Validation Plan (VALP) for Single Remote Tower

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NORACON (LFV, AVINOR, FINAVIA, EANS) NATMIG (SAAB), EUROCONTROL, ETF, ATCEUC, IFATCA	

Abstract

The present document is the Validation Plan for the V2 and V3 Single Remote Tower validation activities of P06.09.03. It describes three activities that contribute to the validation of the Single Remote Tower application:

- Single TWR Trial 1 – a V2 Passive Shadow Mode (PSM) trial assessing a basic technical and operational concept for Remote Provision of ATS to a single aerodrome;
- Single TWR Trial 2 – a V3 passive shadow mode trial progressing the technical and operational capability;
- Single AFIS Trail 1 – a V3 PSM and Advanced Shadow Mode (ASM) trial assessing the Remote Provision of ATS to a single AFIS aerodrome in a range of operational conditions.

Authoring & Approval

Prepared By - *Authors of the document.*		
Name & Company	Position & Title	Date
Conor Mullan (Think Research on behalf of NORACON)	P06.09.03 Validation Team (Main author)	14 Nov 2012
Göran Lindqvist, Thomas Svensson (NORACON/LFV)	P06.09.03 Validation Team	4 May 2012

Reviewed By - *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
Mattias Abel, Pierre Ankartun (LFV/NORACON)	P06.09.03 Project Team	31 Oct 2012
Stein Nielsen, (Avinor/NORACON)	Avinor P06.09.03 Focal Point ATCO Senior	31 Oct 2012
Rene Lull (EANS/NORACON)	P06.09.03 Project Team	31 Oct 2012
Heikki Isomaa, Thomas Karlström (Finavia/NORACON)	P06.09.03 Project Team	31 Oct 2012
Roger Lane, Stéphane Dubuisson, Catherine Chalon-Morgan, Martha Llobet Lopez (EUROCONTROL)	P06.09.03 Project Team	31 Oct 2012

Reviewed By - *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
Bengt-Arne Skoog(Saab/NATMIG)	P12.04.06 and P12.04.07 Project Manager P06.09.03 Project Team	31 Oct 2012
Tord Gustavsson (ETF)	ETF Representative	31 Oct 2012
Emilio Garcia Villegas (ATCEU)	ATCEUC Representative	31 Oct 2012
Maria Nilsson(IFATCA)	IFATCA Representative and P06.09.03 Project Member	31 Oct 2012

Approved for submission to the SJU By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
Pierre Ankartun (NORACON)	P06.09.03 Project Manager	

Rejected By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
None		

Rational for rejection
None.

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Executive summary

This document provides the Validation Plan (VALP) for the Operational Focus Area (OFA) OFA06.03.01 "*Remote Tower*" under Operational Sub-Package PAC 06 "*Remote Provision of ATS to Aerodromes*". It describes the activities that will be conducted in support of validation for the Remote Provision of ATS to a *Single* Aerodrome as defined in the P06.09.03 OSED. It will not address any validation activities related to Remote Provision of ATS to *Multiple* Aerodromes or Remote Provision of ATS in *Contingency* situations. This OFA/Operational Sub-Package of Remote Tower together with another OFA/Operational Sub-Package (iCWP Airport) contribute to operational package PAC06.

The main focus of the concept, and therefore the validation, will be assessment of human performance (including usability), safety, capacity and cost effectiveness.

In keeping with the mappings defined in the OSED, the Remote Provision of ATS to a Single Aerodrome falls under SESAR Operational Step 1 (ATM Service Level 2). This operational service is already quite mature, having been developed initially in the ROT and ART projects. The relevant Operational Improvement (OI) is identified as SDM-0201 "Remote Provision of ATS to a Single Aerodrome."

The main target for the Remote Provision of ATS to a Single Aerodrome application are low to medium density airports, which today very much are struggling with low business margins. These airports are defined in the SWP06.02 Detailed Operational Description (DOD) as being in the "small" size category.

The validation exercises will mainly make use of shadow mode trials in candidate target environments in Scandinavia. (AFIS-trial Værøy Advanced Shadow Mode). Maturity of the concept is V2 to V3.

Operational Package	Operational Sub-Package	Operational Focus Area	OIs or Operational Services	Initial Maturity level	Target Maturity level	Reused validation material from past R&D Initiatives
PAC06	Remotely Provided ATS for Aerodromes	Remote Tower	SDM-0201- "Remotely Provided ATS for Single Aerodromes"	V2	V3	ART, ROT

Three validation trials are described in this VALP:

EXE-06.09.03-VP-056

Remote Provision of ATC to a Single Aerodrome Trial 1

EXE-06.09.03-VP-057

Remote Provision of ATC to a Single Aerodrome Trial 2

EXE-06.09.03-VP-058

Remote Provision of AFIS to a Single Aerodrome Trial 3

In addition to the actual trials, several activities related to validation will also be performed under the Safety and Human Performance Working Areas of the project (as described in Appendix 1 and Appendix 2). Further activities for Rules and Regulations and Business Transversal Assessments will be part of the project but are not yet mature for inclusion in this document.

This is a living document and will be updated as the project progresses to reflect the latest planning with regard all the activities. This version covers all three trials, with relevant inputs from the Human Performance and Safety Assessment plans.

1 Introduction

1.1 Purpose of the document

This document provides the Validation Plan (VALP) for the Operational Focus Area (OFA) OFA06.03.01 "*Remote Tower*" under Operational Sub-Package PAC 06 "*Remote Provision of ATS to Aerodromes*". It describes the activities that will be conducted in support of validation for the Remote Provision of ATS to a *Single* Aerodrome.

This VALP will not address any validation activities related to Remote Provision of ATS to Multiple Aerodromes or Remote Provision of ATS in Contingency situations.

The work and activities conducted under the Human Performance and Safety Working Areas of the project are not a focus of this VALP, but information from them has been used to shape this document and their plans are included as Annexes.

The VALP is produced by NORACON (project leaders) with inputs from NATMIG and EUROCONTROL. It is based on the Operational Services and Environment Description (OSED) **[8]** produced under Working Area A of the P06.09.03.

This VALP has been produced in line with the European Operational Concept Validation Methodology (E-OCVM) Version 3.0 **[7]**. This P06.09.03 project starts in E-OCVM V2 phase.

1.2 Intended readership

The intended audience for this document are other P06.09.03 team members, and those in the corresponding technical projects of P12.04.06, P12.04.07 and P12.04.08. P06.09.02 and P12.04.09 may also have an interest.

At a higher project level, SWP06.02 and WP B are expected to have an interest in this document, using it to ensure top-down consistency across P06.x.y primary projects and as a bottom-up input into their own Validation Strategy (VALS).

External to the SESAR project, other stakeholders are to be found among:

- Appropriate NSA;
- ANS providers;
- Airport owners/providers;
- Affected employee unions;
- 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 scope of the validation, the stakeholders and their expectations, and the level of maturity of the concepts validated.
- **Section 3** describes the objectives of the validation, the stakeholders' validation expectations, and the validation scenarios. It also describes what is required from the system/concept under test to be able to address the validation objectives, the validation platform needs, and the integration, verification or evaluation activities that have to be performed prior to the execution of the validation activities. It lists the intended validation exercises and provides a planning.
- **Section 4** describes the validation exercise plans.
- **Section 5** lists all the applicable and reference documents.

1.4 Glossary of terms

For full Glossary of Terms please refer to the P06.09.03 OSED [8].

1.5 Acronyms and Terminology

Term	Definition
ADD	Architecture Definition Document
AFIS	Aerodrome Flight Information Services
AFISO	Aerodrome Flight Information Services Officer
AGL	Aerodrome Ground Lights
AMP	Airport Messaging Processing
ANSP	Air Navigation Service Provider
APP	Approach Control Service
ART	Advanced Remote Tower Research Project
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATS	Air Traffic Services
AWOS	Automatic Weather Observation System
CAVOK	Ceiling and Visibility OK
CWP	Controller Working Position
DOD	Detailed Operational Description
FPB	Flight Progress Board
HF	Human Factors
HMI	Human-Machine Interface
IFR	Instrument Flight Rules
LCD	Liquid Crystal Display
LFV	Swedish ANSP
OFA	Operational Focus Area
OI	Operational Improvement
OSED	Operational Services and Environment Description
OTW	Out The Window
PTZ	Pan Tilt Zoom Camera
PUT	Product Under Test. This may be used to refer to both System Under Test and Concept Under Test.
RDP	Radar Data Processor
ROT	Remotely Operated Tower (proof of concept project)
R/T	Radio Telephone

Term	Definition
RTC	Remote Tower Centre
R&D	Research and Development
RTS	Real-Time Simulation
RVT	Remote and Virtual Tower Project
RWY	Runway
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SUT	System Under Test
TA	Transversal Assessment
TWR	Aerodrome Control Service (which is a subset of ATC Service)
UHF	Ultra High Frequency(radio spectrum band)
VCS	Voice Communications System
VFR	Visual Flight Rules
VHF	Very High Frequency (radio spectrum band)
V1, V2… V7	Concept Lifecycle Model Phases V1 to V7

2 Context of the Validation

2.1 Scope/perimeter of the validation

This document covers the activities that will be conducted in support of validation for the Remote Provision of ATS to a *Single* Aerodrome as defined in the P06.09.03 OSED. It will not address any validation activities related to Remote Provision of ATS to *Multiple* Aerodromes or Remote Provision of ATS in *Contingency* situations. This OFA/Operational Sub-Package of Remote Tower together with another OFA/Operational Sub-Package (iCWP Airport) contribute to operational package PAC06.

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In keeping with the mappings defined in the OSED, the Remote Provision of ATS to a Single Aerodrome falls under SESAR Operational Step 1 (ATM Service Level 2). This operational service is already quite mature, having been developed initially in the ROT and ART projects. The relevant Operational Improvement (OI) is identified as SDM-0201 “Remote Provision of ATS to a Single Aerodrome.”

The main target for the Remote Provision of ATS to a Single Aerodrome application are low to medium density airports, which today very much are struggling with low business margins. These airports are defined in the SWP06.02 Detailed Operational Description (DOD) as being in the “small” size category.

The validation exercises will mainly make use of shadow mode trials in candidate target environments in Scandinavia (ASM is expected for ENVR-AFIS Trial).

In addition to the actual trials, several activities related to validation will also be performed under the Safety and Human Performance Working Areas of the project (as described in Appendix 1 and Appendix 2)

	EXE-06.09.03-VP-056 : Passive Shadow Mode Trial for Remote Provision of ATC to a Single Aerodrome (1)	
Leading organization	NORACON / LFV	
Validation exercise objectives	OBJ-06.09.03-VALP-0060.0010 OBJ-06.09.03-VALP-0060.0020 OBJ-06.09.03-VALP-0060.0030 OBJ-06.09.03-VALP-0060.0040 OBJ-06.09.03-VALP-0060.0060 OBJ-06.09.03-VALP-0060.0070 OBJ-06.09.03-VALP-0060.0100	
Rationale	The overall aim of this first trail is to assess the technical and operational capability of an initial prototype in an operational environment. Trial 1 builds upon the trials and assessments already made in ROT/ART, bringing previous results into the wider European domain; and re-confirming their top-level findings using a more mature technical and operational system with a wider stakeholder involvement.	
Supporting DOD / Operational Scenario / Use Case	Long Term Planning UC 6 01 Long Term Planning UC 6 06	
OFA addressed	OFA06.03.01 “Remote Tower”	
OI steps addressed	SDM-0201	
Enablers addressed	AERODROME-	Provide Remote Tower Controller position

	ATC-52	with visual reproduction of both remote aerodrome views and other sensor data.
	HUM-SDM-0201-01	New role and responsibilities
	HUM-SDM-0201-02	Social, people management, change and transition management factors for Automated Support for Traffic Complexity Assessment
	HUM-SDM-0201-03	Change and transition management factors for the OI step Network Operation Plan available
	HUM-SDM-0204	Initial training, competence and/or adaptation of new/active operational staff for the application and use of the enhancements and improvements included of the OI Step Remotely Provided Air Traffic Service for Single Aerodrome
	PRO-157ATC	Procedures (Airport) for providing services to a remote location potentially including but not limited to traffic information, separation provision, METEO alerts, and alerting services
Applicable Operational Context	Airports	
Expected results per KPA	Safety, Capacity, Human Performance all maintained.	
Validation Technique	Passive Shadow Mode	
Dependent Validation Exercises	EXE-06.09.03-VP-057 EXE-06.09.03-VP-058	

	EXE-06.09.03-VP-057 : Passive Shadow Mode Trial for Remote Provision of ATC to a Single Aerodrome (2)
Leading organization	NORACON / LFV
Validation exercise objectives	OBJ-06.09.03-VALP-0060.0010 OBJ-06.09.03-VALP-0060.0020 OBJ-06.09.03-VALP-0060.0030 OBJ-06.09.03-VALP-0060.0040 OBJ-06.09.03-VALP-0060.0050 OBJ-06.09.03-VALP-0060.0060 OBJ-06.09.03-VALP-0060.0070 OBJ-06.09.03-VALP-0060.0080 OBJ-06.09.03-VALP-0060.0090 OBJ-06.09.03-VALP-0060.0100
Rationale	The overall aim of this second trial is to build upon the technical and operational findings of EXE-06.09.03-VP-056 and address objectives and scenarios not already addressed or concluded upon in VP-056. The trial will also look at various technical configurations to gain an understanding of the different operational service levels possible using different technical enablers.
Supporting DOD / Operational Scenario / Use Case	Long Term Planning UC 6 01 Long Term Planning UC 6 06

OFA addressed	OFA06.03.01 “Remote Tower”	
OI steps addressed	SDM-0201	
Enablers addressed	AERODROME -ATC-52	Provide Remote Tower Controller position with visual reproduction of both remote aerodrome views and other sensor data.
	HUM-SDM-0201-01	New role and responsibilities
	HUM-SDM-0201-02	Social, people management, change and transition management factors for Automated Support for Traffic Complexity Assessment
	HUM-SDM-0201-03	Change and transition management factors for the OI step Network Operation Plan available
	HUM-SDM-0204	Initial training, competence and/or adaptation of new/active operational staff for the application and use of the enhancements and improvements included of the OI Step Remotely Provided Air Traffic Service for Single Aerodrome
	PRO-157ATC	Procedures (Airport) for providing services to a remote location potentially including but not limited to traffic information, separation provision, METEO alerts, and alerting services
Applicable Operational Context	Airports	
Expected results per KPA	Safety, Capacity, Human Performance all maintained.	
Validation Technique	Passive Shadow Mode	
Dependent Validation Exercises	EXE-06.09.03-VP-058	

	EXE-06.09.03-VP-058 : Shadow Mode Trial for Remote Provision of AFIS to a Single Aerodrome
Leading organization	NORACON / Avinor
Validation exercise objectives	OBJ-06.09.03-VALP-0060.0010 OBJ-06.09.03-VALP-0060.0020 OBJ-06.09.03-VALP-0060.0030 OBJ-06.09.03-VALP-0060.0040 OBJ-06.09.03-VALP-0060.0050 OBJ-06.09.03-VALP-0060.0060 OBJ-06.09.03-VALP-0060.0070 OBJ-06.09.03-VALP-0060.0080 OBJ-06.09.03-VALP-0060.0100
Rationale	The Remote Provision of Aerodrome Flight Information Services (AFIS) to a Single Aerodrome, assessed firstly through Passive Shadow Mode and secondly in Advanced Shadow Mode. The Passive Mode part entails the AFIS Officer (AFISO) observing live traffic in a non-intrusive manner and not interacting with the aircraft or providing any

	service. The Advanced Mode will require the AFISO to provide the full AFIS service to the aircraft as the ATCO-in-the-loop using the prototype system.	
Supporting DOD / Operational Scenario / Use Case	Long Term Planning UC 6 01 Long Term Planning UC 6 06	
OFA addressed	OFA06.03.01 “Remote Tower”	
OI steps addressed	SDM-0201	
Enablers addressed	AERODROME-ATC-52	Provide Remote Tower Controller position with visual reproduction of both remote aerodrome views and other sensor data.
	HUM-SDM-0201-01	New role and responsibilities
	HUM-SDM-0201-02	Social, people management, change and transition management factors for Automated Support for Traffic Complexity Assessment
	HUM-SDM-0201-03	Change and transition management factors for the OI step Network Operation Plan available
	HUM-SDM-0204	Initial training, competence and/or adaptation of new/active operational staff for the application and use of the enhancements and improvements included of the OI Step Remotely Provided Air Traffic Service for Single Aerodrome
	PRO-157ATC	Procedures (Airport) for providing services to a remote location potentially including but not limited to traffic information, separation provision, METEO alerts, and alerting services
Applicable Operational Context	Airports	
Expected results per KPA	Safety, Capacity, Human Performance all maintained.	
Validation Technique	Passive Shadow Mode	
Dependent Validation Exercises	-	

Table 1: Concept Overview

2.2 Stakeholder identification, needs and involvement

Two groups of stakeholders can be identified:

- Internal stakeholders who are part of the SESAR project and are directly impacted by the new airport operations concept and the associated systems. These include ANSPs, Airspace Users, Airport Operators and Network Management who are involved in all operational aspects of the airport operations concept. The Manufacturing Industry, Research Institutes and the SJU are involved in measuring, facilitating and building on the validation results. In the P06.02 Validation Strategy, the involved internal stakeholder (actors) identified are the Tower Ground Controller (TWR), the Tower Runway Controller (RWY) and the AFIS Officer (AFISO). The internal stakeholder organisation listed is the ANSP.

