



## D03 – Remote and Virtual Tower Rules & Regulations Assessment Report

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### **Abstract**

This task will look at any required changes or amendments to existing Rules and regulations that may be required in order to implement the Remote Tower concepts. The report states how P06.09.03 has, with regards to Remote Provision of ATS, contributed to:

- 1.Ensuring a robust strategy for a generic rule change;
- 2.Providing the project with the best strategy in order to achieve local approval;
- 3.Proposing local rules and procedures.

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## Executive summary

The Remote Provision of ATS concept is built on the following justification:

- Enables the Air Traffic Services to provide a more cost effective aerodrome control service from a remote tower, with at least the same levels of efficiency and safety, for low density airports; (Low density - Mostly single simultaneous operations, rarely exceeds 2 simultaneous movements);
- Enables the simultaneous provision of ATS for more than one airport at a time from a single remote tower facility;
- Provides a contingency solution in cases where the local tower is out of service, taking into account availability of different controller systems/tools and local procedures, capturing required safety and capacity needs;
- Allows the provision of Aerodrome Flight Information Service (AFIS) at uncontrolled airports from a remote location;
- Provides a synthetic augmentation of vision to increase situational awareness during poor visibility conditions or at night;
- Enables enhanced safety and security by introducing various visual and tracking features;
- Are as generic as possible in order that they can be adapted easily to different airports.

This report contains a collection of activities connected to rule change in general and then describes some of the proposed working methods specifically developed for the shadow mode exercises in VP-057, Remote Provision of ATC to a Single Aerodrome.

As a result of SESAR activities regarding Remote Provision of ATS both EASA and ICAO are aware of the ongoing activities: EASA in relation to air traffic controller licensing; and ICAO via the working paper 42 (Appendix B) due to be presented at the ANC November 2012.

Since the start of P06.09.03 another Remote Tower project supported by SESAR was started. This project is called RTC Sundsvall. RTC Sundsvall will be an implementation project and therefore the validation will also include Operational Approval by NSA. It is therefore in this project the first fully developed rules and methods will be found. They will build on what has been proposed in the P06.09.03 validation.

In the future validation exercises for Remote Provision of AFIS and Remote Provision of ATS to Multiple Aerodromes further iterations of proposed rule changes and working methods may be produced.

**Note: P06.09.03 has a target maturity of V3, and a Regulatory Case is not produced until after an implementation decision (V4). A formal Regulatory Case will therefore *not* be produced by the project, nor will any new regulations be made within the project. The scope for such regulations *will* be identified meaning that the project will reach the point of proposing a *high level process* of regulatory changes when introducing the new concept of Remote and Virtual Tower. It will provide an overview of on-going initiatives regarding the introduction of remote tower control in Europe and also propose example local procedures for use in passive shadow mode validation trials.**



# 1 Introduction

## 1.1 Purpose of the document

This document is D03 of the P06.09.03 Project, produced under Task 3 – Rules and Regulations Analysis. It describes the high level process of rule changes when introducing the new concept of Remote and Virtual Tower. Furthermore it will provide an overview of on-going initiatives regarding the introduction of remote tower control in Europe.

It will also give some examples of proposed rules and practices when operating from a remote tower and a proposed method of evaluating such rules and procedures. The reference list and appendices serves as a comprehensive list of the regulations that might be of concern.

## 1.2 Intended readership

The intended audience for this document are other WP06.09.03 team members, and those in the corresponding technical projects of WP12.04.06, WP12.04.07, WP12.04.08, WP06.09.02, 16.06.05 and WP12.04.09.

At a higher project level, WP06.02 and WP B are expected to have an interest in this document. External to the SESAR project, other stakeholders are to be found among:

- Appropriate Safety Authorities
- Affected employee unions;
- Air Navigation Service Providers (ANSP);
- Airport owners/providers;
- Airspace users.

## 1.3 Structure of the document

The structure of the document is as follows:

- **Section 1** (this section) describes the purpose and scope of the document, the intended audience, and gives an explanation of the abbreviations and acronyms used throughout the document.
- **Section 2** describes the approach taken in the Rules and Regulations Assessment;
- **Section 3** presents the outputs of the analysis;
- **Section 4** concludes the assessment and presents some recommendations;
- **Section 5** lists the references used in the assessment;
- **Appendix A** contains an analysis of regulations which concern remote tower operations;
- **Appendix B** contains an ICAO Working Paper about Remote Tower procedures;
- **Appendix C** presents an Appendix to ATS Operational Manual RTC sector Ängelholm.

## 1.4 Inputs from other projects

SESAR project 16.06.05 applied the development of a template for SESAR, targeting rule change requirements in general, by using Remote & Virtual Tower as a test case. This template is yet to be finalised by P16.06.05.

## 1.5 Acronyms and Terminology

Term	Definition
A-SMGCS	Advanced Surface Movement Guidance and Control System
AFIS	Airport/Aerodrome Flight Information Service



Term	Definition
ANC	Air Navigation Conference (ICAO organ)
ANSP	Air Navigation Service Provider
APP	Approach Control Service
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATM	Air Traffic Management
ATS	Air Traffic Services
AVF	Advanced Visual Features
CBA	Cost Benefit Analysis
CR	SES Regulation
CS	Certification Specification (EASA)
CWP	Controller Working Position
EASA	European Aviation Safety Authority
E-ATMS	European Air Traffic Management System
ECAC	European Civil Aviation Conference
ESARR	Eurocontrol Safety Regulatory Requirements
EU	European Union
FL	Flight Level
HMI	Human Machine Interface
ICAO	International Civil Aviation Organisation
IFALPA	International Federation of Airline Pilots Association
IFATCA	International Federation of Air Traffic Controllers Associations
IR	Implementing Rule (SES)
LFV	Luftfartsverket
NSA	National Safety Authority
OSED	Operational Service and Environment Definition
OTW	Out of The Window view
PANS	Procedures for Air Navigation Services
PIR	Project Initiation Report
PTZ	Pan Tilt Zoom (camera)
R&R	Rules and Regulations
RTC	Remote Tower Control
RTF	Remote Tower Facility
SES	Single European Sky
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SMS	Safety Management System
SPR	Safety and Performance Requirements

Term	Definition
SWIM	System-Wide Information Management
TWR	Tower Control Centre
VALR	Validation Report

## 2 Rules and Regulations Analysis Approach

### 2.1 Overview of the concept

The objective of Remote Provision for a Single Aerodrome is to provide the air traffic services (ATS) defined in ICAO Documents 4444[1], 9426[2] and EUROCONTROL's Manual for AFIS[3] for one aerodrome from a remote location i.e. not from a Control Tower local to the aerodrome. The full range of ATS should be offered in such a way that the airspace users are not negatively impacted (and possibly benefit) compared to local provision of ATS. The overall ATS will remain classified into either of the two main service subsets of TWR or AFIS.

The Remote Provision of ATS for a Single Aerodrome is expected to be applied mostly to low density aerodromes (where low density is determined as being mostly single simultaneous operations, rarely exceeding two simultaneous movements). In the long-term the concept may also be applied for larger airports or small airports with occasionally more traffic density (for example touristic airports/remote airports during a particular event etc.), however that is not the scope for this OSED[4] at this stage.

The Remote Provision of ATS for a Single Aerodrome is defined in such a way that is appropriate and operable for a single aerodrome, but can ultimately be expanded and scaled to apply to more than one aerodrome under the Multiple Aerodromes concept.

