tower concept is related to cost savings, the safety criteria to be applied should ensure that the level of safety after the introduction of the remote tower concept is at least not reduced with respect to the current operations based on a local (conventional) tower.

Then, the aim of the safety assessment shall be to demonstrate that ATS provided remotely for one aerodrome are as safe as ATS provided currently locally in equivalent conditions of traffic (in terms of capacity and movements) and operational environment than in current operations. In case there is a change to these traffic-related parameters, compared with the current operations, the safety criteria should be reviewed and adapted to the new situation.

The ATS provider may establish the safety criteria taking into account the accidents/incidents that may be induced from the tower operation (either remotely or locally) as, for example, mid-air collision in TMA, controlled flight into terrain, wake vortex-induced accident, taxiway collision and/or runway incursion.

3.2.2.4. Identification of hazards and failure conditions

The SESAR safety work has identified a list of general operational hazards in relation to the provision of ATS. They may not be strictly related to the remote provision of ATS but also to the provision of ATS from a local (conventional) tower. Nevertheless, the introduction into service of a remote tower system at a particular aerodrome may affect the causes or the probability of occurrence of any of those hazards. Then, they should be considered as an initial list for the ATS providers and adapted appropriately taking into account their respective safety baseline for ATS in the target local aerodrome. They are presented in **Table 2** for ATC provision and in **Table 3** for AFIS provision, including a short description, operational effects and severity of the effects (for the operational context considered in the SESAR analyses).

In addition to these operational hazards, the ATS provider should identify those hazards at functional level corresponding to the main functionalities identified in the remote tower system (see Section 3.2.5.). Due to the nature of the system and its operation, at least the following failure modes should be considered (for each of the functions):

— total loss of the function;

— partial loss of the function;

— detected erroneous/corrupted data (not credible error/corruption);

— undetected erroneous/corrupted data (credible error/corruption);

— detected delayed data;

— undetected delayed data.

Based on these failure conditions, the ATS provider should identify additional hazards at functional level. They will be called ‘functional hazards’.

3.2.2.5. Assessment of the hazards’ effects

For information purposes, **Table 2** and **Table 3** include the severity classification for the listed operational hazards identified in the frame of the SESAR safety work, and were taken as a basis for the identification of the safety requirements. The ATS provider should evaluate the severity classification

and update it appropriately taking into account the particularities of the operational environment (e.g. airspace, aerodrome characteristics).

For the additional operational and functional hazards, the ATS provider should perform an assessment of the hazards' effects and the classification of their severity. The assessment should be performed under normal operations and abnormal conditions. The Functional Hazards Assessment (FHA) should take into account the severity of the operational effects stemming from the identified functional hazards.

The ATS provider may define some representative use cases to cover the normal operations and potential abnormal conditions that the ATCOs/AFISOs may face when operating the remote tower. This may be based on existing normal operations and abnormal conditions already identified as part of the operation of the local (conventional) tower. The objective would be to identify those conditions which might be more significantly affected by the particular aspects of the remote tower operation (e.g. visual presentation).

Examples of such use cases (nominal conditions) could be:

— arriving/departing aircraft handled by remotely provided ATS;

— arriving/departing aircraft when an animal is on the manoeuvring area;

— arriving aircraft with landing gear not down;

— VFR flight in the traffic circuit is conflicting with an arriving/departing IFR flight;

— management of Special VFR flights;

— management of flights during darkness conditions;

— low-visibility procedures;

— transition of ATS provision from local TWR to remote TWR;

— control of vehicles and personnel on the manoeuvring area.

Additionally, some abnormal conditions may be identified. Some examples of abnormal conditions might be the following:

— unexpected/unplanned flight in airspace;

— aircraft with urgency or emergency;

— crash on the aerodrome or in its vicinity;

— fire on the aerodrome;

— (unplanned) closure of ATS at the aerodrome;

— ATCO/AFISO overload;

— abnormal weather (for example: low atmospheric pressure, strong winds).

The ATS provider should take into account the potential lack of independence among the identified functional hazards due to the possible use of shared resources among several functions of the remote tower system. Then, a Common Mode Analysis (CMA) should be performed to get the evidence that, based on existing design, the failures, failure modes or hazards, assumed to be independent, are truly independent. The effects of design, manufacturing, maintenance errors (e.g. hardware, software, network) and failures of system components or used resources which impact their independence should be analysed.

3.2.2.6. Determination of the safety objectives and safety requirements

As in previous phases, the determination of the safety objectives and safety requirements should follow the SMS processes whose compliance with Commission Implementing Regulation (EU) No 1035/2011 should be demonstrated, and are accepted by the competent authority. The identification of specific safety objectives and safety requirements will be driven by the dedicated Risk Classification Scheme(s) (RCS(s)) which is (are) part of the SMS.

The ATS provider should pay special attention to some particular aspects that, based on the SESAR safety work, would require the definition of specific safety objectives and/or safety requirements in order to ensure that the level of safety is the same as in the current operations from a local tower (as defined through the safety criteria). Those aspects are the following:

— loss or degradation of the visualisation of the critical parts of the aerodrome (e.g. manoeuvring area, traffic circuit, initial climbing and final approach areas).

— failure or degradation of the ground–ground communication (e.g. with relevant and/or adjacent ATS units, or with personnel/vehicles operating on the aerodrome).

— failure or degradation of the air–ground communication.

— loss or malfunction of the ATCO's/AFISO's manoeuvring capability of the visual and non-visual navigation aids.

Additionally, the introduction of the remote tower concept would also imply some changes to other areas which are not strictly related to the visual presentation but may also be impacted. For example, in case that the surveillance data is used by the ATCO/AFISO in a certain tower, it would be necessary to ensure that the introduction of the remote tower concept does not have a negative impact on the quality (e.g. loss of data, delays) of such data in order to be consistent with the current operations at that local tower. This may occur due to the need to reroute the data available at the local tower to the remote one.

The need for such analysis will depend on the particular configuration and associated operating procedures of each local tower. Nevertheless, the safety assessment activities should evaluate whether some safety requirements (mitigation measures) are necessary in order to ensure that such information (e.g. surveillance data in the previous example) is provided in a similar manner, in terms of integrity and availability, as in the current operations. This may include (depending on the local tower set-up):

— information on arriving and departing procedures;

— information on active/non-active areas in the area of responsibility;

— flight plan information related to the relevant traffic;

— surveillance data;

— availability of meteorological information (as per ICAO PANS-ATM, Chapter 6.6 and Chapter 4.10).

Furthermore, the safety assessment may identify some additional safety requirements in order to ensure that the ATCO/AFISO can apply the relevant current procedures (e.g. coordination and transfer of traffic, management of missed approaches, etc.).

The Software Assurance Level (SWAL) allocation process will identify the required SWAL for the different software components, which are part of the remote tower system. The ATS providers shall apply the SWAL allocation process identified in the respective Software Safety Assurance System

(SSAS), which shall comply with Commission Regulation (EU) No 482/2008[13], in the frame of the safety assessment activities. It is important to note that the activities performed as part of the SESAR project have concluded about the allocation of SWAL2 (as per EUROCAE ED-153) for the software units involved in the visual presentation system when applied to view the critical parts of the aerodrome (manoeuvring area, traffic circuit, initial climbing and final approach areas).

3.2.2.7. Human performance assessment

The introduction into service of the remote tower concept has direct implications on human factors as it may influence the capability of the ATCO/AFISO to accomplish their allocated tasks and to meet their job requirements.

The concept envisages the introduction of new standards in the technology associated to image presentation, which encompasses several aspects. The ATS provider should assess the potential impact of this new technology in the workplace situation where it will be applied, taking into account the working environment and the ergonomic infrastructure.

In addition to the technological aspects, the assessment of other human performance aspects (such as workload and boredom, situational awareness and perception) will be required through simulations and shadow operations.

A list of elements and examples is available in Appendix 1.

3.2.3. Operational context

The remote tower concept is, in principle, envisaged to be implemented at aerodromes of all sizes and conditions. Therefore, it seems reasonable to define those elements that would make an aerodrome suitable for the provision of remote ATS while maintaining safety as if the service was provided from a conventional tower at the aerodrome. The idea is that these elements should be part of the safety assessment to be performed prior to the introduction into service of the remote tower concept at an aerodrome, so that the particular conditions of that given aerodrome are taken into consideration.

On the other hand, the remote tower concept is based on the fact that the ATCO/AFISO will no longer have direct visual observation of their area of responsibility. Therefore, one of the primary objectives of the concept is to introduce a new way to provide visual observation of the area of responsibility of the ATCO/AFISO (aerodrome and its vicinity) that fulfils the existing ICAO provisions. The new features, therefore, relate primarily to visual observation. Due to the nature and characteristics of the new visual observation means, and provided that any visual presentation of the scenario will never be equal to direct visual observation, there is the risk that the new visual presentation could have a negative impact on safety, for which mitigation measures will be needed. As regards the differentiation between ATC provision and AFIS provision, with respect to visual presentation, there have not been identified any significant differences that may affect the implementation of the remote tower concept at a certain aerodrome. However, as far as the other aspects are concerned, specific characteristics for each of the cases should be taken also into consideration in the safety assessment.

Appendix 1 summarises all those characteristics related to the operational context of remote ATS provision that should be taken into consideration when performing the safety assessment. It also includes the reference operational characteristics considered in the analyses and validation exercises performed in the frame of the SESAR project and for which it has been confirmed that the basic equipage (as defined in Section 3.2.1.) may be sufficient to provide for the same level of safety as in the current operations (local conventional tower), subject to the confirmation by the corresponding safety assessment of the local implementation.

[13] Commission Regulation (EC) No 482/2008 of 30 May 2008 establishing a software safety assurance system to be implemented by air navigation service providers and amending Annex II to Regulation (EC) No 2096/2005 (OJ L 141, 31.5.2008, p. 5).