- External stakeholders are all other stakeholders. They include passengers, communities around airports, the European Commission, National/Local political bodies and trade associations and Regulatory Authorities and Standardisation Bodies. These stakeholders have a political and societal interest in the validation outcomes of SESAR. Their requirements and interests are broader and thus harder to quantify. They set the framework for validation exercises rather than set precise tangible targets.

Affected stakeholders were identified in the P06.09.03 PIR [9] with their expectations from the *project* in terms of performance.

Stakeholder	Involvement in the Validation Process	Stakeholder Needs
ANSP	ANSP will be conducting the activities	Cost Effective, Capacity, Safety, levels of service
ATC/AFIS Officers	ATCO/AFISO will be activity participants, operating the system and giving feedback.	Safety, Human Performance, quality of service, working environment.
Industry + WP12.4.6-8	Industry will supply the trial platforms	Requirements, increased maturity, evidence of benefits
SESAR Joint Undertaking	SJU, through various WP and SWP, will monitor the activities and their results/reports.	Contribution to European ATM, within timescales and budget
Regulators (ICAO, EASA, national CAA)	No direct involvement in the validation activities but may be asked to give input into assessments.	Understanding of impact on standards and regulations, evidence of expected performance (including Safety performance).
Airport operators	Airport operators will provide the operating environment for the trials.	Cost of ATS, Safety, capacity
ATCO trade unions (ETF, ATCEU) and ATCO professional federation (IFATCA)	Participation in development and validation process	Acceptable to users, impact on ATCO future working methods, roles, jobs etc
Airspace Users (airlines and pilots)	Participation in development and validation process	Safety, access, quality of service.

2.3 Maturity levels

A preliminary operational concept was defined in the Remotely Operated Tower (ROT) project [10], led by LFV and Saab. This was further enhanced by developments made during the Advanced Remote Tower (ART) project [11] led also by LFV and Saab. Both projects investigated the feasibility of an initial concept and a set of technical enablers for remotely provided ATS to a single aerodrome. Advanced Shadow mode trials were performed at Malmö Airport for the remote Ängelholm Airport 100 km away. A number of licensed ATCO participated in the trials. The trials were safety assessed concerning impact on real ATS operations in collaboration with the national Swedish flight safety authority (SCAA).

Operational Package	Operational Sub-Package	Operational Focus Area	OIs or Operational Services	Initial Maturity level	Target Maturity level	Reused validation material from past R&D Initiatives
PAC06	Remotely Provided ATS for Aerodromes	Remote Tower	SDM-0201- "Remotely Provided ATS for Single Aerodromes"	V2	V3	ART, ROT

Table 2: Maturity levels table

3 Validation Approach

3.1 Validation Approach at OFA (Operational Focus Area) level

The Validation Approach at OFA level is currently under review. Previously only P06.09.03 was assessing OFA 06.03.01 therefore the approach at project level was the same as the approach at OFA level. Recently another project has begun an investigating the OFA and therefore coordination issues are still to be decided.

3.2 Validation Overview

The validation strategy is based on a number of integrated, incremental, steps. The building of the overall concept is somewhat stepwise in that the concepts and technical enablers are initially established in the Single Remote Tower environment, before being used in Contingency/Multiple Tower environments. The development of the technical enablers themselves is also step-wise, given that some are more complex than others, and finally the level of maturity is at different stages for the applications. This approach also enables any potential 'quick wins' to be identified and assessed at an early stage in the Single Tower application early in the project lifecycle, thus potentially expediting implementation of those enablers and applications.

The Single Remote Tower concept is currently most mature having already been assessed in the ROT project and the ART Project. Some elements of the technical enablers were also assessed in the ROT project, and so an initial set of the technical enablers exists in the V2 level of maturity. Therefore the Single Remote Tower concept with initial technical enablers acts as a late V2 to early V3, starting point. The rest of the technical enablers are in V1-V2 and will be gradually introduced into the concept applications as they become available. From this an initial Single Tower AFIS concept can be extracted and assessed. The experiences gained in this concept application will expedite the development of the less mature technical enablers and help identify any quick wins.

The trials will be conducted on a live trials platform developed by WP12.04 (NATMIG). The trial platforms will be built and delivered by P12.04.06-07 according to the WP12 technical specifications which will be based on the P06.09.03 Operational and Functional Requirements[1]. The interaction between P06.09.03 and WP 12.04.06-08 will be iterative. Verification activities will take place in the WP12, before each of the defined trials can be validated by controllers in this WP.

Human-in-the-loop shadow mode trials will be essential since the ATCO/AFISO is a main focus of assessment. Involvement from other stakeholders will come via expert review, user groups and input to the relevant cases.

The validation outputs from the trials will be individual exercise reports and associated findings which will be fed into final, consolidated validation reports. The operational outputs from the trials will be updated concept descriptions including procedures and requirements.

It is important to reiterate that the trials described in this document will be conducted alongside separate and specific assessments for Human Performance, Safety, Rules and Regulations, and Cost-Effectiveness. Each of these transversal assessments areas has a specific assessment plan, activities and will produce separate outputs. Where possible, due to the strong relationships between the trials and the already mature Human Performance and Safety Assessment Plans, links have been made between all activities. This will allow a more complete approach to validation, rather than the trials alone.

By promoting the involvement and interaction with WP12.04 and the industry partner (NATMIG) the end result of the series of trials will be a validation platform which will include the technical requirements of a pre-industrial prototype. These outputs are all compliant with the necessary V3 gate transition requirements.

[1] These Requirements are currently found in the OSED. During the course of the project these will be moved into a Safety and Performance Requirements (SPR) document.

3.3 Stakeholders Validation Expectations

Stakeholder	External / Internal	Involvement	Why it matters to stakeholder	Performance expectations	Exercise Identifier
ANSP	Internal	The NORACON Consortium will be involved in planning, conduct and reporting of the trial. They will also supply the ATCO/AFISO.	These ANSP are candidates for deployment of Remote ATS.	ANSP will expect the validation process to provide evidence that the concept: • Is cost-effective and supports the findings of the business case in that it will reduce overall operating costs; • Provides levels of safety that are at least as good as current operations; • Does not negatively impact human performance in any way and Is acceptable to all operators and service users; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility.	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058
ATCO/AFISO	Internal	The ATCO/AFISO will be the system operators in the trial.	The ATCO/AFISO will be the operators – their day to day work will be affected by Remote ATS	ATC will expect the validation process to provide evidence that the concept: • Provides levels of safety that are at least as good, if not better than current (local) operations; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility; • Is usable and acceptable;	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058
Industry + WP12.4.6-8	Internal	The platform will be provided by NATMIG.	They will wish to market and sell a successful system to others.	Industry will expect the validation process to: • Generate and assess requirements to help mature and prove the concepts; • Gather evidence to help them decide on continued investment and/or concept implementation; • Promote the benefits of the concept.	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058
SESAR Joint Undertaking	External	The SJU will not have direct involvement in the trial, but they may review deliverables and visit the trial.	They will want a successful trial to enable them to meet Release aims, and to allow them to share results.	The SESAR JU will expect the validation process to: • Provide evidence that the concept will make a positive contribution to European ATM; • Be completed within timescales and budget.	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058

Regulators (ICAO, EASA, national)	External	The regulators will want to ensure safety and optimize airspace efficiency.	The regulators are responsible for putting rules, regulations and procedures in place to ensure safety in new concept implementations.	The Regulatory Bodies will expect the validation process to: • Assist in understanding the impact of the concept on current and future standards and regulations; • Provide evidence that the concept meets the required performance levels in terms of safety, capacity, access etc.	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058
Airport operators	External	Airport operators will help facilitate the trial.	They will have to decide to implement the concept at their aerodromes.	Airport operators will expect the validation process to provide evidence that the concept: • Lowers ATS costs as part of airport fees, as much as possible; • Will help them maintain and sustain future operations; • To maximise airport capacity under a variety of operational scenarios and conditions e.g. opening hours, low visibility.	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058
Trade Unions	External	Trade Unions are not directly involved in the trials; however they are representing the end users.	Trade Unions represent the operators as the end users.	The Trade Unions will expect the validation process to provide evidence that the concept: • Is acceptable to the operational users; • Does not lead to unwanted changes to procedure, roles or responsibilities for the operational staff	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058
Airspace Users	External	The Airspace Users will not have direct involvement in the trial, but they may review deliverables and visit the trial. They may also help provide qualitative feedback and input to results.	They will be the service users – the customers.	Airspace Users will expect the validation process to provide evidence that the concept: • At least maintains, and hopefully improves, safety levels; • Lowers ATS costs as part of airport fees, as much as possible; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility;	EXE-06.09.03-VP-056 EXE-06.09.03-VP-057 EXE-06.09.03-VP-058

Table 3: Stakeholders' expectations

3.4 Deviations with respect to the Validation Strategy and Transversal Reference Material

None.

3.5 Benefit Mechanisms Overview

The main area of interest with SDM-0201 is cost effectiveness. This benefit is assessed separately through cost benefit analysis and other similar activities.

All of these activities are based on the assumption that Remote Provision of ATS to a Single Aerodrome is actually feasible; is safe; and does not decrease capacity. The validation trials therefore look at those performance areas rather than cost effectiveness directly.

3.6 Validation Objectives

Following the update of the P06.09.03 OI steps, there is no top down validation objective which can be taken from the WP06.02 Validation Strategy. Instead, the following Validation Objectives have been created for P06.09.03 based on the stakeholder validation expectations.

Identifier	OBJ-06.09.03-VALP-0060.0010
Objective	To assess whether ATS services can be provided for a single airport from a remote location with no degradation of service under a variety of scenarios.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0010	The ATCO/AFISO is able to use the remote facility to perform a sufficient range of tasks to provide ATS under various operational conditions.

Identifier	OBJ-06.09.03-VALP-0060.0020
Objective	Assess whether the levels of safety are maintained or improved under all normal conditions when ATS are remotely provided to a single airport.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0020	The Safety Acceptance Criteria (as per Preliminary Safety Assessment, section 2.4) are satisfied.

Identifier	OBJ-06.09.03-VALP-0060.0030
Objective	Assess whether the ATS can safely continue to be remotely provided to a single airport under external abnormal conditions.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0030	The Safety Acceptance Criteria (as per Preliminary Safety Assessment, section 2.4) are satisfied.

Identifier	OBJ-06.09.03-VALP-0060.0040
Objective	Assess whether the ATS can safely be remotely provided to a single airport during degraded modes of operation, and recovered from.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0040	The Safety Acceptance Criteria (as per Preliminary Safety Assessment, section 2.4) are satisfied.

Identifier	OBJ-06.09.03-VALP-0060.0050
Objective	Assess whether RTC system has sufficient safety functionalities and performance to remotely provide ATS to a single airport, and whether these safety requirements specifying it are realistic.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0050	The set of safety requirements specifying the Remote Tower system for a single airport is complete and they can be implemented in a typical physical architecture.

Identifier	OBJ-06.09.03-VALP-0060.0060
Objective	To assess the impact of the Remote Tower Concept on ATCO/AFISO Human Performance.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0060	Human performance must be shown to be at an acceptable level, in terms of: Situation awareness; Human performance (efficiency) / potential for human error; Acceptability; Trust; Workload. Any instances of Human Performance degradation are either mitigated or acceptably offset by improvements in other areas.

Identifier	OBJ-06.09.03-VALP-0060.0070
Objective	To assess the Acceptability of the Remote Tower Concept to ATCO/AFISO, airport operators and pilots.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0070	The Remote Provision of ATS to a single aerodrome is acceptable to ATCO/AFISO, airport operators and pilots, in terms of: The concept in general; The system; Roles, responsibilities & task allocation; Working methods; Procedures; HMI.

Identifier	OBJ-06.09.03-VALP-0060.0080
Objective	To validate information and assumptions that will be used in any Business Case Transversal Assessments, relating to the Cost Effectiveness of Remote Provision of ATS to Single low to medium density airports

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0080	Information relating to the Cost Effectiveness of the Remote Tower Concept at low to medium density airports can be derived from the validation results.

Identifier	OBJ-06.09.03-VALP-0060.0090
Objective	To assess the impact of the Remote Tower Concept on airport Capacity in terms of: Impact of different weather conditions; Impact of time of day; Impact of varying opening hours.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0090	The airspace and runway capacity for the target candidate environments is not negatively impacted by the Remote Provision of ATS under normal conditions, and may be positively impacted.

Identifier	OBJ-06.09.03-VALP-0060.0100
Objective	To assess the utility of prototype features, functions and technologies for integration into future trial platforms for the Single, Multiple and Contingency applications.

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0100	The utility of proposed/prototype features, functions and technologies is known. Information collected on proposed/prototype features, functions and technologies can enable a decision on integration of these into a future trial platform.

3.7 Validation Scenarios

There are no top down validation scenarios which can be taken from the WP06.02 Validation Strategy. Instead, the following Validation Scenarios have been created for P06.09.03 based on the Validation Objectives and on the requirements identified in the OSED. Validation scenarios are also identified and listed in the HP Assessment Plan and Safety Assessment Plan.