The Remote Provision of ATS relies on the capability of reproducing the visual references of the aerodrome. Within P06.09.03 is done using cameras plus other awareness enhancing technical features such as:

- Movable cameras to allow for panning the sky or the ground (i.e. runway);
- Multiple cameras and locations to ensure coverage of hotspots and remote or hidden areas;
- Zoom functionality on pre-selected camera views;
- Camera tracking, where a camera locks on an object and is supposed to follow it and display a square around the object;
- Radar tracking integrated on the visual screen so that labels can be attached to moving traffic objects;
- Ambient sound.

### 2.2 Overview of Approach Taken

#### 2.2.1 Planned Approach

Task T06.09.03-003 "Rules and Regulation Analysis" is expressed in the Project Initiation Report [5] as follows:

*This task will look at any required changes or amendments to existing Rules and Regulations that may be required in order to implement the Remote Tower concepts.*

*This task will identify and directly contribute to the information required to establish new standards (e.g. SPR, INTEROP, PANS, SARPs ESARR ) while also preparing the way for new regulations (e.g. EUROCAE EU Implementing Rules, EU Common Specification) should an implementation decision be taken. The mandate/scope for such regulations will be identified early in the project, with contributing information prepared in advance where possible.*

In addition, the PIR stated that D03 (this document) would:

*Report on required changes or amendments to existing rules and regulations that may be required in order to implement the Remote Tower/AFIS concepts.*

...whilst providing the following Regulatory Contributions:

*Proposed additions to existing ICAO standards (Annex)*

*Proposed additions to existing ICAO recommended practices (doc)*

*Proposed additions to EU rules & regulations*

Finally, according to the P06.09.03 Project Management Plan (PMP) [6] T06.09.03-003 would be split into sub tasks grouped according to the P06.09.03 OI:

- SDM-0201 – Remote Provision of ATS to a Single Aerodrome;
- SDM-0204 – Remote Provision of ATS to Multiple Aerodromes;
- SDM-0205 – Remote Provision of ATS Aerodromes in Contingency Situations.

For each OI, the PMP stated that T06.09.03-003 would first perform an analysis of the required changes to Rules and Regulations (R&R) and then propose amendments to the R&R.

## 2.2.2 Factors impacting the Planned Approach

As the project progressed, and prior to the commencement of T06.09.03-003, several influential decisions were taken:

- The project clarified that it would not be producing an SPR or an INTEROP;
- Technical standards would not be developed within T06.09.03-003 but would be identified by the Safety Assessment task and referred to in the Safety Assessment;
- T06.09.03-003 was planned to end during 2012, while validation would continue beyond that timescale (in fact, only 2 trials would have taken place by the time T06.09.03-003 finished);
- Local rules and operating methods would be required for the specific validation activities.

In addition, following the start of P06.09.03 a Remote Tower implementation project (supported by SESAR) was started. This purpose of this project, called RTC Sundsvall, is to result in the implementation of a Remote Tower Centre and therefore the validation will also include Operational Approval by the Swedish NSA. The objective to achieve national approval within P06.09.03 is therefore no longer valid.

Finally, since P06.09.03 has a target maturity of V3, and a Regulatory Case is not produced until after an implementation decision (V4), a formal Regulatory Case will not be produced by the project but the scope for such regulations *will* be identified.

Unlike other transversal areas within SESAR, there is no official methodology given for Rules and Regulations Assessments. Similarly, there is no requirement to produce a separate Rules and Regulations Assessment Plan.

Therefore, with a lack of “official” guidance on methodology from within SESAR, and with the changes impacting the planned approach, it was decided to produce new task objectives and to report against these objectives. This approach remains in line with the overall SESAR processes of planning activities according to objectives and reporting directly against those objectives. Also in line with overall SESAR process, a mix of paper-based research, expert judgement and integration with on-going validation activities was adopted.

## 2.2.3 New Task Objectives

The new objectives for T06.09.03-003 are as follows:

1. Ensure a robust strategy for a generic rule change:
  - i. To ensure a consistent approach and a robust strategy concerning the need for a generic rule change during and after the WP lifecycle.
2. Provide the project with the best strategy in order to achieve local approval:
  - i. To provide an overview of possible strategies and related activities so that the project will be able to fulfil all requirements in order to become operational. This includes the possible case where constraints to the scope of the concept are necessary in order to achieve an approval.
  - ii. Provide a description of the level of detail and preciseness that is expected from the validation of the concept in order to achieve approval.

- iii. Plan all activities related to rules and procedures that are leading to an operational approval at least at local level.
- 3. Propose local procedures for validation purposes:
  - i. Ensure that new local rules and procedures are produced in accordance with requirements coming from Regulator(s) so that the concept will eventually be approved.
  - ii. Ensure that new local rules and procedures are well coordinated with and follow the recommendations coming from Safety and Human factor cases.

## 2.3 Methodology

The new task objectives provided an aim and a structure to the assessment. What was then required was a methodology for conducting the assessment.

Perhaps the most pressing constraint on any methodology was the timescale of the tasks, with the R&R task finishing relatively early in the project. Therefore a major priority was ensuring that tasks which would continue throughout the project would still contribute to the R&R analysis.

The Validation, Safety and Human Performance tasks all continue further into the project and so a framework was required whereby some or all of the objectives could be addressed through other (Validation, Safety and Human Performance) tasks. This would then give the *potential* for the R&R contribution to continue in *some* form. Therefore Objective 3 (above) was closely linked to the validation activities and local rules and procedures were proposed for the trials.

This left Objectives 1 and 2 to be addressed through specific R&R activities during the duration of T06.09.03-003.

The Remote Provision of ATS to a Single Aerodrome (SDM-0201) is a V2/V3 maturity concept, since it is based on previous work in other projects. Therefore it was recognised that material from these projects could be updated for inclusion in SESAR P06.09.03 to address Objective 1 and 2. Using this as a starting point, resource could then be applied to generate further contributions towards these two objectives.

Finally, the RTC Sundsvall Implementation project was acknowledged as another potential source of information.

## 3 Outputs of the Analysis

### 3.1 Objective 1 - Ensure a robust strategy for a generic rule change

#### 3.1.1 SESAR development of rule change methodology

P06.09.03 was used as a test project for SESAR P16.06.05 (Human Performance support and coordination functions). P16.06.05 developed a template to be followed when considering rule changes for any concept. Within P06.09.03 the eRIA (Early Regulatory Impact Assessment) template has been tested for an intended change of EU regulation 805/2011, indicated in 06.09.03 OSED.

In parallel to P06.09.03, in SESAR P06.08.04 a DFS initiative has been started. The work includes a study and three validation activities which will also coordinate with P16.06.05.

#### 3.1.2 Regional level – Northern Europe

On-going work with the EU-regulation 805/2011[7], concerning ATCO certificate will not include Remote and virtual tower. However a wide consultation whether ratings / endorsements is needed for single and multiple Remote and Virtual Tower or not will soon be initiated by EASA.

#### 3.1.3 EASA involvement

EASA has been informed about the concept and in 2013 they will request input from European stakeholders regarding licensing of air traffic controllers working at Remote Tower Facilities.

#### 3.1.4 Global level – ICAO

##### 3.1.4.1 Analysis against current ICAO Provisions

In order not to repeat work that had already been conducted, and to allow the task to focus on generating additional material, the existing analysis performed prior to SESAR domain was reviewed and to a large extent, re-used for P06.09.03.

An analysis of ICAO provisions against a Remote Tower Concept was performed in an earlier project involving many of the same partners (LFV, Saab), called the Remotely Operated Tower (ROT) project. The analysis covered both the international regulations as well as national ones. In P06.09.03 the national regulatory framework was deleted and EU 1035/2011[8] and EU 805/2011 were added. The results of the analysis are presented in full in Appendix A.