3.2.3.1. Traffic density

The results of the validation exercises available so far[14] show that the single mode of operation for the remote provision of ATS may be applied to **low-density aerodromes** (where low density is defined as being mostly a single movement, rarely exceeding two simultaneous movements). Therefore, based on the validation exercises and the associated safety assessments conducted, this guidance material can only confirm the sufficiency of the basic equipage in low-density aerodromes subject to the confirmation by the corresponding safety assessment of the local implementation.

For aerodromes where traffic density exceeds the above-mentioned characteristics, the ATS provider should follow the guidelines stated in Section 3.2.1.

3.2.3.2. Air traffic characteristics

The type and characteristics of air traffic operating at an aerodrome with remote ATS provision is an important aspect to focus on, especially when VFR and IFR traffic is combined. Characteristics such as the size of the aircraft or equipment are deemed to be important when considering the visual presentation needs. These characteristics should be considered when performing the safety assessment, as they would have an impact on the visual presentation characteristics (see Section 3.2.5.2).

3.2.3.3. Characteristics of the aerodrome's layout

According to the validation activities and safety assessments conducted, the airfield layout (comprising runways, taxiways, runway entries, and aprons) for which the remote operation is going to be conducted must be taken into consideration when implementing the remote tower concept.

Considering the assumptions which the validation exercises (and their results) have been based upon, certain airfield characteristics (typically 1 or 2 runways, 1 to 3 runway entries per runway, 1 to 4 aprons) are considered validated for the implementation of the concept, based on a basic equipage.

In any case, the objective is not to prevent the implementation of the concept in different scenarios. For each of the cases, a safety assessment should be conducted by the ATS provider, so the objective is to stress the need to consider these airfield characteristics when establishing the necessary functionalities of the system.

3.2.3.4. Airspace characteristics

At this point, attending to the results of the validation exercises, the target aerodrome for which the remote tower concept could be implemented based on a basic equipage should have an associated airspace classified as C or D for the case of ATC provision, or F or G for the case of only AFIS provision.

However, the intention is not to prevent the implementation of the remote tower concept for class A and B airspace (according to Commission Implementing Regulation (EU) No 923/2012), provided that the results of the safety assessment allow so.

3.2.3.5. Aerodrome infrastructure and surroundings (physical orography)

Provided that each aerodrome is unique and has its own characteristics regarding orography (natural obstacles) and surroundings, it is considered important to take into account the specific aspects that may affect the implementation of the concept.

[14] Recent operational approvals include a slightly higher number of simultaneous movements.

3.2.3.6. Environmental characteristics

The environmental factors are another critical aspect to be considered when assessing the impact that the implementation of the concept may have on the aerodrome operations and/or ATS provision.

Therefore, at least the following environmental conditions should be taken into consideration for the development of the safety assessment:

— Low-visibility conditions: both for operations (low-visibility procedures) and for the impact on the visual presentation system (e.g. need for enhanced equipage, such as infrared cameras).

— Snow: both for operations and for the impact on the visual presentation system (e.g. image filters).

— Winds: both for operations and for the impact on the visual presentation system (e.g. cameras siting/installation aspects).

— Icing: both for operations and for the impact on the visual presentation system (e.g. need to monitor de-icing operations).

— Meteorological phenomena (rain, hail, etc.).

— Birds and other animals.

3.2.4. Operator's roles and performance

3.2.4.1. Roles

The ATS provider should identify the particular configuration of the remote tower/RTC and operating methods applied taking into consideration the particular needs of the aerodrome(s) which comply with Commission Implementing Regulation (EU) No 1035/2011. Nevertheless, the ATCO's/AFISO's main responsibilities regarding the provision of ATS should remain the same as the ones when the service is provided from the local (conventional) tower.

3.2.4.2. Training and competence requirements

Together with the ATCO training and competence requirements identified in Chapter 4, personnel involved in the maintenance of facilities, installations and equipment enabling and supporting the remote provision of ATS at an aerodrome 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 and in Commission Regulation (EU) No 139/2014[15], as appropriate.

3.2.5. System/equipment aspects

This Section addresses the system/equipment aspects, focussing mainly on the description of the remote tower system's high-level functions. Both the description of the functions and the identified objectives should be considered by the ATS providers and manufacturers as one of the inputs on which the technical specifications of the remote tower system and its constituents should be based. This should be understood as a minimum list whose level of detail should be further expanded by the ongoing work of the EUROCAE WG-100.

The high-level functional description is focussed on the basic equipage, as defined in Section 3.2.1. Functionalities associated with the enhanced equipment (e.g. infrared, overlay) are not covered.

Additional considerations have been included to cover some installation aspects (e.g. siting aspects, ergonomics) plus specific considerations about how to organise the system's/equipment's

[15] Commission 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).

specifications. Finally, a dedicated section on information and cyber security has been included to address the assessment of the potential impact on safety stemming from security threats.

3.2.5.1. RTM/RTC concept

RTM is the term used to refer to the work station of an operator (ATCO/AFISO) from which remote ATS is provided. It includes both the **Controller Working Positions (CWPs)** (including the necessary ATS systems) and the visual presentation display screens. RTM will enable the remote tower operator to maintain view of the aerodrome, including the manoeuvring area and surfaces, and may be located on the aerodrome site or at a location remote from the aerodrome.

The ATS provider may decide that the provision of remote ATS from an RTM would be from a centralised facility known as **RTC**. RTC (see Figure 1) can house one or more RTMs where remote ATS may be provided to one or several aerodromes in normal conditions or to one aerodrome in contingency situations[16].

An RTC can be set up as shown in Figure 1, with multiple RTMs and one or more supervisor positions (depending on the size and requirements of the RTC). In a single mode of operation scenario, the ATCO/AFISO in an RTM operates **only one aerodrome.** Nevertheless, the ATS provider may decide to change the allocation between RTM and aerodrome in order to improve the efficiency of the resources or to respond to specific contingency situations. The ability to swap RTMs will depend on many factors, such as ATCO licensing (see Chapter 4).

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. Nevertheless, additional/spare RTMs may also be included based on contingency requirements.

If the RTC is composed of several RTMs, the ATS provider should ensure that the ATCO/AFISO use similar operating methods and procedures for all the aerodromes connected to an RTM/RTC and that all RTMs in an RTC should be standardised in terms of Human-Machine Interface (HMI) and equipment (in order to contribute to the overall improvement of uniformity of ATM services).

The ATCO/AFISO should verify the status of an aerodrome and its related systems before assuming responsibility for providing remote ATS to the aerodrome.

[16] Despite this wider applicability of the remote tower concept, the developed material is aimed at covering only single mode of operations where ATS is provided from a Remote Tower Module (RTM) for only one aerodrome at a time.

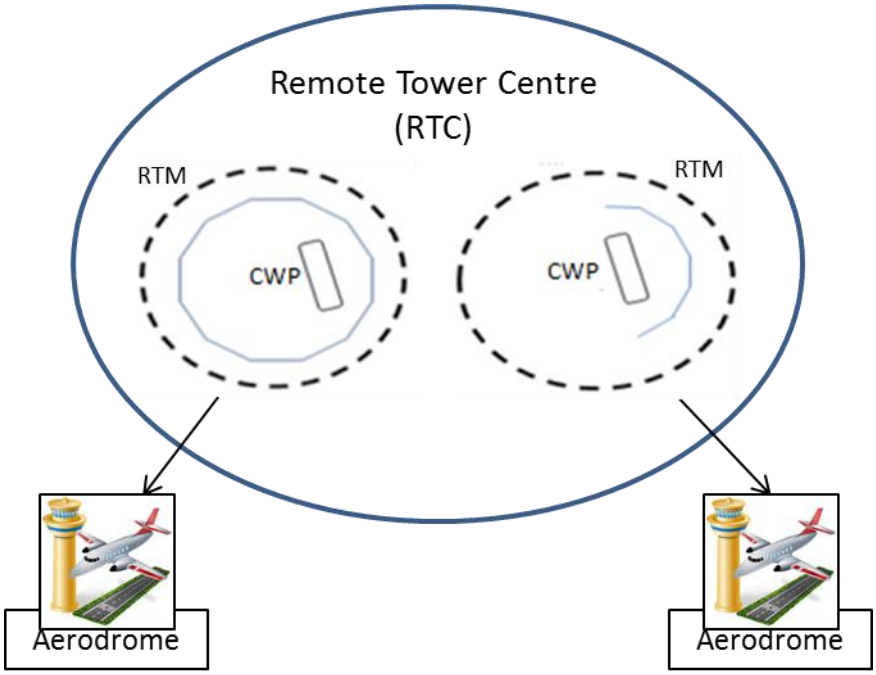


Figure 1: High-level overview of the remote tower provision

3.2.5.2. Human–computer interaction functions

Visual presentation

Visual presentation is the core of the remote provision of ATS and replaces the OTW view. It should provide a presentation which will enable the operator (ATCO/AFISO) to maintain continuous watch on all flight operations on and in the vicinity of an aerodrome as well as on vehicles and personnel on the manoeuvring area.

Visual presentation may take one of several forms and might be the result of many technical solutions. However, as mentioned above, for the purpose of this material, it is assumed that visual presentation is only based on a **visible spectrum, camera-based solution** (where cameras capture the image at the local aerodrome and the image is relayed to the ATCO's/AFISO's screens).

In such a camera-based solution, this overall function may be split into the following sub-functions:

— **Video stream management** responsible for the processing of video data from several local cameras and transferring these data to the RTC. It can include bandwidth management and compression, monitoring of delay times, frame rate, and access control.

— **Camera control** providing access to the control functions of the cameras (conventional and Pan-Tilt-Zoom (PTZ)), including the necessary authentication means and control function related to the camera setting and image adjustment/optimisation.

— **Video data fusion** combining different inputs from the available sensors and generating an aggregated system track for a dedicated object.

The visual presentation function may include other functionalities (e.g. visual tracking for automatic object tracking). Nevertheless, they are outside the scope of this material.