Since the main validation activities conducted for Remote Provision of ATS for a Single Aerodrome will be shadow mode trials, it is not possible to create scenarios in the same way as in a synthetic or simulated environment. The activity will mainly use the real life scenarios that are happening at the chosen aerodromes during the validation activity.

More than one of the following scenarios may occur in combination e.g. IFR flights arriving at, and departing from, an aerodrome (SCN-06.09.03-VALP-0060.0010) during limited visibility (SCN-06.09.03-VALP-0060.0050).

Identifier	SCN-06.09.03-VALP-0060.0010
Scenario	IFR flights arriving at, and departing from, an aerodrome

Identifier	SCN-06.09.03-VALP-0060.0020
Scenario	VFR flights arriving at, and departing from, an aerodrome.

Identifier	SCN-06.09.03-VALP-0060.0030
Scenario	VFR flights in the traffic circuit and e.g. making Touch and Go landings

Identifier	SCN-06.09.03-VALP-0060.0040
Scenario	Remote Provision of ATS during good visibility conditions

Identifier	SCN-06.09.03-VALP-0060.0050
Scenario	Remote Provision of ATS during limited visibility conditions

Identifier	SCN-06.09.03-VALP-0060.0060
Scenario	Remote Provision of ATS during hours of darkness

Identifier	SCN-06.09.03-VALP-0060.0070
Scenario	Ground surface movements at an aerodrome - vehicles and aircraft

Identifier	SCN-06.09.03-VALP-0060.0080
Scenario	Simultaneous service provision of aircraft in flight and on the manoeuvring area by the ATCO/AFISO

Identifier	SCN-06.09.03-VALP-0060.0090
Scenario	Runway Incursion

Identifier	SCN-06.09.03-VALP-0060.0100
Scenario	Obstructions on the manoeuvring area

Identifier	SCN-06.09.03-VALP-0060.0110
Scenario	Occasions or events where lamp signalling by ATCO/AFISO is required

Identifier	SCN-06.09.03-VALP-0060.0120
Scenario	Observation by the ATCO/AFISO of visual communication from the aircraft that are within visual range, such as: - aircraft flashing landing lights or flashing navigation lights (in darkness). - aircraft repeatedly changing its bank angle - “rocking wings” (in daylight)

Identifier	SCN-06.09.03-VALP-0060.0130
Scenario	ATCO use of visual navigation aids

Identifier	SCN-06.09.03-VALP-0060.0140
Scenario	ATCO use of non-visual navigation aids

To increase chances of covering all the objectives and requirements various sources and ways of generating scenarios will be investigated in each trial. These will include:

- Actual events happening during the trial at the aerodrome;
- Requests relayed from the remote facility to the local facility (and onwards to the aircraft if necessary). This will require cooperation of both local ATCO/AFISO and airspace users;
- The use of a specially commissioned aircraft to perform some scripted manoeuvres;
- The use of recorded / playback video if scenarios have been captured outside the time of the validation activity;
- The interpolation of results from regularly occurring scenarios to assess relative to an irregular occurrence e.g. assessing events like visual obstruction to camera viewpoint/lens during periods of low visibility (e.g. thick fog);
- The use of data taken from similar projects either in the past, or which are on-going in parallel to the validation activities (e.g. implementation projects).

3.8 Validation Assumptions

There are no top down validation assumptions which can be taken from the WP06.02 Validation Strategy.

3.9 Validation Requirements

3.9.1 Validation SUT Requirements

Identifier	REQ-06.09.03-VALP-SIN1.030
Requirement	The SUT shall include communication means between remote facility and local aerodrome.

3.9.2 Other Validation Requirements

None.

3.10 Integration and preliminary Validation activities

As a general approach, a series of milestones for technical integration are planned prior to each trial:

- M1 - Requirements produced
- M2 - Prototype developed
- M3 - Prototype Integrated
- M4 - Platform modified
- M5 - Platform integrated
- M6 - Platform technically accepted
- M7 - Platform Configured

The M7 milestone is expected to be complete at least two weeks prior to each trial. In addition, and as mentioned previously, preliminary Safety and Human Performance activities will be conducted in accordance with the Safety and Human Performance plans.

3.11 Validation Exercises List

Identifier	EXE-06.09.03-VP-056

<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0010	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0020	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0030	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0040	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0050	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0060	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0070	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0080	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0090	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0100	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0110	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0120	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0130	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0140	
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

Identifier	EXE-06.09.03-VP-057

<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0010	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0020	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0030	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0040	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0050	

<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0060	
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<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0090	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0100	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0110	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0120	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0130	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0140	
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

Identifier	EXE-06.09.03-VP-058

<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0010	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0020	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0030	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0040	
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<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0080	
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<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0100	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0110	
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<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0130	
<EXECUTES>	<V&V Scenario>	SCN-06.09.03-VALP-0060.0140	
<CHANGED_BECAUSE_OF>	<Change Order>	Change Reference	N/A

Note: For the V&V exercises defined in V&V Roadmap, the existing identifier shall be used.

3.12 Validation Exercises Planning

Trials	Task	Start	End
Single TWR Trial 1 Ängelholm/ Malmö	VALP1.1	15/07/2011	15/09/2011
	Trial Conduct	25/10/2011	15/11/2011
	VALR1.1	15/11/2011	28/02/2012
Single TWR Trial 2 Ängelholm/ Malmö	VALP1.2	02/04/2012	02/05/2012
	Trial Conduct	07/05/2012	25/05/2012
	VALR1.2	28/05/2012	29/07/2012
Single AFIS Trial Værøy/ Bodø	VALP1.3	02/04/2012	30/09/2012
	Trial Conduct PSM	01/12/2012	31/12/2012
	Trial Conduct ASM	01/01/2013	15/03/2013
	VALR1.3	01/01/2013	15/07/2013

3.13 Notes on the Validation Strategy

Some of the objectives identified during the validation planning for the Remote Provision of ATS to Single Airports are best addressed in an active trial. In order to meet the tight timescales demanded by the SESAR programme, the Validation Strategy for the Remote Provision of ATS to Single Airports does not include active trials, focusing instead on Passive Shadow Mode trials. This has been the stated Strategy throughout Project Initiation and planning. However, in Norway, at Vaerøy, the Project will utilize ASM during parts of the AFIS Trial.

This is not to say that evidence from active trials is not, or will not be, available (see above). Advanced Shadow Mode Trials took place under the previous ROT and ART projects and detailed Safety Assessments formed part of those trials. This existing work permits the P06.09.03 Remote Provision of ATS to Single Aerodromes concept, which includes a lot of functionality and technology from the ROT/ART projects, to begin at maturity V3 in Trial 1.

However, not all the results of the ROT/ART trials and assessments are publicly available in the European domain. The purpose of the P06.09.03 Trial 1 is therefore to build upon the trials and assessments already made in ROT/ART; to bring previous results into the wider European domain; and to re-confirm the top-level findings using a more mature technical and operational system with a wider stakeholder involvement. Once this Trial 1 baseline has been established in the context of the SESAR programme, subsequent trials for Remote Provision of ATS to Single Aerodromes can focus on more advanced functionality and include more advanced assessments (including quantitative).

If results generated during active trials are considered essential in order for stakeholders to fully accept the concept, and results from Passive Shadow Mode trials do not suffice, results from the ROT/ART trials can be made available and re-examined in the context of P06.09.03. Furthermore, in parallel to the P06.09.03 Shadow Mode trials, an implementation project is also underway. Whilst results from this implementation and subsequent live operations will not be available immediately, it is thought that in time they could be included as part of the wider Remote Provision of ATS body of evidence.

4 Validation Activities

4.1 Single TWR Trial 1 (EXE-06.09.03-VP-056) Plan

4.1.1 Exercise Scope and Justification

The Remote Provision of ATC to a Single Aerodrome, assessed during a Passive Shadow Mode Trial.

The overall aim of this first trail is to assess the technical and operational capability of an initial prototype in an operational environment. Trial 1 builds upon the trials and assessments already made in ROT/ART, bringing previous results into the wider European domain; and re-confirming their top-level findings using a more mature technical and operational system with a wider stakeholder involvement.

Detailed performance assessments (Safety, Capacity etc) are not the focus of Trial 1.

4.1.1.1 Exercise Level

The Exercise is at the level of: ATM System

4.1.1.2 Description of the Operational concept being addressed

The concept being addressed is the Remote Provision of ATS to a Single Aerodrome, as described in the OSED for Remote Provision of ATS, Section 3.1:

The full range of ATS defined in ICAO Documents 4444, 9426 could be provided remotely by an ATCO. The airspace users could be provided with the appropriate level of services as if the ATS were provided locally. The ATCO will not be located at the aerodrome. They will be located at the Remote Tower Centre in Malmö.

The Remote ATCO will perform ATS tasks using the CWP in the Malmö Remote Tower facility. The visual surveillance will be provided by a reproduction of the OTW view, by using visual information capture.

Nine cameras will be placed on top of the local tower (Ängelholm), with each having a 40° visual view, which is presented on LCD monitors in the RTC .

View and sound from the local tower will be captured with digital video cameras and microphones. The actual airport systems, e.g. runway and taxi lights, will be connected to the network with relevant data displayed in the RTC. Data will be transmitted over a communication network between the actual airport and the RTC.

The CWP in the RTC will include all presentation of all necessary systems e.g. radar, flightplan, Met, airport lights, navaids, alarms, with interfaces to the airport.

4.1.1.3 Stakeholders and their expectations

Stakeholder	External / Internal	Involvement	Why it matters to stakeholder	Performance expectations
ANSP	Internal	The NORACON ANSP will be involved in planning, conduct and reporting of the trial. They will also supply the ATCO.	These ANSP are candidates for deployment of Remote ATS.	The ANSP expect the concept to be proved feasible in this trial. They are not expecting performance gains in this trial, but do not wish to see performance degraded.
ATCO	Internal	ATCO from LFV will be the system operators in the trial.	The ATCO will be the operators – their day to day work will be affected by Remote	The ATCO expect the concept to be operable and acceptable. They expect it to be at least as safe as their current system and

			ATS	enable a level of service as least as good.
Industry	Internal	NATMIG will supply the trial platform	They will wish to market and sell a successful system to others.	Industry expect the concept to be proved feasible in this trial. They are not expecting performance gains in this trial, but do not wish to see performance degraded
SJU	External	The SJU will not have direct involvement in the trial, but they may review deliverables and visit the trial.	They will want a successful trial to enable them to meet Release 1 aims, and to allow them to share results.	The SJU will want the system to make a positive contribution to European ATM modernisation.
Airspace Users	External	The Airspace Users will not have direct involvement in the trial, but they may review deliverables and visit the trial. They may also help provide qualitative feedback and input to results.	They will be the service users – the customers.	Airspace users will want access, equity and safety to be at least maintained.
Airport Operators	External	Ängelholm airport operators will help facilitate the trial.	They will have to decide to implement the concept at their aerodromes.	Airport Operators will want an initial indication of feasibility and costs.

Table 4: Stakeholders' expectations

4.1.1.4 Validation objectives and hypothesis

4.1.1.4.1 Exercise Validation Objectives

The following validation objectives are lower level derivations of the high level validation objectives stated in Section 3.

Identifier	OBJ-06.09.03-VALP-0060.0011
Objective	To assess the completeness and suitability of the functional requirements for Remote Provision of ATS to a single aerodrome (as defined in the OSED)

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0011	The technical capability of the platform, with regards the functional specifications, is known. The functional specifications have been approved by the users in a trial environment. Any changes with regards technical capability are captured in the form of changed, additional or removed functional requirements.

Identifier	OBJ-06.09.03-VALP-0060.0021
Objective	Gain an initial Safety Insight into the Remote Provision of ATS under the normal conditions experienced during the shadow mode trials

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0021	The trial has facilitated the gathering of initial safety feedback, to be used as input into the dedicated safety studies, the OSED and future trials.

Identifier	OBJ-06.09.03-VALP-0060.0031
Objective	Gain an initial Safety Insight into the Remote Provision of ATS under the abnormal conditions experienced during the shadow mode trials

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0031	The trial has facilitated the gathering of initial safety feedback, to be used as input into the dedicated safety studies, the OSED and future trials.

Identifier	OBJ-06.09.03-VALP-0060.0041
Objective	Gain an initial Safety Insight into the Remote Provision of ATS under the degraded conditions experienced during the shadow mode trials

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0041	The trial has facilitated the gathering of initial safety feedback, to be used as input into the dedicated safety studies, the OSED and future trials.

Identifier	OBJ-06.09.03-VALP-0060.0062
Objective	To assess the range of ATC functions that can be performed using the initial prototype, and identify any additional issues that may contribute to the HP Task Analysis.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN02.5006	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0062	Changes to controllers' current roles, tasks and responsibilities under remote tower operations under normal operational conditions are identified & any potential issues not already captured identified.

Identifier	OBJ-06.09.03-VALP-0060.0071
Objective	To assess the Acceptability of the initial working environment to ATCO, when providing Remote ATS to a Single Aerodromes.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0071	The Remote Provision of ATS to a single aerodrome concept, is usable/acceptable to the ATCO in terms of: Visual Reproduction; CWP; Working Environment; Remote Facility Location and resulting social considerations.

Identifier	OBJ-06.09.03-VALP-0060.0072
Objective	Gain an initial insight into the impact of the Remote Provision of ATS on ATCO roles tasks & responsibilities.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0072	The trial has facilitated the gathering of initial feedback, relating to the impact of remote tower ops on ATCO roles, tasks & responsibilities'

Identifier	OBJ-06.09.03-VALP-0060.0101
Objective	To assess the usefulness and utility of prototype features, functions and technologies for integration into future trial platforms e.g. High Definition Cameras, video compression software, IR cameras.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0101	The usefulness and utility of proposed/prototype features, functions and technologies is known. Information collected on proposed/prototype features, functions and technologies can enable a decision on integration of these into a future trial platform.

4.1.1.4.2 Exercise Indicators and Metrics

Identifier	OBJ-06.09.03-VALP-0060.0011
Objective	To assess the completeness and suitability of the functional requirements for Remote Provision of ATS to a single aerodrome (as defined in the OSED)
Indicator	ATCO agreement / comment / consensus on the list of functional requirements assessed.
Assessment Method	The project team will identify the functional requirements they think they can obtain opinion on during the trial. These requirements will be presented to the trial participants during quiet (no traffic) periods during the trial. The participants will be asked to comment on the requirement in terms of: 1. Ability to perform the function using the prototype; 2. Importance of the requirement; 3. Phrasing of the requirement; 4. Category for the requirement; 5. Other.

Identifier	OBJ-06.09.03-VALP-0060.0021 OBJ-06.09.03-VALP-0060.0031 OBJ-06.09.03-VALP-0060.0041
Objective	Gain an initial Safety Insight into the Remote Provision of ATS under the normal conditions experienced during the shadow mode trials. Gain an initial Safety Insight into the Remote Provision of ATS under the abnormal conditions experienced during the shadow mode trials. Gain an initial Safety Insight into the Remote Provision of ATS under the degraded conditions experienced during the shadow mode trials.
Indicator	ATCO opinion on safety during the range of conditions experienced during the trials.