The purpose of the original analysis was to compare the requirements currently in place with the proposed concept for the ROT project in Sweden. The idea was to produce a document highlighting deviations from the regulations currently in force. This would then help guide that project in its decision on how to handle any such deviations, e.g. by starting work on harmonising the regulations to ensure that the ROT concept was properly covered.

##### 3.1.4.2 Presentation to ICAO Air Navigation Conference

A first presentation of the European initiative for Remote and Virtual Tower concepts will be done at the ICAO 12th Air Navigation Conference (19 – 30 November 2012) in Working Paper 42 (presented in full in Appendix B).

The working paper briefly describes the development and early implementation plans for Remote Towers highlighting the need to assess the regulatory and standardisation impact, in particular the impact on ICAO provisions.

*“The Conference is invited to:*

- a. Note the content of the paper; and*
- b. Request ICAO to urgently initiate the necessary actions to update ICAO provisions to provide for:*

1. *Requirements for the use of sensors, and display technologies to replace visual observation of traffic in the provision of Air Traffic Control and Flight Information Services;*
2. *Additional requirements for surveillance and ground/ground communications systems to adapt to the above;*
3. *New operational procedures, where relevant, both at the remote ATC facility and on the airborne side; and*
4. *New requirements for ATCO/pilot training and eventually licensing if necessary”.*

## 3.2 Objective 2 - Provide the project with the best strategy in order to achieve local approval

Both LFV in Sweden and Avinor in Norway will go forward writing local rules and apply for approval with their respective National Safety Authorities.

As mentioned above, initiatives are also on-going at EASA as well as ICAO regarding licensing of controllers and other potential regulation changes.

### 3.2.1 National level

When implementing new concepts or systems at national level, where you cannot fully rely on existing regulations, a comprehensive safety work including safety assessment should be carried out as a basis for operational approval from the NSA.

The work shall be performed in accordance with the SMS system established in connection with the certification of the ANSP according to EU 1035/2011.

The approval from the NSA may be limited and / or contain constraints. This approval is not in itself a change of rules on national level, but an approval for a specific site or equipment.

### 3.2.2 SESAR project RTC Sundsvall

The SESAR project RTC Sundsvall has an objective to implement Remote tower operations 2014. Thereby the national approval and safety case activities lie within this project.

## 3.3 Objective 3 - Write local procedures for validation purposes

### 3.3.1 Safety and Human Factors assessment

Issues identified in the Safety Assessment Plan[9] and Human Factors Assessment Plan[10] led to validation trials where proposed restrictive procedures were proposed to the controllers. Not all procedures and situations are fully validated yet but in general the restrictive approach was acceptable for the controllers. Some of the solutions for avoiding new hazards to be introduced when working remotely are to design the system in such a way that failure is highly unlikely and that back-up systems are always available. Another proposal is to reduce the likelihood of many simultaneous movements by introducing some easy to use traffic planning tools/practices.

### 3.3.2 Integration into Validation Trials

On a general level, an Appendix to the ATS Operational Manual for the aerodrome used in the trials was produced describing how the operations and procedures would be affected when providing services remotely. This document (Appendix to ATS Operational Manual RTC sector ÄNGELHOLM) is presented in full in Appendix C and represents an initial proposal.

Furthermore, based on the fact finding and issues listed in both the Human Factors Plan and the Safety Plan a number of local procedures were designed. They covered mainly separation, failure mode procedures and how to use advanced features such as zoom camera, additional displaced hotspot cameras, camera tracking and camera scanning.



Figure 1 shows an example of one of the checklists that controllers in the Remote Tower were proposed to follow in case of visual reproduction failure.

### Checklist A1 – Screen failure

<b>Unreliable screen</b>	<b>ex. non-critical screens frozen or black</b>
	<ul style="list-style-type: none"> <li>• If there is traffic planned within next 10 minutes revert to one movement mode.</li> <li>• Alert APP "VR unreliable".</li> <li>• Alert technical assistance.</li> <li>• Put on runway lights and stop bars</li> </ul>
<b>Frozen screen</b>	
	<ul style="list-style-type: none"> <li>• If any critical screen(s) are frozen revert immediately to one movement mode. Use the phrase "due to system failure" when instructing aircraft.</li> <li>• Alert APP "VR out of service".</li> <li>• Alert technical assistance.</li> <li>• Put on runway lights and stop bars</li> </ul>
<b>Black screen</b>	
	<ul style="list-style-type: none"> <li>• If any critical screen(s) go black revert immediately to one movement mode. Use the phrase "due to system failure" when instructing aircraft.</li> <li>• Alert APP "VR out of service".</li> <li>• Alert technical assistance.</li> <li>• Put on runway lights and stop bars</li> </ul>
<b>Contingency mode</b>	
	<ul style="list-style-type: none"> <li>• One movement at the time until VR is tested and back in full operation</li> </ul>
<b>Recovering mode</b>	
	<ul style="list-style-type: none"> <li>• Alert APP that VR is in function again.</li> <li>• Gradually step up amount of simultaneous traffic</li> <li>• Keep lights on for 30 minutes</li> </ul>

Figure 1 - Example of checklist used in P06.09.03 VP-057

In the P06.09.03 D06 (Remote Provision of ATS to a Single Aerodrome VALR) more information can be found including recommendations for future trials.



## 4 Conclusions and Recommendations

As International PANS-ATM rule changes are subject to long lead times new concepts are often endorsed in the first instance by NSA following standard safety assessment requirements. Then when experience shows that a certain concept is robust and safe and if this concept becomes more and more widespread the need for new ICAO recommendations or rule changes will be the logical next step. Some countries have already implemented different types of remote ATS (e.g. Japan and Canada). In the ICAO ANC conference no 12 (November 2012) the concept of Remote Provision of ATS will be highlighted by Working Paper 42 (See Appendix B). In particular the issue of Remote Tower as described in P06.09.03 is to be further explored in the presentation at ANC 12. This will likely start the process of validating the need for international rule changes or new ICAO recommendations with regards to remote provision of ATS for one or several airports. The main reason for many of the on-going European initiatives is the need for cost reduction but also the firm belief that the maturity of new technology now allows for this type of service being provided in a safe manner.

- It is recommended that P06.09.03 closely follows the ICAO next steps following ANC 12

The SESAR supported RTC Sundsvall project is aimed at deployment of a remotely operated airport in 2014. This project will therefore be ahead of P06.09.03 in safety assessment and endorsement by NSA.

- It is recommended that P06.09.03 and RTC Sundsvall closely collaborate regarding the development and validation of new rules and procedures.

So far the validation trials of Remote Provision of ATS have been conducted using Passive Shadow Mode. The ATCOs in previous trials have not been providing actual service to the aircraft and, although stakeholders such as Airspace Users and staff unions have taken part in the trials and provided feedback, they have not been fully in the loop.

- It is recommended that future trials will fully involve all relevant actors and stakeholders in the validation of the concept. This should be done both in Active Shadow Mode and by close collaboration in other validation activities with ATC supervisors, engineers, airport operator, flight crews and other relevant actors and stakeholders.

In P06.09.03 the validation activities will continue, with the next trial planned for Remote Provision of ATS in Advanced Shadow Mode (i.e. a prototype system will be used to provide actual service to live aircraft):

- It is recommended that validation of remote AFIS in Norway by Advanced Shadow Mode (Exe-VP-058) will feed into the Safety and Human Factors validation issues raised for Remote Tower. The same is true for any potential implementation projects. In particular information can be obtained on issues regarding airspace user opinion or potential impact when “in the loop” during the future validations.