As part of the visual presentation, one of the most critical parameters for the ATCO's/AFISO's ability to perform the assigned ATS tasks is the time delay between image/data capture and presentation to the ATCO/AFISO on the visual presentation (screens). This is also called **end-to-end delay.** The maximum allowable end-to-end delay should be determined by the safety assessment taking into account the

operational context but, in any case, it should not be longer than **1 second,** as this value is considered to be the maximum delay allowed for very low-density aerodromes (which are representative of the simplest operational contexts)**.** Longer delays may affect the ATCO's/AFISO's situational awareness (compared with the reality) with a potential safety impact. Then, the ATS provider should demonstrate that the end-to-end delay does not exceed the established maximum end-to-end delay value. Additionally, the remote tower system should include a monitor of such delays and the corresponding alerts should be presented to the operator in case the maximum delay value is exceeded.

The fidelity of the visual presentation presented to the ATCO/AFISO also depends on the frame rate, defined as the number of times per second that the visual presentation is updated. The frame rate defines the capability of the ATCO/AFISO to visualise and monitor moving objects (e.g. aircraft, vehicles). The minimum allowable frame rate should be determined by the safety assessment taking into account the operational context in order to ensure adequate tracking of moving objects by the ATCO/AFISO. The required frame rate will drive the frequencies at which the different equipment in the image processing chain should work as well as the amount of visual information to be sent from the equipment located at the aerodrome to the RTM/RTC.

In combination with these performances, the remote tower system should include a monitor of the 'frozen' image (i.e. image not refreshed) and the corresponding alerts should be presented to the operator in such cases.

In conjunction with the aforementioned, there are also other parameters which may affect the 'quality' of the visual presentation (image/data) presented to the ATCO/AFISO, impacting potentially on the ability to safely provide ATS . The 'quality' of the visual presentation can be defined as the combination of the image quality factors and image similarity to human eye vision.

Image quality factors (e.g. sharpness, contrast) are driving the granularity and fidelity in which the reality captured by the camera is presented in the visual presentation. These quality parameters should be part of the remote tower system specification. However, there is no general consensus about the objectives to be met by the remote tower system regarding image sharpness.

These parameters may be defined in the remote tower specification as performance objectives indicating the ATCO's/AFISO's capability to perform specific actions (e.g. detection, recognition) of targets (e.g. aircraft, vehicles, personnel) on certain parts of the aerodrome (e.g. distance or specific points) and under specific environmental conditions (e.g. daylight, darkness). Specific analyses should be conducted by the ATS providers in order to establish such technical (performance) requirements.

These analyses may include:

— Identification of several reference locations at the aerodrome, its vicinity and traffic circuit.

— Definition of the expected action(s) from the ATCO/AFISO on each of those points (e.g. detection/tracking of a vehicle, recognition of an aircraft).

— Identification of the conditions that the ATCO/AFISO may perform each of the actions (e.g. for the same point, a different action may be expected from the ATCO/AFISO depending on the visibility conditions).

— Establishment of the performance requirements for the visual presentation (image quality) taking into account each of the expected action(s), the environmental conditions, and the locations at the aerodrome.

As a result of this process, the image quality factors are presented in terms of expected ATCO/AFISO performance in certain visibility conditions. These requirements might be complemented with additional requirements regarding different visibility conditions (dark and low visibility) or with the detection capabilities of smaller objects but at shorter distances (e.g. vehicles on the manoeuvring area), if found relevant. These requirements should be subject to the corresponding validation activities, including a human factor analysis with confirmation that the image quality allows the ATCO/AFISO to maintain the ability to safely provide ATS.

The similarity of the presented image to the human eye vision, avoiding irregularities or other disruptive effects which may lead to human performance issues (e.g. fatigue) and may also jeopardise the situational awareness of the ATCO/AFISO, is another factor. In this sense, the remote tower technical system should include (as applicable, depending on the selected technical solution) the means to:

— provide in the visual presentation a non-flickering impression to the human eye;

— provide a visual presentation with smooth and regular impression of moving objects to the human eye;

— avoid any unwanted, unnecessary discontinuities or non-uniformities in terms of presented scale, orientation and field of view of the area under observation by the operator (ATCO/AFISO);

— indicate in the visual presentation any existing discontinuities or non-uniformities in terms of presented scale, orientation and field of view of the area under observation by the operator, so as not to cause any misleading impressions regarding the spatial geometry of the area of responsibility.

Furthermore, the visual presentation might be degraded due to the environmental conditions at the aerodrome where the services are provided, either by meteorological conditions, lighting conditions or other effects (e.g. animals action on cameras). In order to avoid the potential effects on the ATCO's/AFISO's ability, the remote tower technical system should include (as applicable, depending on the selected technical solution) the means to reduce the negative impact on the visual presentation caused by animals (e.g. insects, birds), variable light conditions across the field of view of the camera, counter-light effects or precipitation (e.g. rain, snow) which can block the camera.

The set-up of the visual presentation screens in terms of number of screens, layout orientation, area covered/included in the panoramic view, viewing angle, etc., should be tailored and assessed for each environment from where remote ATS are planned to be provided so that all the critical areas (e.g. climbing and landing areas) are fully captured on the visual presentation screens and 'hot spots' (e.g. holding positions, TWY entrance/exits) are clearly visible in the screen layouts (e.g. far-from-screen edges).

Binocular functionality

Binocular functionality is intended to replace the manually operated binocular which is currently used in local aerodrome towers and its availability is required to satisfy the ICAO Annex 11 requirements.

This functionality is additional to the overall visual presentation in that the ATCO/AFISO may be facilitated whenever necessary to look at certain items of interest more closely (e.g. engine on fire, landing gear extended, RWY condition/objects on RWY, etc.). For this purpose, this binocular functionality should provide the ATCO/AFISO with the option to angle the view and zoom in on objects as required.

The binocular functionality should be as simple, quick and easy to use as manually operated binoculars (in a local tower) are, and should include a **moveable zoom feature** with a visual indication of the direction of bore sight, and should be able to follow aircraft moving in the area of the ATCO's/AFICO's responsibility.

The visual presentation provided by the binocular functionality should fulfil the same performance requirements (e.g. end-to-end delay, refresh rate) as the overall visualisation functions do. Regarding image quality, the binocular functionality should be of sufficient quality (image sharpness, magnification, contrast) to support the related ATCO/AFISO tasks.

Moreover, certain aerodrome 'hot spots' may be configured (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, RWY sweep, etc.) utilising predefined positions and automatic scans set for the binocular functionality.

On the other hand, binocular functionality may also include, as part of the enhanced functionalities, automatic tracking of moving aircraft, vehicles or obstructions (e.g. personnel or large animals). It would increase the ATCO's/AFISO's ability to spot and follow relevant objects. This feature of the binocular functionality would be especially useful during non-nominal or distress situations where quick reaction is required. It could provide close-up images of the relevant objects (on a binocular function screen) or highlight the relevant objects in the overall context (visual presentation screen).

Sound reproduction

This function refers to the capture and reproduction of the aerodrome's background sounds at the CWP. It is aimed at further improving the ATCO's/AFISO's situational awareness by combining visual presentation and surrounding noise.

If this function is implemented for actual outdoor sound reproduction, the volume should be adjustable and it should be possible to be turned off by the operator (ATCO/AFISO).

In any case, this functionality should be subject to a human performance assessment.

Voice/data communication

It includes air–ground and ground–ground voice communications between the ATCO and the other actors involved in the provision of ATS:

— **Air–ground voice/data communications:** It corresponds to voice (Very High Frequency (VHF))/data (Controller Pilot Data Link Communications (CPDLC)) communication between ATCOs and aircraft flight crew. This supports the aeronautical mobile service as defined in Chapter 1 of ICAO Doc 4444 and in Chapter 6.1 of ICAO Annex 11.

Note: If a separate ground controller position is introduced, a separate communication channel for the control of traffic operating on the manoeuvring area would be needed.

— **Ground–ground voice/data communications,** covering:

- Voice/data communication between ATCO/AFISO and other relevant and/or adjacent ATS units. This supports the Aeronautical Fixed Service (AFS) as defined in Chapter 1 of ICAO Doc 4444. The ATCO/AFISO shall use AFS (ground–ground communications) in accordance with Chapter 6.2 of ICAO Annex 11.
- Voice communication (VHF) between ATCO/AFISO and vehicle drivers on the aerodrome's surface. The ATCO/AFISO shall use surface movement control service (communications for the control of vehicles other than aircraft on the manoeuvring areas at controlled aerodromes) for the aerodrome(s) under control, in accordance with Chapter 6.3 of ICAO Annex 11.
- Voice/data communication between ATCO/AFISO and aerodrome personnel.

The remote tower infrastructure should allow the ATCO/AFISO to establish such voice/data communication links as in the local conventional tower. The remote tower system should alert the ATCO/AFISO in case of failure of the air–ground and ground–ground voice/data communication links.

Furthermore, regarding air–ground communications, they are typically established through the local radio at the aerodrome. In the remote tower operation scenario, the RTC might need a dedicated connection (e.g. through WAN) to the local radio at the aerodrome in order to have access to the air–ground communication link with the flight crew. Dedicated infrastructure would be necessary for that. This remote command of the local aerodrome radio might be subject to delays due to communication link latency from the RTC to the local radio. The maximum allowable delay should be determined by the safety assessment taking into account the operational context in order to ensure timely communication between flight crew and controller. Additionally, the safety assessment should consider the relative timing between this communication and the visual presentation to the ATCO/AFISO (driven by the end-to-end delay) in order to ensure the necessary level of coherence between the image and sound information available at the ATCO/AFISO.

Also, especially for a backup or emergency radio system, a dedicated and independent backup connection between the aerodrome and the RTM or RTC will be required. Standard fall-back solutions, such as handheld radios used directly in the local conventional tower, cannot be applied to the remote tower scenario.

Visual communication

The remote tower infrastructure should allow the ATCO/AFISO to have equivalent visual communication means with the aircraft as in the conventional local tower implementation in order to ensure that:

— the ATCO/AFISO can communicate via a signalling lamp with the respective aircraft, in accordance with Section 5.1.3 of ICAO Annex 14;

— the ATCO/AFISO can clearly observe visual communication from aircraft that are within the ATCO's/AFISO's visual range, i.e.:

- aircraft flashing or showing landing lights, in darkness;
- aircraft repeatedly changing its bank angle ('rocking wings'), in daylight;

— the ATCO/AFISO can clearly observe visual communication from aircraft that are within visual range on the aerodrome's manoeuvring area, i.e.:

- moving ailerons (or rudder), in daylight;
- flashing or showing landing lights, in darkness.