	ATCO ability to perform tasks safely under degraded conditions.
Assessment Method	A range of "safety scenarios" will be drawn up along with proposed procedures. The procedures will include: a. Procedures to follow during abnormal scenarios (including degraded mode). b. Procedures to follow for using equipment during normal conditions (which may bring safety benefits). As many scenarios as possible will be observed or simulated during the trial. Trial participants will be asked to give their subjective feedback on their safety perception during the scenarios.

Identifier	OBJ-06.09.03-VALP-0060.0061
Objective	To assess the impact of the Remote Tower Concept on TWR ATCO Human Performance under both good and limited visibility conditions, plus day and night time operations in terms of: 1. Situation awareness 2. Trust
Indicator	**Situational Awareness.** SASHA questionnaire ratings and subjective feedback. ATCO identification of scripted events during the trials. **Trust** SATI questionnaire plus subjective feedback
Assessment Method	**Situational Awareness Rating.** Controllers will be asked to fill in the SASHA questionnaire following each session in order to obtain an absolute measure of situation awareness. For ATCO situation awareness to be considered to be at an acceptable level, the rating obtained must be above a predefined value on the rating scale. Further information relating to situation awareness will be obtained from bespoke questionnaires and/or debriefs following each sessions. In addition, certain events e.g. an object on the runway / taxiway will be scripted into sessions to obtain a more objective measure of situation awareness. ATCOs will be observed during the session to see if they identify the obstruction or not. The ATCOs will be then questioned in the post session debrief about the scripted events as well as an other observations made relating to situation awareness. Assessments will be done under both good and limited visibility conditions as well as for daytime and night time operations. **Trust Rating** Controllers will be asked to fill in the SATI rating questionnaire, at the end of the trial. For the level of trust to be considered at an acceptable level, the rating obtained must be above a predefined value on the rating scale. Subjective ATCO feedback through debrief and questionnaire on trust, linked to the influencing factors and platform components e.g. technical enablers

Identifier	OBJ-06.09.03-VALP-0060.0062
Objective	To assess the range of ATC functions that can be performed using the initial prototype, and identify any additional issues that may contribute to the HP Task Analysis.
Indicator	The number of functions and/or tasks that can be performed when providing ATS remotely to a single aerodrome.
Assessment Method	A generic task analysis of current operations has been conducted to describe controllers' roles and tasks in small aerodromes under normal operational conditions. An initial attempt to identify the changes of controllers work resulting from remote tower operations will be conducted prior to the trials using the baseline task

	analysis of current on-site operations and input from operational subject matter experts familiar with the remote tower concept. The trials will be used to verify the identified changes to ATCO/AFISOs roles, tasks and working method under remote tower operations. Information relating to task changes will be gained from observations made during the trials as well as post-trial interviews and / or walk-throughs with the ATCOs. For more information relating to the Task Analysis see Annex 1. Additional potential issues that may be associated with the changes will be identified.

Identifier	OBJ-06.09.03-VALP-0060.0071
Objective	To assess the Acceptability of the initial working environment to ATCO, when providing Remote ATS to a Single Aerodromes.
Indicator	ATCO feedback on acceptability of: 1. Visual reproduction (via display screens) 2. Controller working position 3. Control room 4. Remote facility
Assessment Method	Controllers will be questioned on the following areas (through semi-structured debriefs and/or bespoke questionnaires): 1. Visual reproduction (via display screens) a. Definition b. Contrast (within screen, across screens) c. Viewing angle (human to screen, camera to aerodrome) d. Refresh rate e. Screen position and size. f. Configurability 2. Controller working position a. Integration of CWP and equipment b. Ergonomics c. Functionality d. Ease of use of equipment 3. Control room a. Size b. Lighting c. Ventilation / temperature d. Noise 4. Remote facility a. Location b. Staff presence

Identifier	OBJ-06.09.03-VALP-0060.0072
Objective	Gain an initial insight into the impact of the Remote Provision of ATS on ATCO roles tasks & responsibilities
Indicator	ATCO feedback on acceptability of the remote tower concept in general as well

	as the roles, responsibilities and task allocation.
Assessment Method	ATCO will be asked to give feedback on their opinion of the acceptability of the remote tower concept for single aerodromes in general and more specifically on the roles, responsibilities and task allocation as seen in the remote tower trials. This feedback will be obtained using either a bespoke questionnaire and / or semi-structured debriefs

Identifier	OBJ-06.09.03-VALP-0060.0101
Objective	To assess the usefulness and utility of prototype features, functions and technologies for integration into future trial platforms e.g. High Definition Cameras, video compression software, IR cameras.
Indicator	ATCO feedback on usefulness and utility of prototype features
Assessment Method	In some runs, ATCO will be asked to focus on new or emerging technologies not considered as mature as the rest of the platform. They will be asked to provide feedback for improvements or integration into main platform and subsequent use in later trials.

4.1.1.5 Validation scenarios

4.1.1.5.1 Reference & Solution Scenarios

This trial is a Live trial with live traffic it is not possible to run a reference and solution scenario that will be equal within the trial. It is not possible to compare the services because there is no service provided at the moment.

4.1.1.5.2 Airport Information

Ängelholm-Helsingborg Airport (ESTA)

Environment

- Ängelholm 23,200 inhabitants in 2010
- Helsingborg 97,000 inhabitants in 2010

Airport Layout

- 56°17′46″N 012°50′50″E
- 7km from Ängelholm, 34km Helsingborg
- 1 runway 14/32
- 1945m (6381ft)
- Elevation 68ft (21m)
- 12,500 movements at the Airport (Crossing traffic through CTR/TMA not counted for) and totally 376,000 passengers in 2010

Airport Technologies

- NDB ILS RWY 14
- RNAV (GNSS), NDB DME RWY 32
- 14/32 PAPI
- RWY 14 CAT1 approach, THR, RWY edge, RWY end lights
- RWY 32 THR, RWY edge, RWY end lights

Airspace Characteristics

- Obstacles 6NM SE Airport 2615 FT MSL

- TMA/CTR Class C

Procedures

- SID and STAR
- VFR Holdings: Hjärnarp, Råbocka, Rönne, Vejbystrand
- Right hand circuit RWY 32

Air Traffic Services at ATS Ängelholm (ESTA)

The following services are performed in ESTA TWR:

- Aerodrome control service at Ängelholm airport and within ESTA CTR
- Approach control service, including radar, within ESTA TMA below FL95 in sector A and below FL65 in sector B
- Flight information service
- Alerting service
- METOBS service

The services are normally accomplished by a single controller thus the tower is manned by one controller (AD) with the possibility to open up an extra position (T) during periods of higher traffic. It is the responsibility of the AD controller to ask for opening of the T position if the traffic demand requires radar vectoring of more than one aircraft simultaneously or due to other activities.

All ATC is performed in the tower, that is located SW of the manoeuvrings area

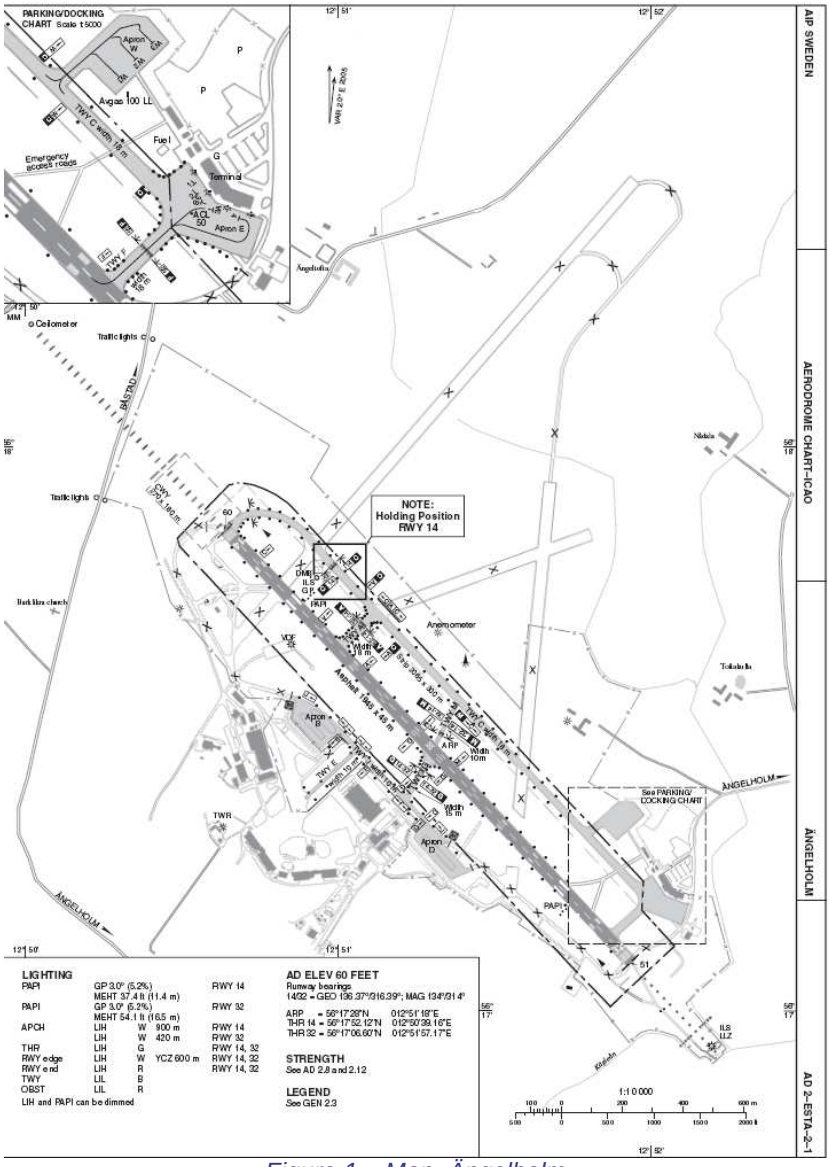

Figure 1 – Map, Ängelholm

4.1.1.5.3 Airspace Information

4.1.1.5.4 Traffic Information

Traffic will be as occurs in real operations. The traffic mix is anticipated as follows:

- Schedule and charter IFR traffic: B737/MD80/A320/AT72
- Business Aviation: Different Dassault Falcon and Cessna Citation models
- General aviation: Piper Cherokees, Cessna 172, Diamond 40, Cirrus SR20
- Non-standard traffic: IFR School flights that makes continues NDB Approaches.
- Touch-and –go landings (TGL)/ School flights by Aviation University, based in nearby Ljungbyhed (ESTL)
- Crossing VFR flights through CTR, mainly north /south (and v.v.) along sea shore.

- Local helicopter flights in CTR/TMA.

4.1.1.5.5 Trial scenarios

During any particular trial day, the scenarios will depend on what is happening in real operations. As noted in Section 3.6, additional scripted, recorded or arranged scenarios may be used. The purpose of these scenarios is to get validation result from specific situations such as:

- More than 1 simultaneously departing aircraft;
- More than 1 simultaneously arriving IFR flight;
- 2 simultaneously operating training flights, making departures, approaches, missed approaches and landings;
- Mix of IFR and VFR flights.

A school flight will be hired to fly locally in the control zone and traffic circuits. This will occur at the same time each of the 2-day patterns.

4.1.1.5.5.1 Additional info

None.

4.1.1.6 Exercise Assumptions

None.

4.1.1.7 Exercise Tool, Validation Technique and/or Platform

The Validation Technique will be Passive Shadow Mode.

As stated in the E-OCVM, this is a validation technique in which the new system is given live feeds in the operational environment and runs in parallel to the operational system. The new system will be non-interfering and will not play an active part in the ATM system.

The controller will follow the Ängelholm traffic from the RTC CWP.

4.1.1.8 Entrance criteria

The following are the entrance criteria for the trial:

- The full number and rating of requested controllers are available;
- Approval for the trial has been granted by the local service provider;
- The prototype platform is tested/accepted.

4.1.1.9 Exit Criteria

The trial will be deemed to be complete when:

- Full 15 days of shadow mode service have been completed;
- A sufficient range of evidence and data has been collected

4.1.1.10 Validation Requirements

4.1.1.10.1 Validation System Under Test Requirements

The top level Validation SUT Requirements are listed in Section 3 and apply to VP-057.

4.1.1.10.2 Other Validation Requirements

The following are additional validation requirements for this trial:

- The trial ATCO will have to have familiarity with the local aerodrome (Ängelholm). Those who are coming from other aerodromes will spend half a day at Ängelholm to familiarise themselves with the aerodrome.

4.1.1.11 Platform Configuration

The visual reproduction from the nine cameras, situated on top of the Ängelholm tower, will be displayed on 42 inches monitors at the RTC, giving a 360-degree view. A Pan Tilt Zoom Camera will be mounted on top of the camera house. Ambient noise from the airport will come from two microphones fitted at the tower, feeding two loudspeakers at the RTC. The controller working position will be situated about 2 m from the monitors, allowing a 2,5 m radius need totally for the CWP.

- Cameras:
  - Totally 9 cameras mounted on top of the local Tower that covers a 360˚ view. 4-6 cameras with high resolution covering runway, northern traffic circuit, runway finals and 3-5 cameras with lower resolution (but still High Definition) covering the remaining area.
  - One Pan Tilt Zoom camera, replacing the binocular in a normal Tower
- Infrared camera:
  - Infrared imaging provides a thermo graphic representation of the focused area. This could be used as a supplement to the regular cameras in a remote tower OTW view, to be used in darkness or in fog
- Display Screens:
  - 9 x 42” LCD monitors
  - Automatically reduce contrast differences in an OTW view
    - Between cameras
    - Between ground and sky
- The CWP is equipped with the following:
  - Voice Communication System (VCS)
  - UHF radio
  - Aerodrome Ground Lights (AGL)
  - NAV equipment control panel (ILS)
  - Flight Progress Board (FPB)Radar Data Processor (RDP)
  - Airport Message Processing (AMP)
  - PTZ camera control unit and display
  - System Control Panel
  - Ambient sound loudspeakers
  - Direct telephone RTC – TWR
- CWP HMI:
  - Further development of the HMI, previously used in ART/ROT projects. Delivered by WP 12.4.7.
- Separate supervision functions outside CWP:
  - Technical Monitoring
  - Alarms
  - Technical Logging

4.1.1.12 Links to other Validation Exercises

As stated in Section 3.1 (Validation Overview) the validation strategy is based on a number of integrated, incremental, steps. The building of the overall concept is stepwise in that the concepts and technical enablers are initially established in the Single Remote Tower environment, before being

used in Contingency/Multiple Tower environments. The development of the technical enablers is also step-wise.

Therefore, this validation exercise is on the critical path for all other P06.09.03 Validation activities. All subsequent activities will re-use some or all of the components developed for this activity.

In addition to the validation activities, the trial objectives have been partially derived from aspects of the Human Performance and Safety Plan. In return, outputs and results from the trial will be fed into the HP and Safety assessments.