SESAR project 16.06.05 has developed a first version of a template to follow when determining if a concept also will generate the need for new standards or new rules.

- It is recommended that P06.09.03 feeds back to P16.06.05 (using this document for example) and also follows any new development regarding the rules and regulation work in P16.06.05.

In both live trials and future implementation it is expected that rules will be more conservative/constraining than current rules regarding separations, different visibility conditions, number of simultaneous movements and fall-back procedures. This is seen as a good approach by controllers until sufficient trust is built up. This is particularly important since it may take quite a long time to collect a substantial amount of movements subject to the new concept if it is to be implemented only at airports with small traffic volumes and very few simultaneous movements.

- It is recommended that implementation of Remote Provision of ATS shall initially apply stricter rules and procedures and some constraints regarding amount of simultaneous movements compared to current operations at the same type of airports. These more strict rules and procedures may be evaluated as time goes by in order to see if/when they can be relaxed on a step-wise basis.

In Appendix A a number of proposed and partly validated rules and procedures can be found. The results regarding these proposed rules and procedures from validation trials 1 and 2 can be found in VALR (6.9.3.deliverable D07)

- It is recommended to keep recording, for good traceability and consistency, all further development of the proposed rules and procedures. This is valid for all future validation in both P06.09.03 and RTC Sundsvall.

Some technical functionalities are not yet fully developed or adjusted to their optimised usability.

- It is recommended that the use of PTZ, hot-spot cameras, alternatives for windows position on OTW screens, primary and secondary screens division, camera scanning, camera tracking and radar labels on OTW view are further validated with regards to procedures, rules and fall-back routines.

## 5 References

- [1] **ICAO Document 4444** "Procedures For Air Navigation Services - Air Traffic Management", 14th Edition, November 2005;
- [2] **ICAO Document 9426** "Air Traffic Services Planning Manual", 1st Edition, December 1992;
- [3] **EUROCONTROL "Manual for AFIS"**, 1st Edition, October 2010;
- [4] **P06.09.03 Operational Services and Environment Description (OSED)**, DEL-693-WA-A-OSED-Part3-00.02.02, NORACON, 31st October 2012;
- [5] **P06.09.03 Project Initiation Report (PIR)**, 06.09.03-PIR-Part1-00.02.00, June 2010;
- [6] **P06.09.03 Project Management Plan (PMP)**, PMP-SJU-P693-00.03.00dat110609, NORACON, 9th June 2011;
- [7] **CR (EU) 805/2011** "laying down detailed rules for air traffic controllers' licences and certain certificates pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council", August 2011;
- [8] **CR (EU) 1035/2011** "laying down common requirements for the provision of air navigation services and amending Regulations (EC) No 482/2008 and (EU) No 691/2010", October 2011;
- [9] **P06.09.03 Validation Plan Appendix - Safety Assessment Plan**, 6.09.03-T014.01-Safety Plan-Remote Tower OFA-00.01.00, July 2011;
- [10] **P06.09.03 Validation Plan Appendix - Human Performance Assessment Plan**, Version 00.00.06, July 2012;

## Appendix A Analysis of the regulations which concern the Remote & Virtual Tower

**LFV**  
**ATS**  
**ASD/CSS**

Document type  
ANALYSIS

Document number  
D-LFV 2007-37354  
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Approved by  
GL

Date  
19.9 2012

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03.00

Reference

Rev.	Date	Drafted by	Information
00.01	23.8.07	Roland Johansson	Version presenting the results of workshop 1 on the regulations concerning the ROT project
00.02	13.9.07	Roland Johansson	Update of the document following comments from the participants
01.00	21.9.07	Roland Johansson	Document drawn up at the workshop on 21.9.07
01.01	24.9.07	Roland Johansson	Version presenting the results of the workshop on the regulations concerning the ROT project held on 21.9.07
02.00	25.9.07	Roland Johansson	Document drafted following the workshop
03.00	19.9.12	Roland Johansson	Update of the document in cooperation with SESAR P06.09.03. National regulatory frameworks has been deleted and EU 1035/2011 and EU 805/2011 has been added.

### A.1 Introduction

The original version of this document was developed for the ROT project in Sweden and covered both the international regulations as well as national ones. In this revision, reused for SESAR P06.09.03 "Remote & Virtual Tower" the national regulatory framework has been deleted and EU 1035/2011 and EU 805/2011 has been added.

### A.2 Purpose Of The Analysis

The purpose of the original analysis is was to compare the requirements currently in place with the proposed concept for the ROT project in Sweden. The idea was to produce a document highlighting deviations from the regulations currently in force. This would then help guide that project in its decision on how to handle any such deviations, e.g. by starting work on harmonising the regulations to ensure that the ROT concept was properly covered.

### A.3 How The Analysis Was Performed

How the original analysis was performed is described in LFV Doc no:

D-LFV 2007-37354 ver. 02.00 (LFV, Sweden).

Para. no.	Document	Comments	Analysis/solution
<b>1</b>	<b>Annex 1 Personnel Licensing</b>		
1.1	Chapter 1 Definitions and General Rules Concerning Licences	The chapter was reviewed – nothing specific affecting ROTs.	In the longer term, some definitions may be needed.
1.2	Chapter 2 Licences and Ratings for Pilots	The chapter was reviewed – nothing specific affecting ROTs.	
1.3	Chapter 3 Licences for Flight Crew Members other than Licences for Pilots	The chapter was reviewed – nothing specific affecting ROTs.	
1.4	Chapter 4 Licences and Ratings for Personnel other than Flight Crew Members	4.3 Air traffic controller licence. The requirements are the same for ROT controllers.	
		4.4 Air traffic controller ratings. At present, we do not feel that a specific rating is required, unless amendments are made to local competencies. We can see long-term benefits in standardising TWR/RTC equipment. This would be an advantage from the point of view of training.	This should be monitored/followed up during validation. In this connection, the period of local competency required at the unit to be operated as an RTC will need to be discussed.  There was a discussion of how one could get local training directly in an ROT without having acquired local competency at the unit. We agreed with regard to this project that controllers must have acquired competency at the airport where they will work via an RTC.  Situational awareness is important and should be checked in shadow mode.
1.5	Chapter 5 Specifications for Personnel Licences	The chapter was reviewed – nothing specific affecting ROTs.	
1.6	Chapter 6 Medical Provisions for Licensing	The chapter was reviewed – nothing specific affecting ROTs.	
1.7	Appendix 1, 2, 3 Attachment A, B	Insofar as they are affected by the above comments.	
<b>2</b>	<b>Annex 2 Rules of the air</b>		
2.1	Chapter 1	The chapter was reviewed – nothing specific	

Para. no.	Document	Comments	Analysis/solution
	Definitions	affecting ROTs.	
2.2	Chapter 2 Applicability of the rules of the air	The chapter was reviewed – nothing specific affecting ROTs.	
2.3	Chapter 3 General rules	3.4 Signals	In the ROT project, it is planned to connect and control via camera binoculars the signal lamp which has to be kept in the TWR for signalling to people, vehicles and aircraft. In the Ångelholm demo <sup>1</sup> , the signal lamps will not be mounted on the camera binoculars. Instead, an ordinary lamp in the tower will be used if necessary.
2.4	Chapter 4 Visual flight rules	The chapter was reviewed – nothing specific affecting ROTs.	
2.5	Chapter 5 Instrument flight rules	The chapter was reviewed – nothing specific affecting ROTs.	
2.6	Appendix 1, 2, 3, 4 Attachment A, B	Insofar as they are affected by the above.	
3	<b>Annex 3 Meteorological Service for International Air Navigation</b>	There is a requirement that ATS must have access to meteorological information.	LFV is currently making savings by training controllers for MET observation and also provides observation services for airports. This is not part of the aerodrome control service. The question is important for LFV and must be resolved for those airports involved in the project. It emerged from the meeting on 21.9.07 that the requirements must be clarified and resolved.
4	<b>Annex 4 Aeronautical Charts</b>	The document was reviewed – nothing specific affecting ROTs.	
5	<b>Annex 5 Units of Measurements to be used in Air and Ground Operations</b>	The document was reviewed – nothing specific affecting ROTs.	
6	<b>Annex 6 Operation of Aircraft</b>	The document was reviewed – nothing specific affecting ROTs.	