The above-mentioned last two capabilities can be used as part of the identification of the required image quality to be presented to the ATCO/AFISO. These criteria may also be used complementary to other quality requirements.

In order to ensure that the ATCO/AFISO can communicate via the signalling lamp, it would be required to have the remote command capabilities of the signalling lamp from the remote tower. This remote operation may require the use of the data network (e.g. WAN). 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 commanding.

3.2.5.3. Voice and data recording

The voice and data recording function is intended to satisfy the recording requirements specified in Chapter 6 of ICAO Annex 11, which cover: any voice communication (either ground–ground or air–ground), any data link communication, and any automatic transfer of data to and/or from ATS computers. For the particular case of the remote tower, in comparison with a local (conventional) tower, the recording functionality should also include: the visual presentation data and the actual ambient sound from the aerodrome (when available) as this information is transferred automatically among the computers. This function will also provide data for the analysis of events in which a particular behaviour of the visual presentation may have contributed to them.

3.2.5.4. Management of assets

Aerodrome lighting system management

This function should enable the remote tower to control the aerodrome's lighting system and to monitor in real time that it is constantly able to support the operational needs in order to assure the conduct of all the aerodrome operations in an appropriate way under all conditions (e.g. Commercial Air Transport (CAT) I, CAT II, CAT III). It should allow the ATCO/AFISO to:

— remotely operate the signalling lamp located in the aerodrome premises;

— remotely monitor the status and operate the aeronautical ground lighting system which is located on the aerodrome's manoeuvring area;

— remotely monitor the status and operate the runway and aeronautical ground lighting system (visual navigation aids) located at the aerodrome.

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

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

Alarm management

At any moment, the ATCO/AFISO shall maintain the ability to monitor and trigger accident, incident and distress alarms as applicable to the aerodrome. The remote tower system should allow such possibility, which may introduce additional requirements on the visualisation part but also on the need to remotely manage the corresponding alarms at the aerodrome.

Additionally, the remote tower system should ensure that relevant aerodrome service/personnel can contact the ATCO/AFISO in order to inform them about any situation or condition on the aerodrome that might affect the safe provision of ATS.

Management of navigation aids

According to Section 7.3 of ICAO Annex 11, the ATS units shall be kept informed of the current 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 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 along this process.

According to ICAO Doc 4444, the ATCO/AFISO shall select the runway in use for which it could be necessary to have the capability to select the navigation aids (e.g. Instrument Landing System (ILS)) associated to the operation. This remote management may require the use of the data network (e.g. WAN). The remote tower system should offer the means to ensure that the remote management of the navigation aids is effectively performed, and the means for the ATCO/AFISO to detect any potential failure in its management.

3.2.5.5. RTC–aerodrome communication aspects

The RTC concept relies on communications as a critical enabler. The manoeuvring of equipment on the aerodrome, air–ground voice and visual presentation, all rely on the RTC–aerodrome communication link. This has the impact that conventional contingency mechanisms will no longer be directly applicable and they will have to be adapted to work remotely.

It is therefore essential that the ANSP take the communication aspect into account when designing the technical architecture. When the ANSP 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.

3.2.5.6. Technical supervision

This function would be aimed at monitoring the services provided by the system and at providing the capability for starting, stopping or restarting the system or part of it. The person responsible for the technical supervision may be in charge of the following tasks:

— Presentation of the system's technical status: monitors system availability by acquiring, synthesising and displaying the technical and functional status of all the system's hardware/software resources.

— Provision of failure detection and analysis assistance: generates alarm or warning upon failure detection.

— Provision of support for the analysis of supervision data (enables queries on the history of events).

— Provision of supervision commands and actions: accepts supervision commands/actions (e.g. (re)start/stop/standby/reset/switch-over) from eligible operators and gives the capability to perform maintenance activities.

In the remote tower context, the person responsible for the technical supervision should be responsible for the equipment installed either at the aerodrome (e.g. cameras, sensors, compression servers, network switches), or at the RTC (e.g. decompression servers, video screens), or at any other location. This may be deployed in a distributed environment but the information should be presented in a way that the person responsible for the supervision (or other assigned person) is able to monitor

the overall technical status and detect any technical failure mode/degraded mode that could impact on the remote tower operation.

3.2.5.7. Other ATS systems

The remote tower system may be combined with other ATS systems used in the conventional towers like the electronic system for the presentation and update of flight plan and control data (electronic strips) or the monitoring of the technical status of the systems. For these cases, the installation of such systems will be subject to the same provisions as local (conventional) towers are, subject to the corresponding safety assessment and, hence, no specific provisions are found to be necessary.

3.2.6. Siting aspects

The remote tower system (e.g. camera's field-of-view, visualisation coverage) and its installation (e.g. number and location of cameras) should ensure that the ATCO/AFISO have access to a visual presentation of the flight operations on and in the vicinity of the aerodrome as well as of vehicles, obstacles and personnel on the manoeuvring area. The vicinity of an aerodrome is defined in Chapter 1 of ICAO Doc 4444 as 'aircraft in, entering or leaving an aerodrome traffic circuit'. The visual presentation of some other aerodrome elements (e.g. windsock) may be necessary.

The cameras used for the remote ATS provision may also be used to satisfy some of the visualisation requirements at the aerodrome (see Section 3.3.) regarding the aerodrome's manoeuvring area, including any remote de-icing/anti-icing facilities. Nevertheless, dedicated cameras may also be installed to meet these needs and the information should be presented at the CWP, as done today in the local conventional tower.

The final determination of the number of cameras to be used and the locations at which the cameras are to be installed may also be influenced by other parameters, such as:

— dimensions of the aerodrome;

— design characteristics and complexity of the aerodrome's layout;

— location of the communication, navigation and surveillance equipment (both existing and planned) to prevent any potential interference;

— types of operations that take place at the aerodrome;

— prevailing weather phenomena;

— functionalities and capabilities of the cameras employed;

— existing constructions (e.g. terminal buildings);

— existing control tower;

— desired line of sight angle of incidence;

— avoidance of creation of new obstacles;

— direct or indirect sun glare;

— night-time lighting glare

— external light sources.

A dedicated, comprehensive and coordinated assessment should be conducted by the ATS provider and the aerodrome operator in order to demonstrate that the number, location and characteristics of the cameras fulfil all the objectives for each individual case.

3.2.7. RTM ergonomics

As a basis, the ATCO/AFISO will be provided with an RTM enabling the provision of ATS from a remote location. Hence, the ATS provider should ensure that all the systems and tools required for the ATCO/AFISO to perform their required tasks are available at the CWP. Despite the introduction of new technical systems, the underlying principles and the ATS systems should remain familiar to the ATCO/AFISO and in line with those used in current operations such as, for example:

— flight progress strips (electronic or paper);

— radio-telephony and/or data link communications (ground and air);

— functionality for monitoring and/or controlling aerodrome lights, signalling lamps, navigation aids, alarms and other aerodrome systems.

On the other hand, the working environment may have a negative impact on the ATCO's/AFISO's observation capabilities of the visual presentation. In addition to the working environment and ergonomics for the CWP in a conventional tower, a dedicated analysis of the working environment and ergonomics should be conducted by the ATS provider in order to ensure that the observation capabilities of the ATCO/AFISO are acceptable in order for them to safely provide remote ATS. As a minimum, the assessment should include the lighting conditions at the RTM as a function of, among others, the presentation solution (e.g. use of video screen or projector), the availability of several RTMs in an RTC, or the possibility of having individual lighting conditions for each RTM (depending on the conditions at the remote aerodrome).

3.2.8. Information and cyber security

The distributed architecture of the remote tower infrastructure and the use of shared resources (e.g. WAN) make it more vulnerable to potential security threats to the computer systems or the data exchanged compared to the local (conventional) tower infrastructure. Among all the data exchanged, the visual presentation data is perceived to be the most sensitive due to the potential safety impact. Nevertheless, high risks may be posed due to unavailability of such data (denial of service) rather than the unauthorised modification (data tampering) due to the different monitoring means available and the capability of the ATCO/AFISO to detect inconsistent or corrupted visualisation data. However, other types of data (e.g. status of the navigation aids) may also be the subject of security vulnerabilities (e.g. unauthorised modification), with limited ATCO/AFISO capability to detect potential integrity problems in the information presented at the RTM.

Additional possible impacts may be due to the loss of the communication with the remote aerodrome (e.g. local radio, signalling lamp) which would impact on the ATCO's/AFISO's capability to communicate with the flight crew or to command the systems at the aerodrome.

Consequently, the introduction of the remote tower concept 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 remote ATS). Based on these considerations, the ATS provider should conduct a dedicated security risk analysis and take the necessary measures to protect its systems and constituents against information and cyber security threats.

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. Note that this may also include malware and the effects of external systems on dependent systems.

3.2.9. Remote tower system constituents

In relation to the compliance demonstration with respect to the interoperability Regulation (Regulation (EC) No 552/2004), 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 CSs 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 tower system may be split into constituents and it is up to the ATS provider, in agreement with the respective competent authority, to decide about the split. It is noted that the term 'remote tower system' only refers to the parts of an RTM that are specific to the remote ATS provision.

On the one hand, from the analysis of the high-level functionalities presented in Section 3.2.5., it can be concluded that the remote tower system constituents may be grouped as follows:

— visual presentation-related functionalities (e.g. visual presentation itself, binocular functionality, visual communication);

— voice/data communication-related functionalities (e.g. air–ground communication);

— manoeuvring and monitoring-related functionalities (e.g. management of assets, 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.