4.1.1.13 Dependent and Independent variables

Although the trial is a shadow mode trial and a full exercise design is not feasible, some variables and levels are anticipated, including:

- Flight Rules:
  - Instrument Flight Rules
  - Visual Flight Rules
- Meteorological Conditions:
  - Various Visibility and Cloud Base.
- Time of operations:
  - Day Time
  - Dawn and Dusk
  - Night Time

4.1.2 Exercises Planning and management

4.1.2.1 Activities

4.1.2.1.1 Preparatory activities

In line with the general milestone identified in Section 3.9, the milestones relevant for this trial are:

Ref.	Milestones	Dates*	Delivering Project
M1	**Requirements produced**	31/03/2011	06.09.03
M2	**Prototype developed**	15/08/2011	12.04.07
M5	**Platform integrated**	15/08/2011	12.04.07
M6	**Platform technically accepted**	15/09/2011	12.04.07
M7	**Platform Configured**	15/10/2011	06.09.03
M8	**Exercise completed**	15/11/2011	06.09.03
M9	**Assessment Completed**	28/02/2012	06.09.03

4.1.2.1.2 Execution activities

The trial will run from 24th October until 11th November 2011.

4.1.2.1.3 Post execution activities

Following the trial, the main focus will be on analysis and reporting of the trial. The trial report is foreseen for delivery in Q1 2012, in order that it can be considered during planning for Trial 2.

Post-trial workshops may be organised to discuss main findings with the participants. A post-trial visitor day will also take place.

4.1.2.2 Roles & Responsibilities in the exercise

The following table shows the different teams involved in the experiment, their responsibilities, and names for participants in the different teams. Underlined names are team leaders.

Actor	Role/responsibility	Name(s)
Project leader		Pierre Ankartun, NORACON
Tower ATCO with ESTA rating	RTC Controller during Passive shadow mode	L-G Bengtsson Eva Ellerstrand Carina Larsson Björn Nilsson
Tower ATCO without ESTA rating	RTC Controller during Passive shadow mode	Mikael Henriksson, ESNZ Marie Hansson, ESNZ Rolf Svensson, ESNZ Mats Olsson, ESNN Lars Bilander, ESNN Olov Esberg, ESNO Peter Brändström, ESNU Nils Homp, ESSV
Validation team	Validation Leader RTC Validation Analysis and reporting	Thomas Svensson, NORACON Göran Lindqvist, NORACON Mattias Abel, NORACON Conor Mullan, NORACON
Safety Team	Specific Safety Assessments and report contributions.	Marta Llobet Lopez, ECTL
HP Team	Specific Human Performance Assessments and report contributions.	Catherine Chalon Morgan, ECTL Billy Josefsson, NORACON
Trial team, technical	Validation technical support	Anders Rhodin, ELTEL Mattias Johansson, NATMIG
Verification team	Platform evaluation and Platform verification	Bengt-Arne Skoog, NATMIG Lars Lundqvist, NATMIG Anders Rhodin, ELTEL

4.1.2.3 Training

Non Ängelholm ATCOs will have a one day familiarisation at the local Ängelholm Tower. All ATCOs will well in advance of the trials receive a package of information including WP 6.9.3 OSED and this validation plan. Before start of the trials each ATCO will fill in a questionnaire, to ensure that each individual ATCO feel confident enough to take part of the validation. Throughout the validation an introduction to each part of the validation will be done by the validation leader. A detailed training plan will be conducted as follows:

Day 1: Familiarization at Ängelholm Tower, for non-ESTA ATCO´s.

Scheduled time: 09.45 – 16.45

Objective: The ATCO shall be familiar with layout of aerodrome and airspace at Ängelholm, in order to be able to validate the RTC platform in trial 1.

The non-ESTA ATCO shall observe:

- ATCO ESTA work tasks.
- Identify when an aircraft normally will be observable/visible from normal tower, e.g. on final, approaching the aerodrome on visual approach (downwind/base), aircraft in traffic circuit.
- Vehicles on different parts of the manoeuvring area

Day 2: Training in the use of RTC/CWP equipment at the RTC-platform at Malmö ATCC (all ATCO´s)

Time frame: Approx. 2 hours

Objective: The ATCO shall have the knowledge needed to handle the equipment in RTC CWP and have relevant knowledge of the upcoming trial (validation), in order to take part in the validation trial

The ATCO will be introduced by the "trial supervisor" how the validation will be performed.

The ATCO will be introduced to the RTC CWP. Practical training and familiarization will be done on the all the involved sub functions in the CWP i.e.:

- Visual reproduction, including adjustments
- Pan-tilt-zoom (PTZ) camera
- Infra-red camera
- Surveillance screen
- Voice communication system (VCS)
- FPB

The Trial-supervisor will go through the procedures connected with the trial incl. templates, expected traffic, met conditions, aim of the 6.9.3 project, practicalities etc.

Quality assurance: The ATCO will, after completed training, fill in a questionnaire, indicating that each individual ATCO has been sufficiently trained and feel confident to take part in the validation trial.

4.1.2.4 Visitors and Observers

Due to the size in the Remote Facility "dome", space for observers and any visitors is extremely limited. In addition, it is preferable to keep the facility free from distraction and to only allow trial controllers and main observers.

To still allow for extra observers and other visitors, an external observation station will be set up in the Remote Tower room. The internal activity of the RTF (including ATCO, CWP and Runway/Apron screens) will be shown on the observer display and sound from the RTF will also be relayed. The observation station is shown below.

Figure 2 - Visitor Observation Station

4.1.2.5 Time planning

Validation SESAR WP 06.09.03 Trial 1 ATCO Schedule Ängelholm Tower familiarisation: 09.30-16.30 Malmö RTC pm: 10.30-20.00 Malmö RTC am: 06.15-13.00						
Date	**Name**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
24th Oct - 28th Oct 2011 Week 43	Mikael H, ESNZ	Ängelholm Tower	Malmö RTC pm	Malmö RTC am		
	Björn N, ESTA		Malmö RTC pm	Malmö RTC am		
	Marie H, ESNZ			Ängelholm Tower	Malmö RTC pm	Malmö RTC am
	Lars B, ESNN			Ängelholm Tower	Malmö RTC pm	Malmö RTC am
	Observer ESTA		13.00-20.00			08.15-13.00
31st Oct - 4th Nov 2011 Week 44	Nils H, ESSV	Ängelholm Tower	Malmö RTC pm	Malmö RTC am		
	Eva E, ESTA		Malmö RTC pm	Malmö RTC am		
	Rolf S, ESNZ			Ängelholm Tower	Malmö RTC pm	Malmö RTC am
	Olov E, ESNO			Ängelholm Tower	Malmö RTC pm	Malmö RTC am
	Observer ESTA		13.00-20.00			08.15-13.00
7th Nov - 11th Nov 2011 Week 45	Peter B, ESNU	Ängelholm Tower	Malmö RTC pm	Malmö RTC am		
	L-G B, ESTA		Malmö RTC pm	Malmö RTC am		
	Carina L, ESTA				Malmö RTC pm	Malmö RTC am
	Mats O, ESNN			Ängelholm Tower	Malmö RTC pm	Malmö RTC am
	Observer ESTA			08.15-13.00	13.00-20.00	

Controller Key, Rating at											
ESNN	Sundsvall ATS	ESNO	Örnsköldsvik ATS	ESNU	Umeå ATS	ESNZ	Östersund ATS	ESSV	Visby ATS	ESTA	Ängelholm ATS

4.1.2.6 Risks

There are no specific risks to this trial. The general risks are those that apply for any shadow mode trial and are:

1. The actual traffic / conditions experienced do not offer enough to complete the assessment.
2. The controllers do not feel able to give opinion, not having used the system for actual control.

4.1.2.7 Errors and Observation handling

N/A

4.1.3 Analysis Specification

4.1.3.1 Data collection methods

The collected data will mainly be qualitative, describing the participating controllers' notions and feelings concerning the validation objectives. Certain quantitative data such as load on the frequency and workload will be used in conjunction with the qualitative data for the interpretation of the results.

The following assessment methods and techniques will be used:

1. Observation during the trial
2. Questionnaires and debriefing
3. Judgmental technique

A Validation leader/ observers will document how operators are solving their tasks, especially for critical situations. Critical situations may be analysed, using the recorded scenarios.

Data from the Sundsvall/ Örnsköldsvik implementation project may also be used, as a complement to WP 6.9.3 trials.

4.1.3.2 Analysis method

The inputs to the analysis will be the simulation objectives, the metrics, questionnaire responses, debrief feedback and observations. For certain analysis the inputs to the simulation will be used as a starting reference point (e.g. the OSED).

Given the scope and design of the trial a lot of analysis will be subjective.

4.1.3.3 Data logging requirements

N/A

4.1.4 Level of Representativeness/ limitations

There limitations of the exercise again focus on the limitations related to any shadow mode trial and are:

1. The actual traffic / conditions experienced do not offer enough to complete the assessment.
2. The controllers do not feel able to give opinion, not having used the system for actual control.

4.2 Single TWR Trial 2 (EXE-06.09.03-VP-057) Plan

4.2.1 Exercise Scope and Justification

The Remote Provision of ATC to a Single Aerodrome, assessed during a Passive Shadow Mode Trial.

The overall aim of this second trial is to build upon the technical and operational findings of EXE-06.09.03-VP-056 and address objectives and scenarios not already addressed or concluded upon in VP-056. The trial will also look at various technical configurations to gain an understanding of the different operational service levels possible using different technical enablers.

4.2.1.1 Exercise Level

The Exercise is at the level of: ATM System

4.2.1.2 Description of the Operational concept being addressed

As with VP-056, the concept being addressed is the Remote Provision of ATS to a Single Aerodrome, described in the OSED for Remote Provision of ATS (Section 3.1).

The ATCO will not be located at the aerodrome and will again be located at the Remote Tower Centre in Malmö. The Remote ATCO will perform ATS tasks using the CWP in the Malmö Remote Tower facility. The visual surveillance will be provided by a reproduction of the OTW view, by using visual information capture.

Nine cameras will be placed on top of the local tower (Ängelholm), with each having a 40° visual view, which is presented on LCD monitors in the RTC.

View and sound from the local tower will be captured with digital video cameras and microphones. The actual airport systems, e.g. runway and taxi lights, will be connected to the network with relevant data displayed in the RTC. Data will be transmitted over a communication network between the actual airport and the RTC.

The main differences compared to VP-056 are as follows:

- Technical features:
  - Six new high definition cameras, representing a 240^{o} view along the runway (camera positions are also rotated slightly compared to VP-056);
  - Additional fixed cameras placed in “hotspots”;
  - Improved picture processing and better quality visual reproduction;
  - New PTZ camera, with improved HMI;
  - Camera tracking;
  - Aircraft label overlays;
  - Inclusion of an e-Strip system;
  - Off-set rear screens showing view “behind” tower. Screens will be lower resolution with lower frame rate.
- Technical Configuration – instead of a single, constant technical configuration, different configurations will be used:
  - Basic Configuration – only basic visual reproduction included and no radar surveillance included;
  - Advanced Configuration – all technical enablers included;
  - Intermediate Configuration(s) – an as yet undetermined configuration or set of configurations. The plan during the trial will be to use any spare time to allow ATCO to suggest configurations they wish to try out.

4.2.1.3 Stakeholders and their expectations

The stakeholder expectations for VP-057 are the same as for VP-056. See section 4.1.1.3 for details.

4.2.1.4 Validation objectives and hypothesis

4.2.1.4.1 Exercise Validation Objectives

The following validation objectives are lower level derivations of the high level validation objectives stated in Section 3.

Identifier	OBJ-06.09.03-VALP-0060.0012
Objective	To gather ATCO opinion on the level of service that can be supplied under a range of technical configuration options.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0012	The requirement for the various technical enablers with respect to service levels provided is known for the scenarios experienced during the trial.

Identifier	OBJ-06.09.03-VALP-0060.0022
Objective	Support the development of working methods & procedures for normal situations related to Visual Separation application, use of Infra-Red, and weather observations

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0022	The working methods & procedures for normal situations related to Visual Separation application, use of Infra-Red, and weather observations have been tested. The working methods & procedures for normal situations related to Visual Separation application are accepted or, where not, suitable suggestions for improvement have been identified.

Identifier	OBJ-06.09.03-VALP-0060.0032
Objective	Support the development of working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft)

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0032	The working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft) have been tested. The working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft) are accepted or, where not, suitable suggestions for improvement have been identified.

0060.0060.0060.0060.

Identifier	OBJ-06.09.03-VALP-0060.0033

Objective	Assess, from a safety viewpoint, the impact of the ATCO Situations Awareness on: detecting hazardous situations on the area of control inducing more or additional hazardous situations

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0033	The ATCO situational awareness is not decreased or has no negative impact on the ability to detect hazardous situations in the area of control and/or inducing more or additional hazardous situations

Identifier	OBJ-06.09.03-VALP-0060.0042
Objective	Support the development of working methods & procedures in degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information)

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0042	The working methods & procedures for degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information) have been tested. The working methods & procedures for degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information) are accepted or, where not, suitable suggestions for improvement have been identified.

Identifier	OBJ-06.09.03-VALP-0060.0051
Objective	Assess the utility of enhanced visual features, by determining their impact on: the human performance, in particular in terms of situational awareness the working methods and procedures, in particular for visual separation and for the use of the infrared.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN02.5006	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0051	The enhanced visual features have a positive impact on human performance.

Identifier	OBJ-06.09.03-VALP-0060.0061
Objective	To assess the impact of the Remote Tower Concept on TWR ATCO Human Performance under good and limited visibility conditions and during the day and night, in terms of: Situation awareness Trust

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN02.5006	N/A

Identifier	Success Criterion

CRT-06.09.03-VALP-0060.0061	ATCO situation awareness must be shown to be within acceptable limits (the value of the 'acceptable limits' will be defined with regard to the tool employed to assess situation awareness). The Remote ATCO is able to detect potential conflicts, hazardous situations and other scripted events that may impact their work, on the airport surface and in the vicinity of the airport under good and limited visibility conditions. Any instances of Human Performance degradation are either mitigated or acceptably offset by improvements in other areas. ATCOs reported level of trust must be shown to be within acceptable limits (the value of the 'acceptable limits' will be defined with regard to the tool employed to assess trust).

Identifier	OBJ-06.09.03-VALP-0060.0073
Objective	Assess the acceptability of single remote tower operations for ATCOs, in terms of: The concept in general; HMI (visual reproduction); HMI (Advanced Visual Features); HMI (CWP); The Working Environment.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0073	The Remote Provision of ATS to a single aerodrome concept, is usable/acceptable to the ATCO in terms of: The concept in general; HMI (visual reproduction); HMI (Advanced Visual Features); HMI (CWP); The Working Environment.

Identifier	OBJ-06.09.03-VALP-0060.0074
Objective	Obtain feedback relating to the remote provision on ATS on ATCO roles, responsibilities & task allocation

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0074	Trial feedback indicates that ATCO find the roles, responsibilities & task allocation acceptable.

Identifier	OBJ-06.09.03-VALP-0060.0080
Objective	To validate information and assumptions that will be used in any Business Case Transversal Assessments, relating to the Cost Effectiveness of Remote Provision of ATS to Single low to medium density airports

Identifier	OBJ-06.09.03-VALP-0060.0091
Objective	To obtain ATCO feedback and opinion on the impact of the Remote Tower Concept on airport Capacity in terms of: Impact of different weather conditions; Impact of time of day; Impact of varying opening hours.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0091	An initial understanding of the impact of the impact of the Remote Tower Concept on airport Capacity is gained.

Identifier	OBJ-06.09.03-VALP-0060.0102
Objective	To assess the utility and usability of enhanced visual features e.g. automatic a/c identification & tracking function, etc.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1001	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1003	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2001	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN03.3001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0102	The ATCO can easily use the enhanced visual features and consider them to be useful for their tasks.