<sup>1</sup> Proof of the concept demonstrator

Para. no.	Document	Comments	Analysis/solution
7	<b>Annex 7 Aircraft Nationality and Registration Marks</b>	The document was reviewed – nothing specific affecting ROTs.	
8	<b>Annex 8 Airworthiness of Aircraft</b>	The document was reviewed – nothing specific affecting ROTs.	
9	<b>Annex 9 Facilitation</b>	The document was reviewed – nothing specific affecting ROTs.	
10	<b>Annex 10 Aeronautical Telecommunications</b>	<i>The document was not reviewed.</i>	
11	<b>Annex 11 Air Traffic Services</b>	The basic requirements here are met by an RTC, apart from the location of the TWR. Supplementary information may possibly be needed for any new concepts.	
12	<b>Annex 12 Search and Rescue</b>	The document was reviewed – nothing specific affecting ROTs.	
13	<b>Annex 13 Aircraft Accident and Incident Investigation</b>	The document was reviewed – nothing specific affecting ROTs.	
14	<b>Annex 14 Aerodromes</b>	The document was reviewed – nothing specific affecting ROTs.	
15	<b>Annex 15 Aeronautical Information Services</b>	The document was reviewed – nothing specific affecting ROTs.	
16	<b>Annex 16 Environmental Protection</b>	The document was reviewed – nothing specific affecting ROTs.	
17	<b>Annex 17</b>		There was a discussion of the security of the information

Para. no.	Document	Comments	Analysis/solution
	<b>Security</b>		<p>exchanged between the airport TWR and RTC. At present, responsibility for protection of the infrastructure is delegated to C ASI in accordance with the Division Manual. <i>Check the EU regulation as well! Further information is provided later in this document.</i> The technical solution chosen for ROT is (end-to-end) encryption, and two separate connections are planned via NATN and the FMIP network. For the Ängelholm demo, two separate connections will be used within NATN.</p>
<b>18</b>	<b>Annex 18 The Safe Transport of Dangerous Goods by Air</b>	The document was reviewed – nothing specific affecting ROTs.	
<b>19</b>	<b>Doc 4444 (24/11 2005)</b>		
19.1	Chapter 1 Definitions	The document was reviewed – nothing specific affecting ROTs.	May need to be supplemented as work progresses.
19.2	Chapter 2 ATS safety management		<p>The question was raised of how safety management is affected when ATS are "moved" from the airport. <i>In Ängelholm controllers point out that they, together with the ground staff at the airport, constitute a team well known to each other. They have regular meetings, they visit each other's working places, and they have a good understanding of their respective tasks. Their experience is that this make things work smoothly.</i> Input from "Case study from Ängelholm 1" by Sven Ternov. The question needs to be monitored and, where possible, reflected in the validation.</p>
19.3	Chapter 3 ATS system capacity and air traffic flow management	The chapter was reviewed – nothing specific affecting ROTs.	
19.4	Chapter 4 General provisions for air traffic	4.1.3 Aerodrome control service shall be provided by an aerodrome control tower	For the Ängelholm demo and any further Swedish airports, the project plans to seek an exemption regarding the



Para. no.	Document	Comments	Analysis/solution
	services		location of the TWR. As regards the concept, there should be further discussion to try to supplement the requirements for an RTC.
		4.2 Responsibility for the provision of flight information service and alerting service	No problems are expected in providing this from an RTC.
		4.3 Division of responsibility for control between air traffic units	There is no difference from the current arrangements.
19.5	Chapter 5 Separation methods and minima		It is assumed that an RTC will be able to handle all types of separation in use today. However, validation is required of whether visual separation and reduced separation on landing will work well from an RTC. As a first stage, it can be agreed that these two forms of separation will not be used.
19.6	Chapter 6. Separation in the vicinity of aerodromes		
19.6.1		6.1 REDUCTION IN SEPARATION MINIMA IN THE VICINITY OF AERODROMES a) adequate separation can be provided by the aerodrome controller when each aircraft is continuously visible to this controller;	See Chapter 5 (subsection 5.11). It is important to monitor for future validation the question of what is visible and how this is to be handled in an ROT. There have been discussions of whether it is possible to have "low level" initially [and] of possibly not applying visual separation to begin with.
19.6.2		6.2 ESSENTIAL LOCAL TRAFFIC 6.2.1 Information on essential local traffic known to the controller shall be transmitted without delay to departing and arriving aircraft concerned. 6.2.1.1 Essential local traffic shall be described so as to be easily identified.	<i>Note 1.— Essential local traffic in this context consists of any aircraft, vehicle or personnel on or near the runway to be used, or traffic in the take-off and climb-out area or the final approach area, which may constitute a collision hazard to a departing or arriving aircraft.</i> How is the word "known" to be interpreted? How important is it to be able to "scan" the runway system and arriving/departing aircraft? It is important to validate whether aircraft, vehicles and

Para. no.	Document	Comments	Analysis/solution
			personnel can be identified as easily as from the tower at the airport so that information can be provided on them.
19.6.3		6.5 PROCEDURES FOR ARRIVING AIRCRAFT 6.5.6.1.2 Succeeding aircraft shall be cleared for approach: b) when the preceding aircraft is in communication with and sighted by the aerodrome control tower and reasonable assurance exists that a normal landing can be accomplished;	This probably has no implications for ROTs. There is a slightly lower capacity but a longer distance/time between aircraft. The procedures can be carried out even in an ROT.
19.6.4		6.6 INFORMATION FOR ARRIVING AIRCRAFT 6.6.5 During final approach, the following information shall be transmitted without delay: a) the sudden occurrence of hazards (e.g. unauthorized traffic on the runway); c) significant changes in runway surface conditions;	NB: We must assume that information via camera(s) is sufficient for the purposes of a), and that instant information in the form of MET reports etc. from the airport will be provided for the purposes of c). The aerodrome service/aerodrome manager is currently responsible for runway conditions. At present, the work is carried out in close cooperation between ATS and the aerodrome. Will this cooperation be affected? Will the aerodrome need new instructions? A discussion arose about the need for information on changes in runway temperature. Can this be resolved at aerodrome level, or is a technical solution required? Validation is required.
19.6.5		6.7 OPERATIONS ON PARALLEL OR NEAR-PARALLEL RUNWAYS	This paragraph was not studied in detail, since it seems to fall outside the scope of the activities proposed for ROTs.
19.7	Chapter 7. Procedures for aerodrome control service		
19.7.1		7.1 FUNCTIONS OF AERODROME CONTROL TOWERS 7.1.1.2 Aerodrome controllers shall maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring	NB: This article clearly states that personnel on the manoeuvring area must be observed visually! Validation will be required.