On the other hand, it is important to analyse the ATM/ANS service for which a constituent should be considered. This might also affect the possible split of the system into constituents. The main question would be whether the visual presentation part should be considered as a single constituent in the ATS domain or as a combination of ATS constituents and CNS (surveillance) constituents (e.g. cameras) or, in other words, if the visualisation means (cameras) can be considered as surveillance equipment. With regard to that, the definition of 'ATS surveillance system' of ICAO Doc 4444 is recalled here:

'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 is used for the identification of aircraft by the ATCO/AFISO, but is also used for other purposes (e.g. vehicles and personnel, events at the aerodrome) on which the safety of the ATS provision also relies.

Furthermore, the consideration of the cameras as a separate (surveillance) constituent may require that the communication between these devices and the rest of the remote tower system (e.g. compressor servers) is performed according to well-identified and publicly available standards, as it is the case for other surveillance means. This may not be feasible insofar as there could be a dependence on the particular technical solution.

Following this analysis, it has been concluded that the ground infrastructure for capturing images at the aerodrome and its vicinity should be considered as ATS constituent (or part of it) and, hence, it should be under the managerial control of the ATS provider.

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 (Basic equipage, Section 3.2.5.2.)	ATM/ANS service
Visual presentation	Visual presentation Binocular functionality Visual communication	ATS
Voice/data communication	Sound reproduction (optional) Voice/data communication	CNS
Manoeuvring and monitoring	Voice and data recording Aerodrome lights management Alarms management Navigation aids management Technical supervision	ATS

The following is noted:

— Current EUROCAE WG-100 work is aiming to produce an MASPS for the visual presentation function.

— 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 RTC), which would require the definition of the interface specifications (standards) among the identified new constituents.

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

— The ATS provider may consider to add 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 to merge visual presentation with manoeuvring and monitoring, as they belong to the same domain.

3.2.10. Abnormal situations and contingency procedures

Contingency procedures must be adapted to the specific local conditions, taking into consideration elements such as:

— the use of emergency flares or signal lights, and signal light gun use procedure;

— alerting in case of failure conditions;

— the continuation of the service in case of major failure;

— the management of existing traffic in the scenario of complete failure at the time when the failure occurs.

In case ATS provision is affected by the degradation of the system or during an abnormal situation, the system should be able to fulfil the following requirements:

— remote ATS provision shall be ceased 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 shall be notified without undue delay when ATS cannot be provided anymore (unplanned termination of the ATS provision due to system failures);

— the remote tower shall enable, as in current operations, the detection of unexpected flights in the area of responsibility where ATS are being provided;

— the remote tower shall enable the detection of emergency situations on the aircraft (gear problems, fire on tyres or aircraft, tail strike, etc.);

— the remote tower shall enable the initiation of emergency procedures and shall follow emergency situations for aircraft;

— the remote tower shall enable the detection and management of a crash situation on the aerodrome or in its vicinity;

— the remote tower shall enable the detection and management of potential abnormal situations (abnormal weather, fire on terminal or aerodrome building, overload on the apron, etc.) in the aerodrome that could affect or even force the termination (unplanned terminations) of the provision of ATS;

— the remote provision of ATS shall appropriately (safely) be ceased for unplanned terminations;

— airspace users, relevant and adjacent ATS units and respective aerodrome services units shall be notified without undue delay when the remote provision of ATC service is terminated (as per unplanned terminations).

The following items represent, as examples, situations that may result in an abnormal situation for which contingency procedures should be applied.

— Events related to visual presentation, 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 loss of visual presentation/image degraded or loss/degradation of zooming/binocular functionality.

— Events related to other system aspects, including:

  - loss/degradation of audio/ambient sound (if available);
  - loss/degradation of mobile communication;
  - loss/degradation of other systems (aerodrome operating lights, signal lights, etc.).

3.2.11. Transition plan

As part of the introduction into service of the remote tower concept, the ATS provider should establish a transition plan in the way that ATS are migrated from the local (conventional) tower to the remote facility, in coordination with the aerodrome operator. This transition plan should define the different phases to be followed (and the associated transition criteria), allowing in any case the fall-back procedure to the ATS provided from the local (conventional) tower in case of unexpected events or problems. Then, the capability of providing ATS from the local (conventional) tower should be kept during all the transition process plus an additional period (to be defined by the ATS provider) for

contingency reasons. The transition plan should be documented as it should be subject to a safety assessment.

The transition plan may consider the following states:

— Local control: While in this state, ATS will be provided locally to the particular aerodrome.

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

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

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

— While maintaining the provision of ATS from the local tower (local control state), the remote officer calls the local facility in order to declare their ability to assume responsibility for ATS.

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

— When all the necessary information is transferred, and when all the required technical operations in order to allow the remote system to work properly are completed, the remote officer's acceptance of the responsibility will trigger the transition to the 'remote control' state. The local 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 successfully completed 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 'local control' state from the 'remote control' state should be maintained throughout the transition process, and should be also maintained for some time after the successful transition for contingency reasons.

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 (planned and/or exceptional provision of ATS), or when ATS from the remote tower is planned to be terminated (as per planned schedules). This notification process should be applied through the AIP (e.g. NOTAMs).

Moreover, when the transition is completed, the following requirements should be met:

— ATCO/AFISO (or the responsible person designated by the ANSP) providing ATS from a remote tower should apply the relevant remote tower position start-up procedure before providing ATS from that remote position. This start-up procedure shall include the confirmation of the remote tower's capability to provide the service. This procedure should cover at least the following elements:

  - MET information;
  - ground–ground (with other ATS units), air–ground, and ground–ground (with aerodrome services and personnel) communication system;
  - visualisation system;
  - visual and non-visual navigation aids.

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

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

— Prior to an unplanned termination, ATCO/AFISO shall ensure that ATS is appropriately (safely) terminated.

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

3.3. Aerodrome-related aspects

It is important to ensure coordination between the competent authority, the ATS provider and the aerodrome operator throughout the remote tower concept process of implementation and approval. The following aspects should be taking into consideration to meet this objective.

3.3.1. Certification and approval

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

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

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

— the way ATS is provided:

- locally (ATS unit established at the aerodrome), or
- remotely (ATS unit not established at the aerodrome).

If ATS is not provided locally, the submitted documentation, apart from the necessary arrangements between the aerodrome operator and the ATS provider, should clearly identify:

— the location of the remote ATS unit;

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

— the organisation that will carry out these tasks locally.

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 its vicinity (e.g. cameras, sensors, etc.) to enable and support the provision of remote 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 remote ATS unit and the relevant aerodrome units (e.g. RFSS station, apron management services unit), or vehicles operating on the manoeuvring or movement area (if apron management services are also provided by the remote ATS unit);

— the operation of the alerting system for RFSS purposes;

— the operation of the signalling lamp;

— the provision of light and pyrotechnic signals to aerodrome traffic as provided for in Commission Implementing Regulation (EU) No 923/2012 (SERA.3301, Appendix 1); and

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

3.3.1.2. Aerodrome manual

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

— the provision of relevant information to the AIS for publication in the AIP (see Section 3.5.);

— the maps and charts of the aerodrome showing the location of facilities, installations and equipment enabling and supporting the remote provision of ATS, within and outside the aerodrome's boundaries;

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

— the procedures for meteorological observation and provision;

— the procedures for the protection of facilities, installations and equipment enabling and supporting the remote provision of 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; and

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

3.3.2. Operational aspects

3.3.2.1. Coordination between the aerodrome operator and the ATS provider in the event of system failure

In the event of failure of any of the facilities, installations and equipment enabling and supporting the remote provision of ATS, the aerodrome operator should coordinate with the ATS unit and, if necessary, initiate the issue of a NOTAM declaring the aerodrome closed.

3.3.2.2. Aerodrome operator — Aerodrome safeguarding

In case of remote provision of 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 provision of ATS is assessed and mitigated; and

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

3.3.2.3. Maintenance of the remote tower system facilities

Where ATS is provided remotely, the maintenance programme of the remote tower systems at the aerodrome should also address the maintenance needs of the facilities, installations and equipment, including electrical systems, which enable and support the remote provision of ATS.

A preventive maintenance programme should be established and implemented to cover the facilities, installations and equipment enabling and supporting the remote provision of ATS. Such a preventive maintenance 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 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, while the preventive maintenance programme should be based on the maintenance instructions of the manufacturer of the respective facility, installation and equipment, as appropriate.

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:

— identified either during preventive maintenance activities; or

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

Such arrangements should also specify the maintenance responsibilities of the involved organisations.

3.3.2.4. Remote provision of ATS — Management of the change — Aerodrome operator

At aerodromes where ATS is provided by an ATS unit which is established at the aerodrome and the introduction of remote ATS provision is planned, due care and time should be taken for the adequate preparation of the transition plan before the change is introduced.

Due to the significance of the change, a competent authority approval may be required. Therefore, the aerodrome operator should communicate its intentions and plan to the 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 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, but also with 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 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:

  - 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 will be needed 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 similar arrangements. Such tasks may include but are not limited to:
    - maintenance of facilities, installations and equipment necessary for the remote provision of ATS;

- meteorological observations;
- provision of pyrotechnic signals to aerodrome traffic;
- other.

- 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 are not limited to:
  - regular inspections conducted by the aerodrome operator;
  - safeguarding and protection of facilities, installations and equipment necessary for the remote provision of ATS (e.g. obstacles, interference from various sources, etc.);
  - security procedures for the protection of facilities, installations and equipment necessary for the remote provision of ATS;
  - other.

— Need for review of the necessary documentation, including the aerodrome manual, in order to identify any need for updates of or changes to the relevant procedures or the roles allocated to the ATS or aerodrome personnel. This may include but is not limited to:

- maps and charts;
- aerodrome maintenance programme and related procedures;
- establishment of new procedures to cover new or amended areas of responsibilities;
- roles of different organisations in the aerodrome emergency plan;
- (A)-SMGCS appropriateness and effectiveness;
- ATS provider representation in local working procedures (e.g. safety teams, crisis management, etc.);
- provision of relevant information to the AIS;
- other.