4.2.1.4.2 Exercise Indicators and Metrics

Identifier	OBJ-06.09.03-VALP-0060.0012
Objective	To gather ATCO opinion on the level of service that can be supplied under a range of technical configuration options.
Indicator	ATCO agreement/ comment/ consensus on the list of services to be provided. ATCO opinion on safety during the range of conditions experienced during the trials. ATCO ability to perform tasks safely under various/ degraded conditions.
Assessment Method	Assess ATCO on: 1. Subjective feedback on ability to provide sufficient services under various (degraded) conditions; 2. Subjective feedback on ability to perform tasks safely under various (degraded) conditions.

Identifier	OBJ-06.09.03-VALP-0060.0022 OBJ-06.09.03-VALP-0060.0032 OBJ-06.09.03-VALP-0060.0042
Objective	Support the development of working methods & procedures for normal situations related to Visual Separation application, use of Infra Red, and weather observations Support the development of working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft) Support the development of working methods & procedures in degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information)
Indicator	Procedures agreed on based on talk-throughs conducted with ATCOs Assess ATCO feedback on usefulness and utility of Infra Red features, the visual system, and visual separation application. Obtain ATCO opinion on working methods & procedures under (degraded) conditions. **Support the development of working methods & procedures in degraded mode situations**

	The following scenarios may be presented during the trial: a. Type of failure mode (Black-out, Frozen, Corrupted, Non-usable) b. Number of screen affected (One screen, Several screens, All screens) c. Traffic presence on the airport and its vicinity when the failure occurs (Presence/Absence of traffic) d. Light conditions on the airport and its vicinity when the failure occurs (daytime, darkness)
Assessment Method	A range of "safety scenarios" will be drawn up along with proposed procedures. The procedures will include: a. Procedures to follow during abnormal scenarios (including degraded mode). b. Procedures to follow for using equipment during normal conditions. c. Feedback for improvement or integration for Visual Separation application, infrared camera, and visual system. As many scenarios as possible will be observed or simulated during the trial. Trial participants will be asked to give their subjective feedback on their safety perception during the scenarios. **Visual Separation** Assess the capability of applying reduced separation using the Visualisation Reproduction System. 1. Ask the controller to estimate the distance between concerned aircraft using only the visualisation reproduction system 2. Record the distance based on surveillance information for the same pair of aircraft at the same time the estimation has been done. Apart from these measures (or replacing them if not possible to be done), this item could be included in the debriefing to be conducted after each session or the corresponding questionnaire. **Infra Red View** Assessment of: a. The conditions of using IR: based for example in some weather parameters provided in the METAR, or based on a "daily time of light" table. b. Which parts of the manoeuvring area needs more the use of IR (as it cannot be used for the whole aerodrome surface) Collect the feedback from ATCOs during the debriefing / using a questionnaire after each session. **Weather Observations** - Record if the ATCO is able to detect the object on the RWY **C. Degraded mode** In total there are 48 potential scenarios that can be assessed. *Detection phase*: - time to detect the failure by the controller This is to be done, when relevant, with and without alarm from the system *Transition phase*: - time to decide on the application of the degraded mode procedure - time to apply the degraded mode procedure, in terms of actions to be done by the ATCO on the equipment and actions related to traffic management in order to achieve an stable "degraded situation".

	- Feedback on the need of surveillance information to effectively apply corresponding degraded mode procedure in this transition phase - Feedback on the need of switch-off all/the affected screens. *Degraded situation phase*: - feedback on how long the degraded situation can be maintained - Feedback on the need of surveillance information to effectively apply corresponding degraded mode procedure - Feedback on the need of switch-off all/the affected screens. Recovering phase: - Time to decide on stop applying degraded mode procedures - Time to apply the recovering procedure, in terms of actions to be done by the ATCo on the equipment and actions related to traffic management in order to achieve a nominal situation again

Identifier	OBJ-06.09.03-VALP-0060.0033
Objective	Assess, from a safety viewpoint, the impact of the ATCO Situations Awareness on: • detecting hazardous situations on the area of control • inducing more or additional hazardous situations
Indicator	**Situational Awareness:** SASHA questionnaire ratings and subjective feedback ATCO identification of scripted events during the trials
Assessment Method	**Situational Awareness rating.** Controllers will be asked to fill in the SASHA questionnaire following each session in order to obtain an absolute measure of situation awareness. For ATCO situation awareness to be considered to be at an acceptable level, the rating obtained must be above a predefined value on the rating scale. Further information relating situational awareness will be obtained from bespoke questionnaires and/or debriefs following each session. In addition, certain events e.g. an object on the runway/ taxiway will be scripted into sessions to obtain a more objective measure of situational awareness. ATCOs will be observed during the session to see if they identify the obstruction or not. The ATCOs will be then questioned in the post session debrief about the scripted events as well as another observation made relating to situation awareness. Assessments will be done under both good and limited visibility conditions as well as for daytime and night time operations.

Identifier	OBJ-06.09.03-VALP-0060.0051
Objective	Assess the utility of enhanced visual features, by determining their impact on: • the human performance, in particular in terms of situational awareness • the working methods and procedures, in particular for visual separation and for the use of the infrared
Indicator	ATCO feedback on utility and impact assessment of Human-Machine cooperation on ATCO in terms of: 1. Situational Awareness 2. Working methods & procedures e.g. visual separation and use of infrared
Assessment Method	**Situational Awareness:** SASHA questionnaire ratings and subjective feedback

Identifier	OBJ-06.09.03-VALP-0060.0061
Objective	To assess the impact of the Remote Tower Concept on TWR ATCO Human Performance under good and limited visibility conditions and during the day and night, in terms of: I. Situation awareness II. Trust
Indicator	**Situational Awareness:** SASHA questionnaire ratings and subjective feedback ATCO identification of scripted events during the trials **Trust** Madsen & Gregor (2000) questionnaire for acceptability
Assessment Method	**Situational Awareness rating.** Controllers will be asked to fill in the SASHA questionnaire following each session in order to obtain an absolute measure of situation awareness. For ATCO situation awareness to be considered to be at an acceptable level, the rating obtained must be above a predefined value on the rating scale. Further information relating situational awareness will be obtained from bespoke questionnaires and/or debriefs following each session. In addition, certain events e.g. an object on the runway/ taxiway will be scripted into sessions to obtain a more objective measure of situational awareness. ATCOs will be observed during the session to see if they identify the obstruction or not. The ATCOs will be then questioned in the post session debrief about the scripted events as well as another observation made relating to situation awareness. Assessments will be done under both good and limited visibility conditions as well as for daytime and night time operations. **Trust Rating** Controllers will be asked to fill in the Madsen & Gregor (2000) rating questionnaire, For the level of trust to be considered at an acceptable level, the rating obtained must be above a predefined value on the rating scale. Subjective ATCO feedback through debrief and questionnaire on trust, linked to the influencing factors and platform components e.g. technical enablers.

Identifier	OBJ-06.09.03-VALP-0060.0073
Objective	Assess the acceptability of single remote tower operations for ATCOs, in terms of: • The concept in general • HMI (visual reproduction) • HMI (Advanced Visual Features) • HMI (CWP) • The Working Environment
Indicator	Obtain ATCO feedback on acceptability of: 1. The concept the remote facility 2. Visual reproduction 3. Controller working position 4. Controller working environment
Assessment Method	Controllers will be questioned on the following areas (through semi-structured debriefs and/or bespoke questionnaires): 1. The concept in general: a. Acceptability of the concept b. Roles, responsibilities and tasks

	c. Opinion on ability to perform tasks safely 2. HMI (visual reproduction): a. Definition b. Contrast (within and across screens) c. Viewing angle (human to screen, camera to aerodrome) d. Refresh rate e. Screen position and size f. Configurability 3. Controller Working Position: a. Integration of CWP and equipment b. Ergonomics c. Functionality d. Ease of equipment use 4. Controller working environment: a. Size b. Lighting c. Ventilation/temperature d. Noise

Identifier	OBJ-06.09.03-VALP-0060.0074
Objective	Obtain feedback relating to the remote provision on ATS on ATCO roles, responsibilities & task allocation
Indicator	ATCO subjective feedback on acceptability of the roles, responsibilities and task allocation.
Assessment Method	ATCO will be asked to give feedback on their opinion of the acceptability of the remote tower concept for single aerodromes in general and more This feedback will be obtained using either a bespoke questionnaire and/or semi-structured debriefs. Specifically on the roles, responsibilities and task allocation as seen in the remote tower trials.

Identifier	OBJ-06.09.03-VALP-0060.0091
Objective	To obtain ATCO feedback and opinion on the impact of the Remote Tower Concept on airport Capacity in terms of: • Impact of different weather conditions; • Impact of time of day; • Impact of varying opening hours
Indicator	Ask for ATCO feedback and opinion on the impact of the Remote Tower Concept on airport capacity
Assessment Method	Assess the impact of Remote Tower Concept by asking ATCOs their subjective feedback on following topics: 1. Impact of different weather conditions 2. Impact of time of day 3. Impact of varying opening hours

Identifier	OBJ-06.09.03-VALP-0060.0102
Objective	To assess the utility and usability of enhanced visual features e.g. automatic a/c

	identification & tracking function, etc.
Indicator	Obtain ATCO feedback on usefulness and utility of enhanced visual features
Assessment Method	In some runs, ATCO will be asked to focus on the features and to provide feedback for improvements or integration.

4.2.1.5 Validation scenario

The Validation Scenario is the same as for VP-056 and is described in Section 4.1.1.5. As in VP-056, a small VFR aircraft (Cherokee) from the local flying school will be hired to perform specific manoeuvres.
Recorded scenarios will also be used in this trial to assess the Remote Tower platform in conditions that cannot be shown live at the moment of the trial simulation. These recorded scenarios will be used to assess the platform in abnormal situations, or adverse weather conditions. For example, a recorded scenario could be night time scenarios, foggy conditions, or an altered traffic scenario.

4.2.1.6 Exercise Assumptions

None.

4.2.1.7 Exercise Tool, Validation Technique and/or Platform

The Validation Technique will be Passive Shadow Mode.

As stated in the E-OCVM, this is a validation technique in which the new system is given live feeds in the operational environment and runs in parallel to the operational system. The new system will be non-interfering and will not play an active part in the ATM system.

The controller will follow the Ängelholm traffic from the RTC CWP.

4.2.1.8 Entrance criteria

The following are the entrance criteria for the trial:

- The full number and rating of requested controllers are available;
- Approval for the trial has been granted by the local service provider;
- The prototype platform is tested/accepted.

4.2.1.9 Exit Criteria

The trial will be deemed to be complete when:

- Full 12 days of shadow mode service have been completed;
- A sufficient range of evidence and data has been collected

4.2.1.10 Validation Requirements

4.2.1.10.1 Validation System Under Test Requirements

The top level Validation SUT Requirements are listed in Section 3 and apply to VP-057.

4.2.1.10.2 Other Validation Requirements

None

4.2.1.11 Platform Configuration

The platform will be configured in two

4.2.1.12 Links to other Validation Exercises

VP-057 builds upon the work done in EXE-06.09.03-VP-056. The outputs of VP-057 will be used by:

- EXE-06.09.03-VP-058 (Remote Provision of AFIS to a Single Aerodrome)

- EXE-06.09.03-VP-059 (Remote Provision of ATS in Contingency, Trial 1)
- EXE-06.09.03-VP-060 (Remote Provision of ATS to Multiple Aerodromes, Simulation)
- EXE-06.09.03-VP-061 (Remote Provision of ATS to Multiple Aerodromes, Trial 1)

4.2.1.13 Dependent and Independent variables

Although the trial is a shadow mode trial and a full exercise design is not feasible, some variables and levels are anticipated. The new variables compared to VP-056 are shown in bold:

- Flight Rules:
  - Instrument Flight Rules
  - Visual Flight Rules
- Meteorological Conditions:
  - Various Visibility and Cloud Base.
- Time of operations:
  - Day Time
  - Dawn and Dusk
  - Night Time
- Technical Configuration:
  - Basic Configuration – only basic visual reproduction included and no radar surveillance included;
  - Advanced Configuration – all technical enablers included;
  - Intermediate Configuration(s) – an as yet undetermined configuration or set of configurations. The plan during the trial will be to use any spare time to allow ATCO to suggest configurations they wish to try out.

4.2.2 Exercises Planning and management

4.2.2.1 Activities

4.2.2.1.1 Preparatory activities

In line with the general milestone identified in Section 3.9, the milestones relevant for this trial are:

Ref.(*)	Milestone	Milestone Date	Delivering Project	Deliverable or Task ID
M1	Requirements produced	15/07/2011	P06.09.03	D02
M2	Prototype developed	17/03/2012	P12.04.07	T011
M3	*Prototypes Integrated*	N/A	N/A	N/A
M4	Platform modified	03/04/2012	P12.04.07	T011
M5	Platform integrated	03/04/2012	P12.04.07	T011
M6	Platform technically	17/04/2012	P12.04.07	D11

	accepted			
M7	Platform Configured	28/04/2012	P06.09.03	T007
M8	Exercise completed	31/05/2012	P06.09.03	T007
M9	Assessment Completed	29/09/2012	P06.09.03	D07

4.2.2.1.2 Execution activities

The trial will run from 7th May 2012 to 25th May 2012.

4.2.2.1.3 Post execution activities

As with VP-056, following the trial, the main focus will be on analysis and reporting of the trial. The trial report is foreseen for delivery in Q2 2012.

Post-trial workshops may be organised to discuss main findings with the participants.

A post-trial visitor day will also take place.

4.2.2.2 Responsibilities in the exercise

The following table shows the different teams involved in the experiment, their responsibilities, and names for participants in the different teams. Underlined names are team leaders.

Actor	Role/responsibility	Name(s)
Project leader	Acting PM 6 9 3	Göran Lindqvist, NORACON
Tower ATCO with TWR ratings	RTC Controllers during Passive shadow mode (one is AFISO)	(all from NORACON) Mikael Henriksson Olof Esberg Martin Emson Caroline Johansson Lars Belander Thomas Karlström Stein Nielsen Ann-Mari Hillstad Mats Olsson Jakob Wikman-Modig René Lull Tord Gustavsson, ETF Emilio Garcia, ATCEUC and IVT Maria Nilsson, IFATCA and IVT
Validation team	Validation Leader RTC Validation Analysis and reporting	Thomas Svensson, NORACON Göran Lindqvist, NORACON Conor Mullan, NORACON
Safety Team	Specific Safety Assessments and report contributions.	Marta Llobet Lopez, ECTL
HP Team	Specific Human Performance Assessments and report contributions.	Catherine Chalon Morgan, ECTL Billy Josefsson, NORACON
Rules and Regulations team	Specific Rules and Regulations Assessments	Anna Wennerberg ECTL Roland Johansson, NORACON
Trial team, technical	Validation technical support	Bengt-Arne Skoog, NATMIG Mattias Johansson, NATMIG

Verification team	Platform evaluation and Platform verification	Bengt-Arne Skoog, NATMIG Lars Lundqvist, NATMIG Mats Landén, ELTEL

4.2.2.3 Training

The participating controllers received a briefing on the first day with the duration of one morning. In this briefing all the technical configurations were explained (Advanced and Basic setup) as well as how to use the various features within the platform, including radar, PTZ Camera, Advanced Camera Viewpoints, Infra Red Camera, e-strip bay, etc. After the training the controllers received a training feedback form to evaluate the training.