Para. no.	Document	Comments	Analysis/solution
		area. Watch shall be maintained by visual observation, augmented in low visibility conditions by an ATS surveillance system when available.	
19.7.2		<p>7.3 INFORMATION TO AIRCRAFT BY AERODROME CONTROL TOWERS</p> <p>7.3.1.3.2 Essential local traffic shall be considered to consist of any aircraft, vehicle or personnel on or near the manoeuvring area or traffic operating in the vicinity of the aerodrome, which may constitute a hazard to the aircraft concerned.</p> <p>7.3.1.3.3 Essential local traffic shall be described so as to be easily identified.</p> <p>7.3.1.4 RUNWAY INCURSION OR OBSTRUCTED RUNWAY</p> <p><i>Note.— Animals and flocks of birds may constitute an obstruction with regard to runway operations. In addition, an aborted take-off or a go-around executed after touchdown may expose the aeroplane to the risk of overrunning the runway. Moreover, a low altitude missed approach may expose the aeroplane to the risk of a tail strike. Pilots may, therefore, have to exercise their judgement in accordance with Annex 2, 2.4 concerning the authority of the pilot-in-command of an aircraft.</i></p>	<p>See para. 6.2.1 above on essential traffic.</p> <p>The runway incursion or obstructed runway paragraph requires both scanning and visibility. Note that even flocks of birds, etc. are mentioned.</p> <p>We need to validate that the ability to identify flocks of birds is just as good in the ROT as in the current TWR. Comparative studies need carrying out at Ångelholm.</p>
19.7.3		<p>7.3.1.6 ABNORMAL AIRCRAFT CONFIGURATION AND CONDITION</p> <p>7.3.1.6.1 Whenever an abnormal configuration</p>	This requires visibility! See validation requirements in 19.7.2.

Para. no.	Document	Comments	Analysis/solution
		or condition of an aircraft, including conditions such as landing gear not extended or only partly extended, or unusual smoke emissions from any part of the aircraft, is observed by or reported to the aerodrome controller, the aircraft concerned shall be advised without delay.	
19.7.4		7.5 CONTROL OF AERODROME TRAFFIC 7.5.2 Designated positions of aircraft in the aerodrome traffic and taxi circuits The following positions of aircraft in the traffic and taxi circuits are the positions where the aircraft normally receive aerodrome control tower clearances. Aircraft should be watched closely as they approach these positions so that proper clearances may be issued without delay. Where practicable, all clearances should be issued without waiting for aircraft to initiate the call.	7.5.2 requires visibility! The "designated positions" – this term needs to be verified – could possibly be watched by camera binoculars. See validation requirements in 19.7.2.
19.7.5		7.10 REDUCED RUNWAY SEPARATION MINIMA BETWEEN AIRCRAFT USING THE SAME RUNWAY 7.10.6 Reduced runway separation minima shall be subject to the following conditions: d) there shall be available means, such as suitable landmarks, to assist the controller in assessing the distances between aircraft. A surface surveillance system that provides the air traffic controller with position information on aircraft may be utilized, provided that approval for operational use of such equipment includes a safety assessment to ensure that all requisite operational and performance requirements are met;	7.10 requires visibility! (It allows for the possibility of some type of surveillance system for assessing the distances between various objects.)
19.8	Chapter 8. ATS surveillance services	General for ATM, nothing specific for ROT	
19.9	Chapter 9. Flight information service	General for ATM, nothing specific for ROTs	

Para. no.	Document	Comments	Analysis/solution
19.10	and Alerting service Chapter 10. Coordination	General for ATM, nothing specific for ROTs	It is assumed that all existing coordination provisions for the traditional TWR also apply for the ROT. There was also a discussion on the importance of clear handover procedures/rules when the service is divided between an RTC and a traditional TWR. An ATS operational manual must be drawn up.
19.11	Chapter 11. Air traffic services messages	<p>11.4.3.4 MESSAGES CONTAINING INFORMATION ON AERODROME CONDITIONS</p> <p><i>Note.— Provisions regarding the issuance of information on aerodrome conditions are contained in Chapter 7, 7.4.</i></p> <p>11.4.3.4.1 Whenever information is provided on aerodrome conditions, this shall be done in a clear and concise manner so as to facilitate appreciation by the pilot of the situation described. It shall be issued whenever deemed necessary by the controller on duty in the interest of safety, or when requested by an aircraft. If the information is provided on the initiative of the controller, it shall be transmitted to each aircraft concerned in sufficient time to enable the pilot to make proper use of the information.</p> <p>11.4.3.4.2 Information that water is present on a runway shall be transmitted to each aircraft concerned, on the initiative of the controller, using the following terms: DAMP — the surface shows a change of colour due to moisture. WET — the surface is soaked but there is no standing water. WATER PATCHES — patches of standing</p>	It was noted that it is the controller who takes the initiative to transmit the message, but it should be possible for the conditions to be interpreted and seen by another observer.

Para. no.	Document	Comments	Analysis/solution
		water are visible. FLOODED — extensive standing water is visible.	
19.12	Chapter 12. Phraseologies	General for ATM, nothing specific for ROTs	If there are occasions when it must be expressly stated that the service is being provided from an RTC, maybe an appropriate call sign should be found for RTC TWR. The current designation is (airport name) tower. Maybe (airport name) remote tower might be used? In the discussion that followed, no occasions were identified in which such a designation would need to be given. This needs to be followed up.
19.13	Chapter 13. Automatic dependent surveillance – contract (ADS-C) services	General for ATM, nothing specific for ROTs	
19.14	Chapter 14. Controller-pilot data link communications (CPDLC)	General for ATM, nothing specific for ROTs	
19.15	Chapter 15. Procedures related to emergencies, communication failure and contingencies	General for ATM, nothing specific for ROTs	
19.16	Chapter 16. Miscellaneous procedures	General for ATM, nothing specific for ROTs	
19.17	Appendices 1-5	General for ATM, nothing specific for ROTs	
<b>20</b>	<b>Doc 7030</b>		
	Doc 7030/4 Amendment 211 (2/6 2006)EUR/AOP subsection 5.0	Visual departures	How should these be dealt with? There is a need to follow up general validation of both visual approaches and visual departures.
<b>21</b>	<b>EU Regulations</b>		
21.1	EU 1035/2011 Commission Implementing regulation laying down common requirements for the provision of air navigation services		Requirement for the provision of air navigation services, no direct impact on Remote & virtual tower
21.2	EU 805/2011 Commission regulation laying down detailed rules for air traffic controllers' licences and certain certificates pursuant to Regulation	EASA is already engaged in the discussion of the rating and endorsement	Some type of rating and/or endorsement will likely be needed

Para. no.	Document	Comments	Analysis/solution
	(EC) No 216/2008 of the European Parliament and of the Council		

## Appendix B ICAO ANC WP 42



International Civil Aviation Organization

AN-Conf/12-WP/42  
../..12

### WORKING PAPER

## TWELFTH AIR NAVIGATION CONFERENCE

Montréal, 19 to 30 November 2012

### Agenda Item 2: Aerodrome Operations 2.1: Improving airport performance

### PROCEDURES OF REMOTE TOWERS

(Presented by the Presidency of the European Union on behalf of European Union and its Member States<sup>2</sup>; and by the other Members States of the European Civil Aviation Conference<sup>3</sup>; and by the Member States of EUROCONTROL)

#### SUMMARY

This paper briefly describes the development and early implementation plans for Remote Towers (ASBU module B1-81), highlighting the need to assess the regulatory and standardisation impact, in particular the impact on ICAO provisions. The provision of remotely operated aerodrome control offers the opportunity to provide improved service levels, reduce costs and improve safety at aerodromes by taking advantage of new technologies and better use of safety nets taking advantage of new technologies. Developments are now at an advanced stage, with live operational validation trails and early deployments planning underway. It is therefore necessary to ensure that the required regulation/standardisation needs are identified, including the need to incorporate the provision of remotely operated aerodrome control services in ICAO documentation (e.g. PANS/ATM and Annex 10).