— 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 employed:

- remotely for the implementation of the remote provision of ATS, such as:
  - operation/control of the aerodrome's lighting systems and their individual elements, as appropriate;
  - communication systems between the remote ATS unit and the relevant aerodrome units (e.g. RFFS station, apron management services unit) or vehicles operating on the manoeuvring or movement (if apron management services are also provided by the remote ATS unit) area;
  - operation of the alerting system for RFFS purposes;
  - other.
- at the aerodrome in order to support the implementation of the remote provision of ATS, such as:

- provision of power supply to the facilities, installations and equipment for providing and supporting ATS remotely;
- location/installation of cameras;
- other.

3.3.2.5. Power supply at aerodromes

Electrical power supply systems for the remote provision of ATS

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

— Cameras and related facilities located at an aerodrome, for enabling and supporting the remote provision of ATS, 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 on failure of the primary power supply.

— The power supply for cameras and related facilities mentioned in the previous paragraphs should, irrespective of the runway type, be continuous/uninterrupted.

Guidance Material — Electrical power supply systems for the remote provision of ATS

The type and number of related facilities, located at an aerodrome, that should be provided with secondary power supply (apart from the cameras themselves) is a function of the design of each individual system and the solution(s) adopted in each case.

In any case, all such facilities — whose function is such that if failure of their primary power source would result in an interruption of the transmission of the visual presentation to the ATS unit — should be identified and provided with a secondary power supply meeting the relevant continuity requirements.

The continuity requirement regarding power supply for cameras and related facilities is without prejudice to the applicable switchover times of other facilities located at the aerodrome (e.g. visual approach slope indicators, runway-threshold lights, runway-end lights, runway-edge lights, runway-touchdown-zone lights, stop-bars, etc.).

3.3.2.6. Cameras at aerodromes

At aerodromes where ATS is provided remotely, appropriately located cameras should be used to provide visual presentation of an unobstructed view of at least:

— the aerodrome's manoeuvring area, including any remote de-icing/anti-icing facilities; and

— the aerodrome's traffic circuit as well as arriving and departing traffic

to the ATS personnel.

At aerodromes where ATS is provided remotely and the respective ATS unit is also responsible for the provision of apron management services at the aerodrome, cameras should be so located as to provide visual presentation of an unobstructed view of the apron(s) under the responsibility of that ATS unit.

Location of de-icing/anti-icing facilities

Where ATS is provided remotely, suitably located cameras should be used to ensure that the de-icing/anti-icing facilities are clearly visible to the ATS personnel.

3.4. Possible impacts on airspace users

It is anticipated that it may be hard to distinguish small aircraft while manoeuvring (e.g. when turning, the angle of the aircraft to the camera may be such that the aircraft's dimensions could not/hardly be distinguished by the human eye). This also depends on the resolution capabilities of the visualisation equipment and the mode in which it is used. The ATS provider should take these elements into consideration when conducting the safety assessment in order to propose mitigation measures, if needed.

If it is chosen to equip the remote tower with secondary surveillance equipment, the ATS provider should evaluate the need to establish a TMZ within the ATZ and to propose it to the relevant competent authority.

The quality of the visual presentation and the end-to-end delay (described in Section 3.2.5.2) could also impact on the ability to establish and maintain visual surveillance and monitor separation, which could potentially limit operations. As examples of potential mitigation measures, ATS providers may need to consider applying a different separation or require users to request permission to land.

3.5. AIP

As a consequence of the implementation of the remote tower concept, the following additional elements have been identified as necessary to be published through the AIS:

— Remote aerodrome ATC/AFIS provision;

— Location of signalling lamp (in case of communication failure).

4. Draft Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) 2015/340 (Draft EASA Decision)

Regarding the EU ATCO regulatory framework, the following amendments to the existing AMC/GM[17] associated to Commission Regulation (EU) 2015/340 are proposed.

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

(a) deleted text is marked with ~~strike through~~;

(b) new or amended text is highlighted in grey;

(c) an ellipsis (…) indicates that the remaining text is unchanged in front of or following the reflected amendment.

AMC1 ATCO.B.020(a) Unit endorsements

GENERAL

When aerodrome control service is provided from a remote location, each aerodrome should constitute its own unit endorsement.

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

ATC UNIT FOR AERODROME CONTROL FROM A REMOTE TOWER

For the purpose of establishing a unit training plan, a Remote Tower Centre (RTC) may be considered as one Air Traffic Control (ATC) unit.

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

PERFORMANCE OBJECTIVES FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL 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 (RMT), 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 local (conventional) tower.

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

TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL 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:

[17] 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.

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 (RTM), Remote Tower Centre (RTC)
Subtopic RTO 1.3 — Advanced Visual Features (AVF) — 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 2.3 — 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

GM2 ATCO.D.080(b) Refresher training

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

For air traffic controllers 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
TRAINING FOR AIR TRAFFIC CONTROLLERS PROVIDING AERODROME CONTROL FROM A REMOTE TOWER

The conversion training for air traffic controllers providing aerodrome control service from a remote tower should at least include the subjects, subject objectives, topics and subtopics as specified in GM3 ATCO.D.060.

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

5. References

5.1. Affected regulations

Not applicable.

5.2. Affected CS, AMC and GM

— 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

5.3. Reference documents

— ICAO ANNEX 11 'Air Traffic Services'

— ICAO Doc 4444 'Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM)'

— ICAO Doc 9750, 4th Edition, 'Global Air Navigation Plan (GANP)'

— ICAO Working Document for The Aviation System Block Upgrades — 28 March 2013 (Section B1-RATS Remotely Operated Aerodrome Control)

— ICAO Doc 9859 'Safety Management Manual', Second Edition, Appendix 1 to Chapter 7, 'System Description Of An Aerodrome'

— ICAO Doc 9734 'Oversight Manual', Part C, 'The Establishment and Management of a State's Aviation Security Oversight System'

— EUROCONTROL Manual for Aerodrome Flight Information Service (Edition number 1.0)

— D04 — OSED for Remote Provision of ATS to Aerodromes, including Functional Specification, Edition 00.04.01 (SESAR)

— D08 'Remote Provision of ATS to a Single Aerodrome VALR', Edition 00.04.00 (SESAR)

— D03 'Remote and Virtual Tower: Rules & Regulations Assessment Report', Edition 00.01.01 (SESAR)

— OFA06.03.01 Remote Tower 'Safety Assessment Report for Single Remote Tower', Edition 00.01.00 (SESAR)

— PP 6.9.3 Intermediate HP Assessment Report, Edition 00.01.01 (SESAR)

— 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 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 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)

- Regulation (EU) No 1035/2011 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 Regulation (EU) 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)
- 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)
- ICAO Annex 3 on Meteorological Service for International Air Navigation
- Subpart D 'Instruments, Data, Equipment' of Annex IV to Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 296, 25.10.2012, p. 1)
- ICAO Annex 14 'Aerodromes Volume I Aerodrome Design and Operations'
- ICAO Annex 14 'Aerodromes Volume II Heliports'
- ICAO Doc 9426 'Air Traffic Services Planning Manual'
- ICAO Circular 211-AN/128 'Aerodrome Flight Information Service'

6. Appendices

6.1. Appendix 1: Human performance aspects

Technology aspects:

- Depth of perception
- Contrast & brightness
- Screen layout
- Resolution
- Field of view
- Colours
- Dynamic range
- Automation of camera movements
- Avoidance of blind areas
- Reliability of the visual presentation
- Availability of the visual presentation
- Integrity of the visual presentation
- Accuracy of the visual presentation
- Time delays between image capture and visual presentation
- Appearance of image freezing issues
- Capability of the visual presentation to provide smooth and regular impression of moving objects to the human eye eventually in both 2D and 3D presentation
- Quality of the visual presentation to allow the ATCO to discriminate distance between objects
- Procedures in case of image integrity failure

Elements of the human performance assessment:

- ATCO/AFISO situational awareness
- ATCO/AFISO perception
- ATCO/AFISO capacity to detect all aircraft
- Maintenance of continuous watch through visual contact on all flight operations and all people and vehicle movement on the manoeuvring area. Effect of time delays on visual presentation in all situations, with special importance for the case of emergency situations (e.g. runway incursions)
- Potential confusion between 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
- Partial obstruction of visual detection during sunrise or sunset
- Contrast of screens with the background

— Colour balance with different daylight configurations

— Screens arrangement (e.g. 6 or 9 screens, 240 or 360 degrees)

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

— Management of the 'cone of silence' (flight area too high and too close to be visible on the screens)

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

— Availability of aerodrome ambient sound and acoustic characteristics of the control room

— Camera angles and screen orientation in relation to aerodrome layouts and in relation to the different legs of the VFR circuit

— 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

— Visual object tracking functionality (if available), either automatically (rotation, tilt to the desired elevation angle and focus at the indicated distance) or through a manual pan-and-tilt/zoom function

Other human performance-related aspects:

Apart from the above-mentioned elements, some other aspects not strictly related to the direct visual observation replacement need to be assessed. The following aspects should be used as an example:,

— Local procedures to manage movement of vehicles and persons on the manoeuvring area

— Local procedures on coordination of remote tower and approach control (APP) services, whether merged or not in the same dependency

— Local procedures for operations during low-cloud situations, limited visibility or similar

— Specific training elements related to local aerodrome characteristics

— Potential impact on VFR flights, compared to the equivalent in a conventional TWR environment Effect of the types of airspace surrounding the aerodrome concerned (e.g. class C and D) on issuing take-off clearances

— Effect on the visual observation of size, equipment, flight patterns and behaviour of VFR

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

- additional separations
- ground equipment (e.g. radar)
- on-board equipment (e.g. transponder, ADS-B)
- specific camera configuration (e.g. two layers of cameras for ground and one for sky to minimise contrast)
- specific camera additional equipment (e.g. adaptable housing to mitigate sunshine effects)
- specific screen requirements (e.g. automatic adjustable contrast to mitigate daylight variations)
- specific ancillary equipment (e.g. automatic cleaning system for the windows protecting the cameras to avoid snowflakes affecting image capturing)

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

Table 3 below lists the operational hazards, the operational effects and the severity classification for the ATC services, according to the results of the SESAR safety work.