4.2.2.4 Time Planning

4.2.2.4.1 Trial Timetable

The trial timetable is show in Table 5 overleaf.

Malmö RTC pm: 10.30-20.00
Malmö RTC am: 06.15-16.00

Date	Name	Monday	Tuesday	Wednesday	Thursday	Friday
7th May-11th May 2012 Week 19	***Validation Leader***	***Thomas S***	***Thomas S***	***Göran L***	***Göran L***	
	René L, EETN	Malmö RTC pm	Malmö RTC am			
	Tord G, ETF	Malmö RTC pm	Malmö RTC am			
	Caroline J, ESMS			Malmö RTC pm	Malmö RTC am	
	Martin E, ESKN			Malmö RTC pm	Malmö RTC am	
14th May - 16th May 2012 Week 20	***Validation Leader***	***Thomas S***	***Thomas S/Göran L***	***Göran L***		
	Mikael H, ESNZ	Malmö RTC pm	Malmö RTC am			
	Emilio G, ATCEUC	Malmö RTC pm	Malmö RTC am			
	Mats O, ESNN		Malmö RTC pm	Malmö RTC am		
	Jakob W, ESMT		Malmö RTC pm	Malmö RTC am		
21th May-25th May 2012 Week 21	***Validation Leader***	***Martin E***	***Martin E/Thomas S***	***Thomas S***	***Martin E***	***Martin E***
	Stein N, AVINOR	Malmö RTC pm	Malmö RTC am			
	Ann Mari H, AVINOR	Malmö RTC pm	Malmö RTC am			
	Maria N, ESNS		Malmö RTC pm*	Malmö RTC am		
	Lars B, ESNN		Malmö RTC pm*	Malmö RTC am		
	Olov E, ESNO				Malmö RTC pm	Malmö RTC am
	Thomas K, EFHK				Malmö RTC pm	Malmö RTC am

*Start time 10.45 due to late arrival

Controller Key, Rating at							
EETN	Tallinn ATS	ESMS	Sturup ATS	ESNO	Örnsköldsvik ATS	ESSV	Visby ATS
EFHK	Helsinki ATS	ESMT	Halmstad ATS	ESNS	Skellefteå	ESTA	Ängelholm ATS
ESKN	Stockholm/ Skavsta	ESNN	Sundsvall ATS	ESNZ	Östersund ATS		

Table 5: Detailed time planning

4.2.2.4.2 Daily Schedule

Day 1			Day 2	
10:30	Introduction		06:15	Daily Briefing
11:30	Lunch		06:30	Validation ATCO 1 + ATCO 2
12:15	HF/Safety/Rules		07:30	Validation ATCO 1
13:00	Practice in RTC ATCO1 + ATCO 2		08:30	Validation ATCO 2
14:30	Validation ATCO 1		09:30	Validation ATCO 1
15:30	Validation ATCO 2		10:00	Validation ATCO 2
16:30	Validation ATCO 1		10:30	Validation ATCO 1
17:30	Validation ATCO 2		11:00	Validation ATCO 2
18:00	Validation ATCO 1		11:30	Lunch
18:30	Validation ATCO 2		12:30	Validation ATCO 1 + ATCO 2
19:00	Debrief		13:00	End of Trial Questionnaire
20:00	End of day		15:00	Debrief
			16:00	End of day

4.2.2.4.3 Trial Design

In this trial recorded scenarios will be used.

4.2.2.5 Risks

There are no specific risks to this trial. The general risks are those that apply for any shadow mode trial and are:

1. The actual traffic / conditions experienced do not offer enough to complete the assessment.
2. The controllers do not feel able to give opinion, not having used the system for actual control.

4.2.2.6 Errors and Observation handling

N/A

4.2.3 Analysis Specification

The Analysis methods and processes used for VP-056 will be applied again in VP-057. See Section 4.1.3 for more information.

4.3 Single AFIS Trial (EXE-06.09.03-VP-058) Plan

4.3.1 Exercise Scope and Justification

The Remote Provision of Aerodrome Flight Information Services (AFIS) to a Single Aerodrome, assessed firstly through Passive Shadow Mode and secondly in Advanced Shadow Mode. The Passive Mode part entails the AFIS Officer (AFISO) observing live traffic in a non-intrusive manner and not interacting with the aircraft or providing any service. The Advanced Mode will require the AFISO to provide the full AFIS service to the aircraft as the ATCO-in-the-loop using the prototype system.

The purpose of the first, Passive Shadow Mode element of the exercise is to assess confidence and assurance among stakeholders that the system can be used for provision of ATS in live traffic during the second part of the trial. Because the Advanced Shadow Mode will follow after the Passive Shadow Mode, there will be an opportunity to familiarise the AFISO with the platform and indicate the confidence in providing AFIS from a Remote Tower and meet the regulator requirements in order to start providing AFIS in Advanced Mode.

This platform used builds upon the validation trials done in EXE-06.09.03-VP-056 and of EXE-06.09.03-VP-057.

4.3.1.1 Exercise Level

The Exercise is at the level of: ATM System

4.3.1.2 Description of the Operational concept being addressed

The concept being addressed is the Remote Provision of ATS to a Single Aerodrome, as described in the OSED for Remote Provision of ATS, Section 3.1:

The full range of AFIS defined by the EUROCONTROL Guidelines for AFIS will be provided. The airspace users will be provided with the appropriate level of services as if the AFIS were provided locally at Værøy. The AFISO will not be located at the aerodrome. They will be located at the Remote Tower Centre in Bodø.

The Remote AFIS will perform AFIS tasks using the CWP in the Bodø Remote Tower facility. The visual surveillance will be provided by a reproduction of the OTW view, by using visual information capture.

On top of a strategically placed mast at the Heliport (Værøy) 14 cameras will be placed, having a 360° visual view, which is presented on 55 inch LCD monitors in the RTC.

View and sound from the Heliport will be captured with digital video cameras and microphones. The actual airport systems, e.g. runway and taxi lights, will be connected to the network with relevant data displayed in the RTC.

The CWP in the RTC will include all presentation of all necessary systems e.g. flight plan, Met, airport lights, navaids, alarms, with interfaces to the airport.

The exact range of operational tasks and procedures to be addressed is a focus of the trial and the aim is to include as many as possible.

Compared to VP-057 many technical features have stayed the same while others have changed slightly as follows:

- Technical features:
  - 14 high definition cameras, representing a 360^{o} view around the Heliport;
  - 14 55” screens, presented in portrait orientation;
  - ~~o~~ Off-set rear screens showing view “behind” tower.
  - Picture processing and quality visual reproduction will be the same, with 30 frames per second;

- Radar coverage to GND level, covering whole TIZ;
- The same PTZ camera, with better operability;
- InfraRed Camera;
- Visual Tracking, radar tracking plus combined tracking;
- Inclusion of an e-Strip system (manual activation of strips);
- Integrated MET (AWOS);

- Technical Configuration – unlike VP-057, where there where different technical configurations – a single configuration will be used. However, the AFISO may choose to temporarily disable certain features from time to time (e.g. radar, advanced visual features) for the purposes of comparison.

4.3.1.3 Stakeholders and their expectations

Stakeholder	External / Internal	Involvement	Why it matters to stakeholder	Performance expectations
ANSP	Internal	The NORACON Consortium will be involved in planning, conduct and reporting of the trial. They will also supply the AFISO.	These ANSP are candidates for deployment of Remote AFIS.	ANSP will expect the validation process to provide evidence that the concept: • Is cost-effective and supports the findings of the business case in that it will reduce overall operating costs; • Provides levels of safety that are at least as good as current operations; • Does not negatively impact human performance in any way and Is acceptable to all operators and service users; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility.
AFIS Officers	Internal	The AFIS from Avinor will be the system operators in the trial.	The AFISO will be the operator – their day to day work will be affected by Remote AFIS.	AFIS Officers will expect the validation process to provide evidence that the concept: • Provides levels of safety that are at least as good, if not better than current (local) operations; • Allows the same, if not better, levels of service to be provided in terms of efficiency and flexibility; • Is usable and acceptable;
Industry + WP12.4.6-8	Internal	The platform will be provided by NATMIG.	They will wish to market and sell a successful system to others.	Industry will expect the validation process to: • Generate and assess requirements to help mature and prove the concepts; • Gather evidence to help them decide on continued investment and/or concept implementation; • Promote the benefits of the concept. • Assist in the development of a marketable concept.
SESAR Joint Undertaking	External	The SJU will not have direct involvement in the trial, but they may review deliverables and visit the trial.	They will want a successful trial to enable them to meet Release aims, and to allow them to share results.	The SESAR JU will expect the validation process to: • Provide evidence that the concept will make a positive contribution to European ATM; • Be completed within timescales and budget.
Regulators	External	The regulators will	The regulators are	The Regulatory Bodies will expect the

(CAA, ICAO, EASA, national)		want to ensure safety and optimize airspace efficiency.	responsible for putting rules, regulations and procedures in place to ensure safety in new concept implementations.	validation process to: • Provide evidence that the concept meets the required performance levels in terms of safety, capacity, access etc.
Airport operators	External	Værøy and Bodø airport operators will help facilitate the trial.	They will have to decide to implement the concept at their aerodromes.	Airport operators will expect the validation process to provide evidence that the concept: • Lowers ATS costs, as much as possible; • Will help them maintain and sustain future operations;
Trade Unions	External	Trade Unions do not have a direct involvement, but they do represent the end users of the concept: the operators.	They represent the concept operators as end users.	The Trade Unions will expect the validation process to provide evidence that the concept: • Is acceptable to the operational users; • Does not lead to unwanted changes to procedure, roles or responsibilities for the operational staff
Airspace Users	External	The Airspace Users will not have direct involvement in the trial, but they may review deliverables and visit the trial. They may also help provide qualitative feedback and input to results.	They will be the service users – the customers.	Airspace Users will expect the validation process to provide evidence that the concept: • At least maintains, or improves, safety levels; • Lowers ATS costs, as much as possible; • Allows the same, if not better, levels of service to be provided in terms of predictability, efficiency and flexibility;

4.3.1.4 Validation objectives and hypothesis

4.3.1.4.1 Exercise Validation Objectives

The following validation objectives are lower level derivations of the high level validation objectives stated in Section 3.

Some of them are relevant only to the first (Passive Shadow Mode) part of the trial and focus on gathering assurance that it is safe to proceed to the Advanced Shadow Mode part of the trial. Others apply only to the Advanced Shadow Mode part, while the remainder apply to both Passive and Advanced Shadow mode.

Identifier	OBJ-06.09.03-VALP-0060.0013
Objective	Gain feedback on the technical capability of the Remote AFIS Platform and its systems.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0013	The trial has facilitated the gathering of technical capability feedback. The AFISO indicates satisfactory workings of the technical platform and its systems. The technical platform has been assessed and works optimally.

Identifier	OBJ-06.09.03-VALP-0060.0014

Objective	All the participants (Bodø TWR, Bodø ATCC, Værøy - personnel, technicians, operators, pilots and RNoAF) in the trial are fully aware of all the relevant procedures and have been either trained or briefed prior to entering Advanced Shadow Mode.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0014	The trial participants have shown full understanding of the relevant procedures prior to entering Advanced Shadow Mode.

Identifier	OBJ-06.09.03-VALP-0060.0015
Objective	To assess, during Passive Mode, the range of AFIS functions that could be performed, including: The visual surveillance of the aerodrome and vicinity of the aerodrome area, in any weather condition. Providing information to aircraft based on the remote MET observation. Assess the confidence the AFISO has in the accuracy of the MET observation.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0015	The Remote AFISO indicates that they could perform a sufficient range of functions and tasks using the platform, to provide live service to the aircraft. Sufficient feedback has been gathered and the AFISO indicates that the MET observations are accurate

Identifier	OBJ-06.09.03-VALP-0060.0016
Objective	To gather AFISO opinion, during Passive Mode, on the level of service that can be provided under the current technical configuration to a single aerodrome

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0016	The requirement for the various technical enablers with respect to service levels provided is known for the scenarios experienced during the trial.

Identifier	OBJ-06.09.03-VALP-0060.0022
Objective	Support the development of working methods & procedures for normal situations related to Visual Separation application, use of Infra-Red, and weather observations

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0022	The working methods & procedures for normal situations related to Visual Separation application, use of Infra-Red, and weather observations have been tested. The working methods & procedures for normal situations related to Visual Separation application are accepted or, where not, suitable suggestions for improvement have been identified.

Identifier	OBJ-06.09.03-VALP-0060.0023

Objective	Obtain feedback on the safety, under normal conditions, of the Remote AFIS Concept during the Advanced Mode.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0023	The trial has facilitated the gathering of safety feedback by the AFISO.

Identifier	OBJ-06.09.03-VALP-0060.0032
Objective	Support the development of working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft)

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0032	The working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft) have been tested. The working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft) are accepted or, where not, suitable suggestions for improvement have been identified.

Identifier	OBJ-06.09.03-VALP-0060.0042
Objective	Support the development of working methods & procedures in degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information)

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0042	The working methods & procedures for degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information) have been tested. The working methods & procedures for degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information) are accepted or, where not, suitable suggestions for improvement have been identified.

Identifier	OBJ-06.09.03-VALP-0060.0052
Objective	Assess the utility of the Remote AFIS Concept, by determining its impact on: the human performance, in particular in terms of situational awareness; the working methods and procedures, in particular for visual assessment of the aerodrome area.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN02.5006	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0052	The trial has facilitated the gathering of feedback. The concept does not have a negative impact on safety and human performance.

Identifier	OBJ-06.09.03-VALP-0060.0063
Objective	To assess the impact of the Remote AFIS Concept on AFISO Human Performance during Passive Mode in all weather and visibility (including daylight and darkness) conditions: Situation awareness Trust

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN02.5006	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0063	AFIS situation awareness must be shown to be within acceptable limits (the value of the 'acceptable limits' will be defined with regard to the tool(s) employed to assess situation awareness). The Remote AFISO is able to detect potential conflicts, hazardous situations and other events that may impact their work, on the airport surface and in the vicinity of the airport under good and limited visibility conditions. Any instances of Human Performance degradation are either mitigated or acceptably offset by improvements in other areas. AFISOs reported level of trust must be shown to be acceptable.

Identifier	OBJ-06.09.03-VALP-0060.0064
Objective	To assess the impact of the Remote AFIS Concept on AFISO Human Performance during Advanced Mode in all weather and visibility (including daylight and darkness) conditions : Situation awareness Trust Workload

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN02.5006	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0064	AFISO situation awareness. is within acceptable limits ('acceptable limits' to be defined with regard to the tool used for the assessment). The Remote AFISO is able to detect potential conflicts, hazardous situations that may impact their work, on the airport surface and in the vicinity of the airport under good and limited visibility conditions. AFISOs reported level of trust must be shown to be acceptable. AFISO Level of workload is within acceptable limits ('acceptable limits' to be defined with regard to the tool used for the assessment).