**Action:** The Conference is invited to agree to the recommendation in paragraph 6.

## 1. INTRODUCTION

- 1.1 Remotely operated aerodrome control concerns the provision of ATS to aerodrome(s) from a facility which is not located at the aerodrome itself (ref. ASBU module B1-81).

<sup>2</sup> Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom. All these 27 States are also Members of ECAC.

<sup>3</sup> Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Georgia, Iceland, Moldova, Monaco, Montenegro, Norway, San Marino, Serbia, Switzerland, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.



- 1.2 Remotely operated aerodrome control can be applied to:
- A single aerodrome (either ATC or AFIS) where the local tower can be replaced by a remote facility;
  - Multiple aerodromes, where the local towers of several aerodromes can be replaced by a single remote facility;
  - Larger single aerodromes that require a facility to be used in contingency situations.
- 1.3 In Europe, development and validation activities associated with the three cases listed above are being undertaken primarily through the SESAR programme.
- 1.4 The key drivers for the developments and implementation planning of remote towers are the ability to increase service levels, to reduce costs and to improve safety through the better use of safety nets.

## 2. EUROPEAN DEVELOPMENT ACTIVITIES

### 2.1 The Concept

- 2.1.1 The concept does not seek to change the air traffic services provided to airspace users or change the levels of those services. Instead it changes the way those same services will be provided through the introduction of new technologies and working methods.
- 2.1.2 The visual surveillance will be provided by a reproduction of the Out of The Window (OTW) view by using visual information capture and/or other sensors. The visual reproduction can be overlaid with information from additional sources such as surface movement radar, surveillance radar, Multilateration or other positioning and surveillance systems providing the position of moving objects within the airport movement area and its vicinity. The collected data, either from a single source or combined, is reproduced for the ATCO/AFISO on data/monitor screens, projectors or similar technical solutions.
- 2.1.3 The provision of ATS from a local tower building (as in today's operations) has some constraints at some airports due to the single operational viewpoint from a central, high up perspective, and subject to prevailing viewing conditions at the time (e.g. clear, foggy). This can create some minor limitations in capability, which is accepted in 'traditional' air traffic control. With the use of reproduced OTW views, these limitations can be eliminated. Visual information capture and reproduction can still be used to replicate the operational viewpoint obtained from a traditional tower view, which may ease the transition from current operations to remote operations and provide some common reference points. Alternatively, several operational viewpoints may be available, based on information captured from a range of different positions (viewpoints need not be limited to the original tower position). This may provide an enhanced situational awareness. In all cases, the visual reproduction shall enable visual surveillance of the airport surface and surrounding area.
- 2.1.4 With the digitisation, or computer generation of the relayed information, visual enhancements are possible. These can be used to ensure situational awareness in all visibilities.
- 2.1.5 With the removal or decommissioning of individual local towers, disparate systems and procedures can be standardised to a greater level in a shared uniform facility.
- 2.1.6 With many aerodromes operating from a shared facility using common systems, the possibility to share system wide information (i.e. SWIM) can be increased.
- 2.1.7 Although not necessary, it will be possible to remove the local control tower as it will no longer be used for the provision of air traffic services. The need to have a single, tall tower building

at the aerodrome will disappear. The infrastructure (service, maintenance etc.) that goes along with maintaining such a building will also become redundant. Instead, a local installation consisting of systems/sensors will be maintained by central maintenance teams. The remote facility will also require maintenance, but it is expected that simpler building using common systems and components will lead to a reduction in overall maintenance costs.

## 2.2 Procedures (Air & Ground)

2.2.1 The concept aims to maintain as many of the current air and ground procedures as possible. The services provided remain the same and there should be no impact on airspace users.

2.2.2 Some new operating methods may be required for tasks which are external to the current aerodrome tower. The ATCO/AFISO will not have the ability to perform any tasks that are external to the control facility e.g. physical runway inspection. The aim is that they will primarily focus on the pure ATS tasks, and other tasks will be secondary and/or performed by personnel local to the aerodrome. It must however be recognised that the ability of the sensors has many other qualities which might prove a positive impact of safety compared to today's operational tools. New fall-back procedures are required in case of full or partial failure of the remote tower system. In cases of complete failure it may not be possible to provide reduced operations. All ATS will be suspended until the system can be at least partially restored and traffic may be diverted to other aerodromes in the meantime

2.2.3 In cases of partial failure, it is expected that the scenario can be mapped to existing procedures. For example, loss of visual reproduction when operating remotely can be likened to low visibility when operating from a local tower. Therefore LVP could be 'adapted' for use at the remote tower facility in such a case (though there may be other contingency solutions that could be applied locally).

## 2.3 Technology (Air & Ground)

2.3.1 For remotely operated aerodrome control developments in Europe the main technologies being exploited are:

- Camera and display technologies that create a uniform visual view which is perceived as smooth and delivers the level of quality and information required to provide safe and efficient ATS;
- Radar and Multilateration surveillance technologies, such as those being used in the deployment of A-SMGCS Level 1;
- Data fusion, bringing together heterogeneous data sources (such as surveillance data listed above plus map data, terrain models, 3D satellite data) to provide a coherent representative model of an airport, its surrounding and traffic, enabling an ATCO/AFISO to provide a real time service;
- CWP and HMI technologies to create an acceptable method for interaction with the remote tower systems and controller working position as a whole.

2.3.2 Using these technologies situational awareness is addressed by the appropriate placement of surveillance sensors, augmented by means of night vision and image enhancement, with graphical overlay such as tracking information, weather data, visual range values and ground light status etc.

2.3.3 In addition, suitable communication capabilities between the airports and the remote tower facility are also required. These needs will be addressed through the SWIM developments of SESAR.

## 2.4 Planned or On-going validation trials

- 2.4.1 In support of deployment and further developments, several validation trials are taking place during the 2011 to 2014 period. The SESAR operational validation trials involve a range of typical ATS operational environments in Sweden, Norway, and Germany.

## 3. DEVELOPMENT ACTIVITIES OUTSIDE EUROPE

- 3.1 It is known that there is considerable development activity being undertaken in other ICAO States and regions, in particular the USA, Canada and Australia. Whilst these developments are not known in detail, it is understood that although there may be some differences, the overall concepts are compatible with those of Europe (i.e. there is scope for a global approach to remotely operated aerodrome control).

## 4. EUROPEAN DEPLOYMENT STATUS

- 4.1 There is no current operational use of remotely operated aerodrome control in normal operations. Some aerodromes have contingency facilities, but none of these include a reproduction of the OTW view.
- 4.2 An implementation project in Sweden began in 2011 (Sundsvall and Örnsköldsvik aerodromes). The system is expected to be installed and tested in 2012 and to become operational in 2012/2013. Air traffic at Sundsvall and Örnsköldsvik airports will then be controlled from a joint remote tower centre located in Sundsvall.