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

ID	Description	Operational effects	Severity (SESAR)
OH-01	Remote ATC incorrectly coordinates with other ATSU with respect to inbound/outbound traffic	A potential conflict can be induced Imminent infringement	SC3
OH-02	Remote ATC incorrectly manages the entry of a flight into traffic circuit	A potential conflict can be induced Imminent infringement	SC3
OH-03	Remote ATC incorrectly manages arriving aircraft	A potential conflict can be induced Imminent infringement	SC3
OH-04	Remote ATC incorrectly manages departing aircraft	A potential conflict can be induced Imminent infringement	SC3
OH-05	Remote ATC fails to provide appropriate separation to traffic in the vicinity of the aerodrome	Imminent infringement	SC3
OH-06	Remote ATC fails to provide appropriate separation to traffic with respect to restricted areas	Tactical conflict	SC4
OH-07	Remote ATC incorrectly manages missed approach situation	Imminent infringement	SC3
OH-08	Remote ATC does not detect in time conflicts/ potential collision between aircraft in the vicinity of the aerodrome	Imminent collision	SC2
OH-09	Remote ATC does not detect in time restricted area infringements	Tactical conflict	SC4
OH-10	Remote ATC fails to provide appropriate instruction to resolve a conflict between traffic in the vicinity of the aerodrome	Imminent collision	SC2
OH-11	Remote ATC fails to provide appropriate instruction to resolve an airspace infringement	Tactical conflict	SC4
OH-12	Remote ATC fails to provide appropriate information to departing aircraft for the start-up	Tactical taxiway conflict generated	SC5
OH-13	Remote ATC fails to enable push-back-towing operations to appropriate aircraft	Tactical taxiway conflict generated	SC5
OH-14	Remote ATC provides inadequate taxiing instruction to aircraft on the manoeuvring area	Encounter with aircraft, vehicle or obstacle	SC4
OH-15	Remote ATC provides inadequate taxiing instruction to vehicle on the manoeuvring area	Encounter with aircraft, vehicle or obstacle	SC4
OH-16	Remote ATC does not detect in time potential conflict on the manoeuvring area	Imminent collision	SC3
OH-17	Remote ATC fails to provide appropriate	Imminent collision	SC3

ID	Description	Operational effects	Severity (SESAR)
	instruction to resolve conflicts on the manoeuvring area		
OH-18	Remote ATC fails to provide (appropriate) navigation support to AC and vehicle on the manoeuvring area	Tactical taxiway conflict generated	SC5
OH-19	Remote ATC incorrectly manages runway entry for a departing aircraft (occupied runway)	Runway conflict	SC3
OH-20	Remote ATC incorrectly manages runway exit for a landing aircraft	Runway conflict	SC3
OH-21	Remote ATC incorrectly manages runway crossing (occupied runway) for a vehicle or an aircraft	Runway conflict	SC3
OH-22	Remote ATC fails to properly support departing and landing aircraft (with respect to visual aids)	Runway conflict	SC3
OH-23	Remote ATC incorrectly manages vehicle-related tasks on the runway	Runway conflict	SC3
OH-24	Remote ATC incorrectly manages aircraft take-off (occupied runway)	Runway conflict	SC3
OH-25	Remote ATC incorrectly manages aircraft landing (occupied runway)	Runway conflict	SC3
OH-26	Remote ATC fails to detect in time runway incursions (aircraft or vehicles)	Runway penetration	SC4
OH-27	Remote ATC fails to provide appropriate instruction to resolve runway incursion and prevent potential collision on the runway	Runway penetration	SC4
OH-28	Remote ATC fails to detect in time a flight towards terrain in the vicinity of the aerodrome	Imminent CFIT	SC2
OH-29	Remote ATC fails to provide appropriate support to pilot on a CFIT situation	Imminent CFIT	SC2
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	SC3
OH-31	Remote ATC fails to properly support landing/ take-off operations with respect to weather conditions	Potentially to a landing accident	No severity allocated[18]
OH-32	Remote ATC fails to properly support landing/ take-off operations with respect to runway conditions and potential foreign objective debris	Potentially to a landing accident	No severity allocated[18]
OH-33	Remote ATC fails to properly support departing and arriving aircraft on the runway with respect to non-visual aids	Potentially to a landing accident	No severity allocated[18]

[18] By the time of publication of this NPA, the severity of this operational hazard was still under final consolidation in the context of the SESAR project.

ID	Description	Operational effects	Severity (SESAR)
OH-34	Remote ATC fails to detect in time an intrusion inside landing-air protection area	Potentially to a landing accident	No severity allocated[18]

6.3. Appendix 3: List of operational hazards for AFIS services

Table 4 below lists the operational hazards that may be considered by the ATS provider for the AFIS service. SESAR safety work has focussed on the ATC case applied assuming that the most constraining results specifying the remote tower concept would be derived from ATC services. Then, this list should be considered as an initial list by the ATS provider to be further developed as necessary.

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 airport.
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 airport conditions to departing and arriving traffic (surface conditions, maintenance works, obstacles, birds, lighting system failure, etc.): — 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 airport 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 entry to the manoeuvring area.
OH-AFIS-15	Remote AFIS fails to provide light signals to ground 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 airport 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 airport 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.

6.4. Appendix 4: Checklist for the approval of the implementation of the remote tower concept

Based on the content of this NPA, the following elements are listed (for reference purposes only) in order to summarise the aspects to be considered during the approval of the implementation of the remote tower concept.

— Transition plan developed by the ATS provider and the aerodrome operator.

— Implementation timeline agreed by the ATS provider, the aerodrome operator and the competent authority(ies).

— Siting assessment to meet view and visual presentation requirements.

— Working environment, human performance and ergonomics analysis.

— Aerodrome's documents affected by the certification process.

— Contingency coordination plan between the ATS provider and the aerodrome operator.

— Review and documentation of roles and responsibilities assigned to the ATS provider and the aerodrome operator.

— Safety assessment which includes but is not limited to the following topics:

- documentation that the basic equipage requirements will be met;
- assessment of the need for enhanced equipage functionalities based on traffic density, air traffic characteristics, aerodrome layout, airspace characteristics, aerodrome infrastructure and surroundings, and environmental characteristics;

- reassignment of tasks among the ATS provider and the aerodrome operator;
- tasks requiring modification or enhancement;
- review and update of the training requirements for ATS provider's and aerodrome operator's personnel;
- analysis of the interdependencies with other service providers and aviation undertakings, and analysis of the necessary coordination processes;
- review and update of the aerodrome documentation;
- requirements for airspace users (e.g. equipment on board, etc.);
- functional hazards assessment and CMA;
- determination of safety requirements and mitigations;
- security risk analysis;
- AIP modification proposals.

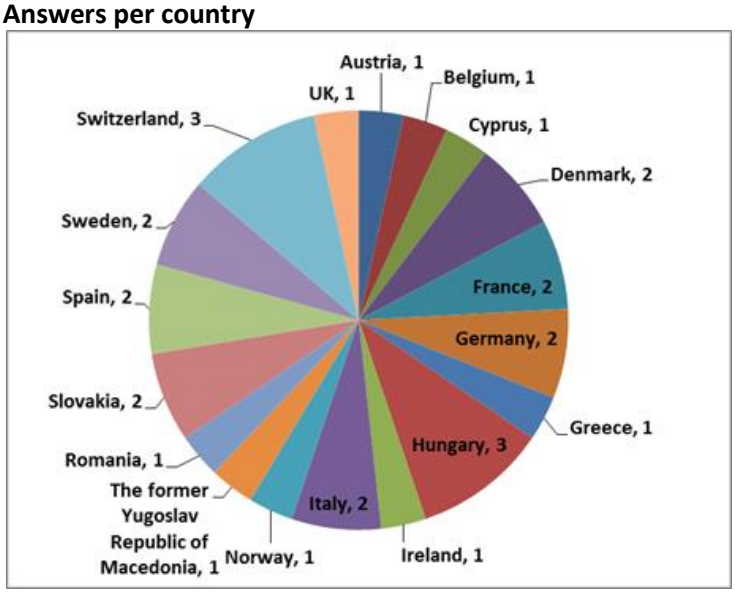
6.5. Appendix 5: Overview of the results of the questionnaire sent to the stakeholders

A questionnaire was sent to the ATM advisory groups (RAG/TAG and SSCC) on 30 January 2015 in order to get feedback from aviation stakeholders whether they believe that the current ATM regulatory framework is suitable for the introduction and implementation of the remote tower concept. The initial deadline was set for 2 March 2015, and was extended until 11 March 2015 due to low response rate.

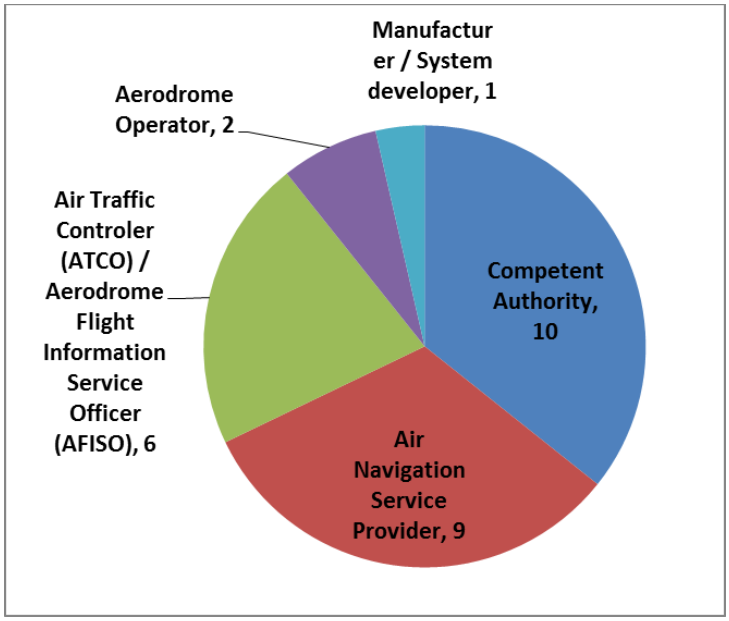
There were 28 answers in total. They are obviously not sufficient to draw firm conclusions; however, they confirm that the issues identified in Chapter 2, Section 1, of the Explanatory Note are in line with the respondents' answers. Therefore, this Appendix will not present a summary of the issues identified by the respondents.