## 5. REGULATORY/STANDARDISATION NEEDS

- 5.1 In order to allow the competent Authorities to issue the appropriate authorisations to remotely operate aerodrome control, while ensuring global interoperability, there is a need to have in place ICAO provisions and Industry standards which do not currently exist, and which will serve as the basis for national regulatory frameworks on this topic. This regulatory aspect will therefore need assessment and further development before deployment of the remote tower operations.
- 5.2 Aspects that should be addressed at ICAO level should include:
- Requirements for the use of sensors, and display technologies to replace visual observation of traffic in the provision of Air Traffic Control and Flight Information Services;
  - Additional requirements for surveillance and ground/ground communications systems to adapt to the above.
  - New operational procedures, where relevant, both at the remote ATC facility and at the airborne side.
  - New requirements for ATCO/pilot training and eventually licensing if necessary;

## 6. CONCLUSIONS AND RECOMMENDATIONS

- 6.1 This paper briefly describes the development and early implementation plans for Remote Towers, highlighting the need to assess the regulatory and standardisation impact, in particular the impact on ICAO provisions.

- 6.2 The provision of remotely operated aerodrome control offers the opportunity to provide improved service levels, reduce costs and improve safety at aerodromes by taking advantage of new technologies and better use of safety nets taking advantage of new technologies.
- 6.3 Developments are now at an advanced stage, with live trials and early deployments in various places in the world.
- 6.4 It is therefore necessary to ensure that the required regulation/standardisation needs are identified, including the need to incorporate the provision of remotely operated aerodrome control services in ICAO documentation (e.g. PANS/ATM and Annex 10).
- 6.5 The Conference is invited to:
  - a) Note the content of the paper; and
  - b) Request ICAO to urgently initiate the necessary actions to update ICAO provisions to provide for:
    - 1. Requirements for the use of sensors, and display technologies to replace visual observation of traffic in the provision of Air Traffic Control and Flight Information Services;
    - 2. Additional requirements for surveillance and ground/ground communications systems to adapt to the above;
    - 3. New operational procedures, where relevant, both at the remote ATC facility and on the airborne side; and
    - 4. New requirements for ATCO/pilot training and eventually licensing if necessary.

— END —

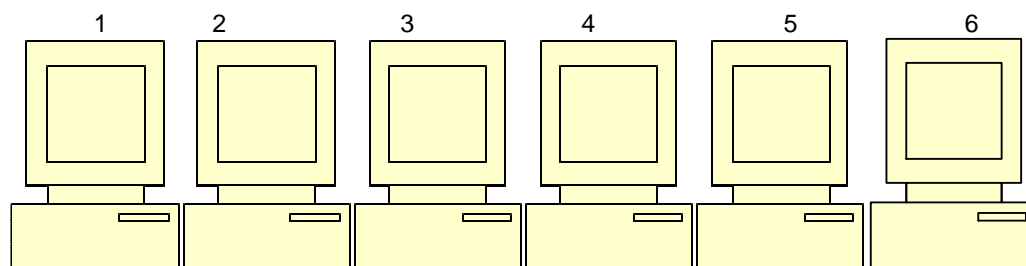
## Appendix C Proposed Appendix to ATS Operational Manual RTC sector Ängelholm:

# Appendix to ATS Operational Manual RTC sector ÄNGELHOLM

**NOTE.** This document is produced to be valid for WP 6.9.3 trial 1 and 2 only. To be seen as an example, how a first step local ATC Manual could look like. The Manual will then be revised and less restrictive as more data are collected

## 1 RTC sector Ängelholm

Screen number in RTC:



Definition: Critical screens - the screens that cover the short final and the entire path of the runway

Critical screens RWY 14: 2, 3, 4 and 5

Critical screens RWY 32: No. 5, 4, 3 and 2

## 2 Start-up - RTC

### 2.1 Control of screens

Request "runway inspection"(should be standard procedure). Ask the vehicle to stop at predetermined positions and report by radio. Check the positions on the screen.

### 2.2 Soundcheck – airport sound

Listen to the car that makes "runway inspection". Ask the driver to sound the horn.

## 3 Contact with the airport

### 3.1 Airport manager

0431 – xx xx xx

### 3.2 Met-obs

0431 – xx xx xx

### 3.3 Report of FOD (Foreign Object Damage)

When pilot report on objects, obstacles, animals on the runway or its vicinity:

- Check with PTZ camera and possible IR camera
- If you can't see the object - ask the pilot to report the position of the object
- Is the aircraft able to move on or is other action required – decision together with the pilot
- Call the airport staff for a "runway inspection" and possible action 0431 - xx xx xx

## 4 Separations - deviations

### 4.1 Reduced runway separation

Reduced runway separation may **not** be exercised by the RTC.

### 4.2 Reduced separation in the vicinity of the airport

Visual separation as described in Doc 4444 chapter 6 may **not** be exercised by the RTC, with following exception:

Departing aircraft with diverging tracks after take-off

- During daytime and VMC
- All cameras and displays shall be working

## 5 IR-Camera

Checking the runway or other parts of the manoeuvring area, in order to identify the position of animals or FOD, based on a report. Reporting may be received from a pilot, vehicle driver or other person located on the manoeuvring area.

Use the IR camera with caution. Remember when you are using infrared camera you can have a better picture of the situation on the manoeuvring area than the individual situated there.

## 6 LVP

During LVP, two simultaneous movements may be allowed (two departures, two landings, a departing and a landing or an aircraft and a vehicle) on the manoeuvring area if the IR camera is used to verify the reports.

- A report "runway free" of aircraft or vehicles.
- Report of being at the "holding point" of aircraft or vehicles

## 7 One Movement mode

A reduced mode when the visual presentation is not available.

Provided that no vehicle or aircraft are reported on the manoeuvring area, you can allow an aircraft to land.

The mode may not be used directly after start-up of RTC. RTC have to have had visual control of the airport before using this mode.

Weather Requirements: CAVOK? visibility and cloud base?

## 8 Abnormal occurrences

### 8.1 Aircraft which are not visible for RTC-controller (Checklist B)

#### AIRBORNE ARRIVALS

If reported position is outside 8 NM from the runway:



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- Check against radar position if available
- Wait 30 seconds in order to achieve visual contact
- If still no visual contact assume the visual reproduction is unreliable or frozen
- Follow checklist A1

If reported position is between 8 NM and 4 NM and there is more than one movement

- Ask flight crew for reconfirmation of position
- Check visual screen status
- Otherwise confirm radar position by contacting APP
- Abort the approach and order a go-around
- VFR can continue towards or remain in published VFR-holding
- Follow checklist A1

If reported position is inside 4 NM and there is more than one movement

- Abort the approach
- VFR shall go back to published holding
- Follow checklist A1

#### AIRBORNE DEPARTURES

If there is more than one movement

- IFR-Continue as normal
- Coordinate with APP
- VFR-Proceed to holding and thereafter exit point
- Follow checklist A1

#### LOCAL TRAFFIC IN THE CIRCUIT

If there is more than one movement

##### IFR

- Coordinate with APP
- Climb and transfer to APP

##### VFR

- Go back to published holding
- Follow checklist A1

#### TRAFFIC ON GROUND

If there is more than one movement/vehicle

- Follow checklist A1

## 8.2 Weather information

### 8.2.1 Loss of Met-report

Call the Met-obs in Ängelholm 0431 - xx xx xx and requests Met-report - notes on paper. Request transmission by fax until the the connection is ok.

Call maintenance 0431 - xx xx xx



## 8.2.2 When you perceive the weather different from the report.

Call Met-Obs in Ängelholm 0431 - xx xx xx for verification.

## 8.3 Loss of airport sound

Loss of local airport sound - required?

Is it acceptable to work without airport sound? Switched off for RTC?

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