This Appendix provides a statistical overview of the answers to the questions which are not qualitative (e.g. providing comments). This makes that 24 out of the 28 answers are really comparable.

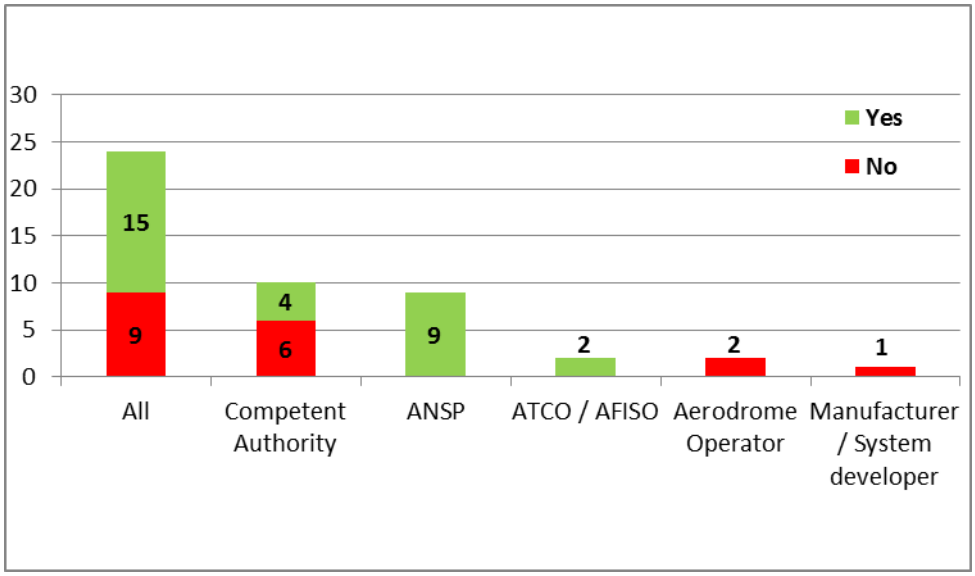
Answers per country



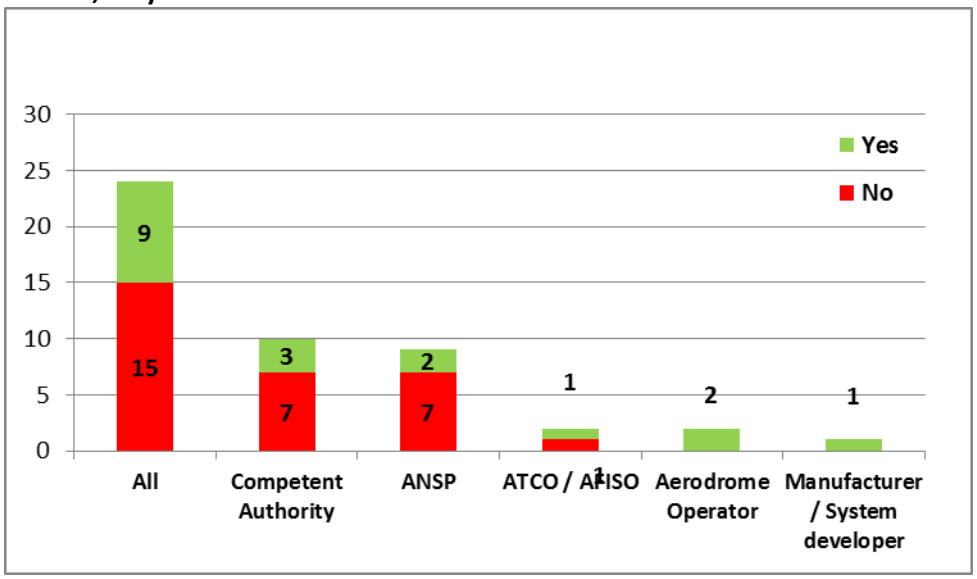
Answers per stakeholder type



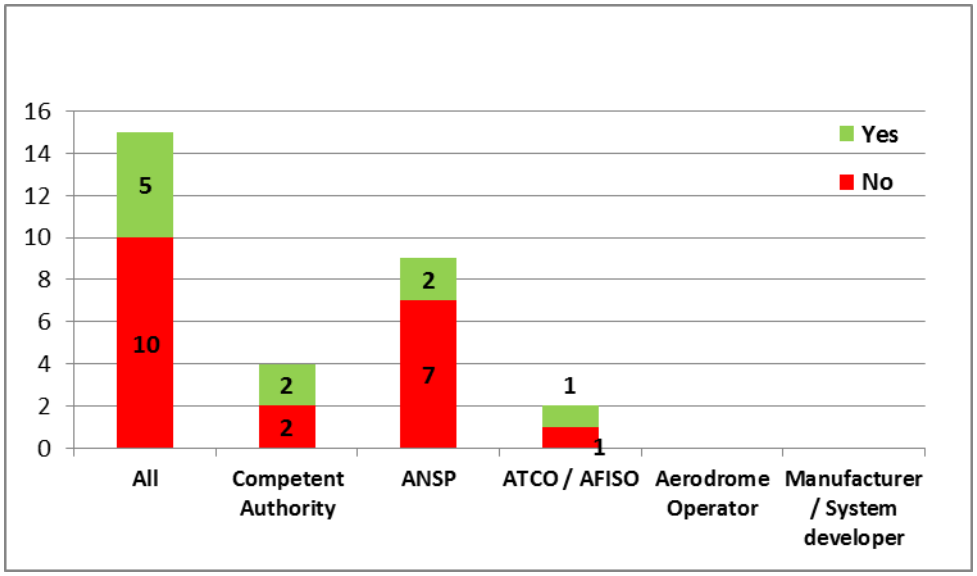
Are you involved in a remote tower project or in its implementation?



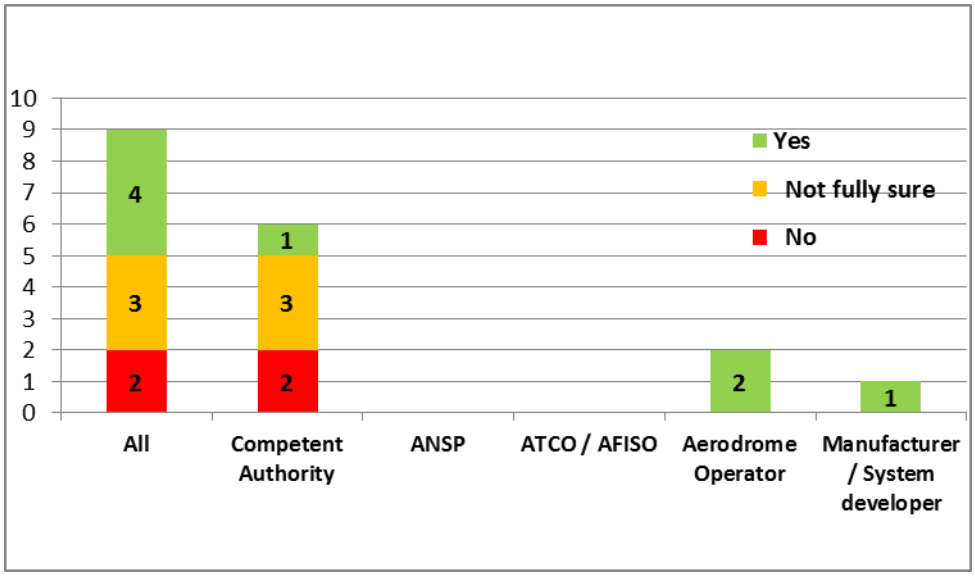
Overall, do you consider that the current ATM rules are sufficient?



If your are involved in a remote tower project or in its implementation, do you consider that the current ATM rules are sufficient?



If you are not currently involved in a remote tower project or in its implementation, do you consider that the current ATM rules are sufficient?



6.6. List of acronyms

AFIS	Aerodrome Flight Information Service
AFISO	Aerodrome Flight Information Service Officer
AFS	Aeronautical Fixed Service
AGLS	Aeronautical Ground Lighting System
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
AMC	Acceptable Means of Compliance
ANS	Air Navigation Service
ANSP	Air Navigation Service Provider
APP	Approach Control
ATCO	Air Traffic Control Officer
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
ATZ	Aerodrome Traffic Zone
AVF	Advance Visual Features
CA	Competent Authority
CAT	Commercial Air Transport
CNS	Communication Navigation Surveillance
CMA	Common Mode Analysis
CPDLC	Controller Pilot Data Link Communications
CS	Community Specifications
CTR	Aerodrome Control Zone
CWP	Controller Working Position
DOC	Declaration Of Conformity
DSU	Declaration of Suitability of Use
FHA	Functional Hazards Assessment
FIS	Flight Information Service
GM	Guidance Material
HF	Human Factors
HMI	Human–Machine Interface
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
MASPS	Minimum Aviation System Performance Standards
MET	Meteorological
MOPS	Minimum Operational Performance Standards
NOTAM	Notice to Airmen
NPA	Notice of Proposed Amendment
OTW	Out-The-Window
PTZ	Pan-Tilt-Zoom
RATS	Remote Aerodrome Traffic Service

RCS	Risk Classification Scheme
RFFS	Rescue and Fire Fighting Services
RMZ	Radio Mandatory Zone
RTC	Remote Tower Centre
RTM	Remote Tower Module
RTO	Remote Tower Operation
RWY	Runway
SSAS	Software Safety Assurance System
SWAL	Software Assurance Level
SESAR	Single European Sky ATM Research
SLA	Service Level Agreement
SMS	Safety Management System
TMA	Terminal Manoeuvring Area
TMZ	Transponder Mandatory Zone
TWR	Tower
TWY	Taxiway
VFR	Visual Flight Rules
VHF	Very High Frequency
WAN	Wide Area Network