Identifier	OBJ-06.09.03-VALP-0060.0075
Objective	Assess the acceptability of the Remote AFIS prototype for AFISO, in terms of: The prototype in general HMI (visual reproduction) HMI (Advanced Visual Features) HMI (CWP) The Working Environment

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion

CRT-06.09.03-VALP-0060.0075	The Remote Provision of ATS to a single aerodrome concept, is usable/acceptable to the ATCO in terms of: The prototype in general; HMI (visual reproduction); HMI (Advanced Visual Features); HMI (CWP); The Working Environment.

Identifier	OBJ-06.09.03-VALP-0060.0076
Objective	Gain feedback into the impact of the Remote Provision of AFIS on AFISO roles tasks & responsibilities.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0076	The trial has facilitated the gathering of feedback, relating to the impact of remote tower ops on AFISO roles, tasks & responsibilities'. The operators find the proposed their current roles tasks & responsibilities to be clear and acceptable to them. Feedback has been gathered where the roles and responsibilities could be improved if necessary.

Identifier	OBJ-06.09.03-VALP-0060.0080
Objective	To validate information and assumptions that will be used in any Business Case Transversal Assessments, relating to the Cost Effectiveness of Remote Provision of ATS to Single low to medium density airports

Identifier	OBJ-06.09.03-VALP-0060.0103
Objective	To gather feedback of the operability ,usability and utility of the various technical features for Remote Provision of ATS to a single aerodrome, including PTZ Camera, Radar, Advanced Visual Features etc

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1001	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1003	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2001	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN03.3001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0103	The requirement for the various technical enablers with respect to service levels provided is known for the scenarios experienced during the trial. The usability and operability of the Remote Provision platform of AFIS to a single aerodrome is acceptable, i.e. the system is user friendly

Identifier	OBJ-06.09.03-VALP-0060.0104
Objective	Gain feedback on Communication facility utility, usability and acceptability in the Remote Tower platform during Passive Mode, including: Communication with Værøy personnel through radio Communication with Værøy personnel through telephone Internal and External communication in case of an emergency

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1001	N/A

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1003	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2001	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN03.3001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0104	The trial has facilitated the gathering of communication feedback, the AFIS indicates having confidence in the communication facilities and systems during normal and abnormal operations.

Identifier	OBJ-06.09.03-VALP-0060.0105
Objective	Assess the Communication facility utility, usability and acceptability in the Remote Tower platform during Advanced Mode, including: Communication with Værøy personnel through radio Communication with Værøy personnel through telephone Internal and External communication in case of an emergency

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1001	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-VG03.1003	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2001	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-AS03.2002	N/A
<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-FN03.3001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0105	The trial has facilitated the gathering of communication feedback, the AFIS indicates having confidence in the communication facilities and systems during normal and abnormal operations.

Identifier	OBJ-06.09.03-VALP-0060.0017
Objective	Gain feedback from the airspace users relating to: Communication, quality, consistency, problems experienced; Surveillance, clearances received, “trust in the system”, separation; Flight Safety, conditions observed, but not reported by ATC (birds, objects in the FATO area etc.); General impression.

<COVERS>	<ATMS Requirement>	REQ-06.09.03-OSED-BC01.0001	N/A

Identifier	Success Criterion
CRT-06.09.03-VALP-0060.0017	The trial has facilitated the gathering of feedback from airspace users. The airspace users have trust in the prototype and find the concept acceptable.

4.3.1.4.2 Exercise Indicators and Metrics

Identifier	OBJ-06.09.03-VALP-0060.0013
Objective	Gain feedback on the technical capability of the Remote AFIS Platform and its systems.
Indicator	AFISO opinion and subjective feedback
Assessment Method	Gather AFISO opinion on: • The technical capability of the platform relative to the expected requirements; • The appropriateness of the functional requirements with regards provision of AFIS • The technical performance (stability, speed, robustness etc) of the

	platform.

Identifier	OBJ-06.09.03-VALP-0060.0014
Objective	All the participants (Bodø TWR, Bodø ATCC, Værøy – personnel, technicians, operators, pilots and RNoAF) in the trial are fully aware of all the relevant procedures and have been either trained or briefed prior to entering Advanced Shadow Mode.
Indicator	Subjective feedback from trial participants and agreement that they feel prepared and aware.
Assessment Method	All participants (and visitors to the trial) will be briefed on the relevant procedures and trial set up. Trial participants will be asked to give their subjective feedback on their preparedness and awareness following the training/briefings. A short, post-briefing feedback form may be used.

Identifier	OBJ-06.09.03-VALP-0060.0015
Objective	To assess, during Passive Mode, the range of AFIS functions that could be performed, including: • The visual surveillance of the aerodrome and vicinity of the aerodrome area, in any weather condition; • Providing information to aircraft based on the remote MET observation; • Assess the confidence the AFISO has in the accuracy of the MET observation.
Indicator	AFISO confirmation that functionality is enough to provide AFIS to aircraft during live operations.
Assessment Method	Gather feedback from AFISO through semi-structured debriefs and/or bespoke questionnaires.

Identifier	OBJ-06.09.03-VALP-0060.0016
Objective	To gather AFISO opinion, during Passive Mode, on the level of service that can be provided under the current technical configuration to a single aerodrome
Indicator	AFISO agreement/ comment/ consensus on the services to be provided. AFISO opinion on safety during the range of conditions experienced during the trials. AFISO ability to perform tasks safely under various/degraded conditions.
Assessment Method	Assess ATCO on: 1. Subjective feedback on ability to provide sufficient services under various conditions; 2. Subjective feedback on ability to perform tasks safely under various conditions.

Identifier	OBJ-06.09.03-VALP-0060.0022 OBJ-06.09.03-VALP-0060.0032 OBJ-06.09.03-VALP-0060.0042
Objective	Support the development of working methods & procedures for normal situations related to Visual Separation application, use of Infra-Red, and weather observations Support the development of working methods & procedures for abnormal situations potentially experienced during the trial (e.g. emergency situations in an aircraft, communication failure with one aircraft) Support the development of working methods & procedures in degraded mode situations related to the failure of the visualisation system (black-out, frozen, corrupted information)

Indicator	Procedures agreed on based on talk-throughs conducted with AFISO. Obtain AFISO opinion on working methods & procedures under (degraded) conditions. Support the development of working methods & procedures in degraded mode situations The following scenarios may be presented during the trial: a. Type of failure mode (Black-out, Frozen, Corrupted, Non-usable) b. Number of screen affected (One screen, Several screens, All screens) c. Traffic presence on the airport and its vicinity when the failure occurs (Presence/Absence of traffic) d. Light conditions on the airport and its vicinity when the failure occurs (daytime, darkness)
Assessment Method	Gather feedback from AFISO through semi-structured debriefs and/or bespoke questionnaires. Talk-throughs conducted with AFISO regarding procedures for various scenarios. The procedures will include: a. Procedures to follow for using equipment during normal conditions. b. Procedures to follow during abnormal scenarios (including degraded mode). c. Feedback for improvement or integration for Visual Separation application, infrared camera, and visual system. As many scenarios as possible will be observed or simulated during the trial. Trial participants will be asked to give their subjective feedback on their safety perception during the scenarios.

Identifier	OBJ-06.09.03-VALP-0060.0023
Objective	Obtain feedback on the safety, under normal conditions, of the Remote AFIS Concept during the **Advanced Mode.**
Indicator	AFISO opinion on safety during the conditions experienced during the trials.
Assessment Method	Trial participants will be asked to give their subjective feedback on their safety perception during the scenarios.

Identifier	OBJ-06.09.03-VALP-0060.0052
Objective	Assess the utility of the Remote AFIS Concept, by determining its impact on: • the human performance, in particular in terms of situational awareness; • the working methods and procedures, in particular for visual assessment of the aerodrome area.
Indicator	AFISO feedback on utility and impact assessment of Human-Machine cooperation on AFISO in terms of: • Situational Awareness • Working methods & procedures e.g. visual separation and use of infrared
Assessment Method	**Situational Awareness:** SASHA questionnaire ratings and subjective feedback

Identifier	OBJ-06.09.03-VALP-0060.0063
Objective	To assess the impact of the Remote AFIS Concept on AFISO Human Performance during **Passive Mode** in all weather and visibility (including daylight and darkness) conditions:

	a. Situation awareness b. Trust
Indicator	**Situational Awareness.** SASHA questionnaire ratings and subjective feedback. **Trust** SATI questionnaire plus subjective feedback
Assessment Method	**Situational Awareness Rating.** The AFISO will be asked to fill in the SASHA questionnaire following each session in order to obtain an absolute measure of situation awareness. The AFISOs will be then questioned in the post session debrief as well as another observations made relating to situation awareness. Assessments will be done under both good and limited visibility conditions as well as for daytime and night time operations. **Trust Rating** The AFISO will be asked to fill in the SATI rating questionnaire, at the end of the trial. Subjective AFISO feedback through debrief and questionnaire on trust, linked to the influencing factors and platform components e.g. technical enablers

Identifier	OBJ-06.09.03-VALP-0060.0064
Objective	To assess the impact of the Remote AFIS Concept on AFISO Human Performance during **Advanced Mode** in all weather and visibility (including daylight and darkness) conditions : a. Situation awareness b. Trust c. Workload
Indicator	**Situational Awareness.** SASHA questionnaire ratings and subjective feedback. **Trust** SATI questionnaire plus subjective feedback **Workload** NASA TLX questionnaire and/or Instantaneous Self-Assessment
Assessment Method	**Situational Awareness Rating.** The AFISO will be asked to fill in the SASHA questionnaire following each session in order to obtain an absolute measure of situation awareness. Further information relating to situation awareness will be obtained from bespoke questionnaires and/or debriefs following each sessions. In addition, certain events will be scripted into sessions to obtain a more objective measure of situation awareness. AFISOs will be observed during the session to see if there is an impact on SA or not. The AFISOs will be then questioned in the post session debrief about the events as well as another observations made relating to situation awareness. Assessments will be done under both good and limited visibility conditions as well as for daytime and night time operations. **Trust Rating** The AFISO will be asked to fill in the SATI rating questionnaire, at the end of the trial. Subjective AFISO feedback through debrief and questionnaire on trust, linked to the influencing factors and platform components e.g. technical enablers. **Workload** The AFISO will be asked to fill in the NASA TLX questionnaire following each session in order to obtain an absolute measure of task load index. An Instantaneous Self-Assessment measurement device may be installed into the platform with the AFISO asked to enter a response on a rating scale at periodic intervals.

	Further information relating to workload will be obtained from bespoke questionnaires and/or debriefs following each sessions.

Identifier	OBJ-06.09.03-VALP-0060.0075
Objective	Assess the acceptability of the Remote AFIS prototype for AFISO, in terms of: • The prototype in general • HMI (visual reproduction) • HMI (Advanced Visual Features) • HMI (CWP) • The Working Environment
Indicator	AFISO feedback on acceptability of: • The prototype in general • HMI (visual reproduction) • HMI (Advanced Visual Features) • HMI (CWP) • The Working Environment
Assessment Method	The AFISO will be questioned on the following areas (through semi-structured debriefs and/or bespoke questionnaires): 1. Prototype in general: a. System reliability; b. Accuracy of the prototype; c. Understandability; d. Confidence when using the prototype; e. Extent of deficiencies (if any) with the prototype; 2. Visual reproduction (via display screens): a. Picture Quality; b. Contrast (within screen, across screens); c. Viewing angle (human to screen, camera to aerodrome); d. Refresh rate; e. Screen position and size; f. Configurability; 3. Advanced Visual Features: a. PTZ Camera; b. IR camera; c. Label overlays; 4. Controller working position: a. Integration of CWP and equipment; b. Ergonomics; c. Functionality; d. Ease of use of equipment; 5. Working Environment: a. Size; b. Lighting; c. Ventilation / temperature; d. Noise; e. Location; f. Staff presence.

Identifier	OBJ-06.09.03-VALP-0060.0076
Objective	Gain feedback into the impact of the Remote Provision of AFIS on AFISO roles tasks & responsibilities.
Indicator	AFISO feedback on acceptability of the remote tower concept in general as well as the roles, responsibilities and task allocation.
Assessment Method	AFISO will be asked to give feedback on their opinion of the acceptability of the remote tower concept for single aerodromes in general and more specifically on the roles, responsibilities and task allocation as seen in the remote tower trials.

	This feedback will be obtained using either a bespoke questionnaire and / or semi-structured debriefs

Identifier	OBJ-06.09.03-VALP-0060.0103
Objective	To gather feedback of the operability ,usability and utility of the various technical features for Remote Provision of ATS to a single aerodrome, including PTZ Camera, Radar, Advanced Visual Features etc
Indicator	AFISO feedback on usability and utility of prototype features
Assessment Method	Gather feedback from AFISO through semi-structured debriefs and/or bespoke questionnaires.

Identifier	OBJ-06.09.03-VALP-0060.0104
Objective	Gain feedback on Communication facility utility, usability and acceptability in the Remote Tower platform during **Passive Mode**, including: • Communication with Værøy personnel through radio; • Communication with Værøy personnel through telephone; • Internal and External communication in case of an emergency.
Indicator	AFISO feedback on communication facility utility, usability and acceptability
Assessment Method	Gather feedback from AFISO through semi-structured debriefs and/or bespoke questionnaires.

Identifier	OBJ-06.09.03-VALP-0060.0105
Objective	Assess the Communication facility utility, usability and acceptability in the Remote Tower platform during **Advanced Mode**, including: • Communication with Værøy personnel through radio; • Communication with Værøy personnel through telephone; • Internal and External communication in case of an emergency.
Indicator	AFISO feedback on communication facility utility, usability and acceptability
Assessment Method	Gather feedback from AFISO through semi-structured debriefs and/or bespoke questionnaires.

4.3.1.5 Validation scenario

In this trial the Validation Scenario will consist of four scheduled helicopter flights a day (2 x return flights between Bodø and Værøy). AFIS service will be provided, and done so by one person. The AFISO will provide weather information to the aircraft on the weather observation.

4.3.1.5.1 Airport Information

The remote services are provided to Værøy Heliport from Bodø Airport where the Bodø ACC is also located. At Bodø the remote facility is housed in the terminal building in a former NCAA office.

Værøy heliport/ENVR

- Environment
- Værøy 748 inhabitants in 2011
- Bodø 47847 inhabitants in 2011

Airport Layout

- 67°39′16″N 012°43′37″E
- Ca 85 km NW of Bodø
- 1 helipad FATO 03/21
- 56M

- Elevation 15FT
- 1388 movements at the Heliport and 10261 passengers in 2011

Airport Technologies

- FATO and TLOF 03/21 edge lgts,

Airspace Characteristics

- Obstacles 2,5NM W of Heliport 1513FT MSL
- Obstacles 2,5NM N of Heliport 1477 FT MSL
- Obstacles APRX 250M NW of Heliport 174 FT MSL
- TIZ Class G+

Procedures

- RNAV (GNSS) 027°
- RNAV (GNSS) 200°
- RNAV (GNSS) 267°

Air Traffic Services at Værøy (ENVR)

Except during test, normally the following services are performed in Værøy TIZ:

- FIS/ Flight information service provided by Bodø ATCC sec N
- Alerting service
- METOBS service provided by dedicated MET observers at Værøy

The services is normally accomplished by a controller.

Figure 3 - Map showing Værøy (A) and Bodø (B)

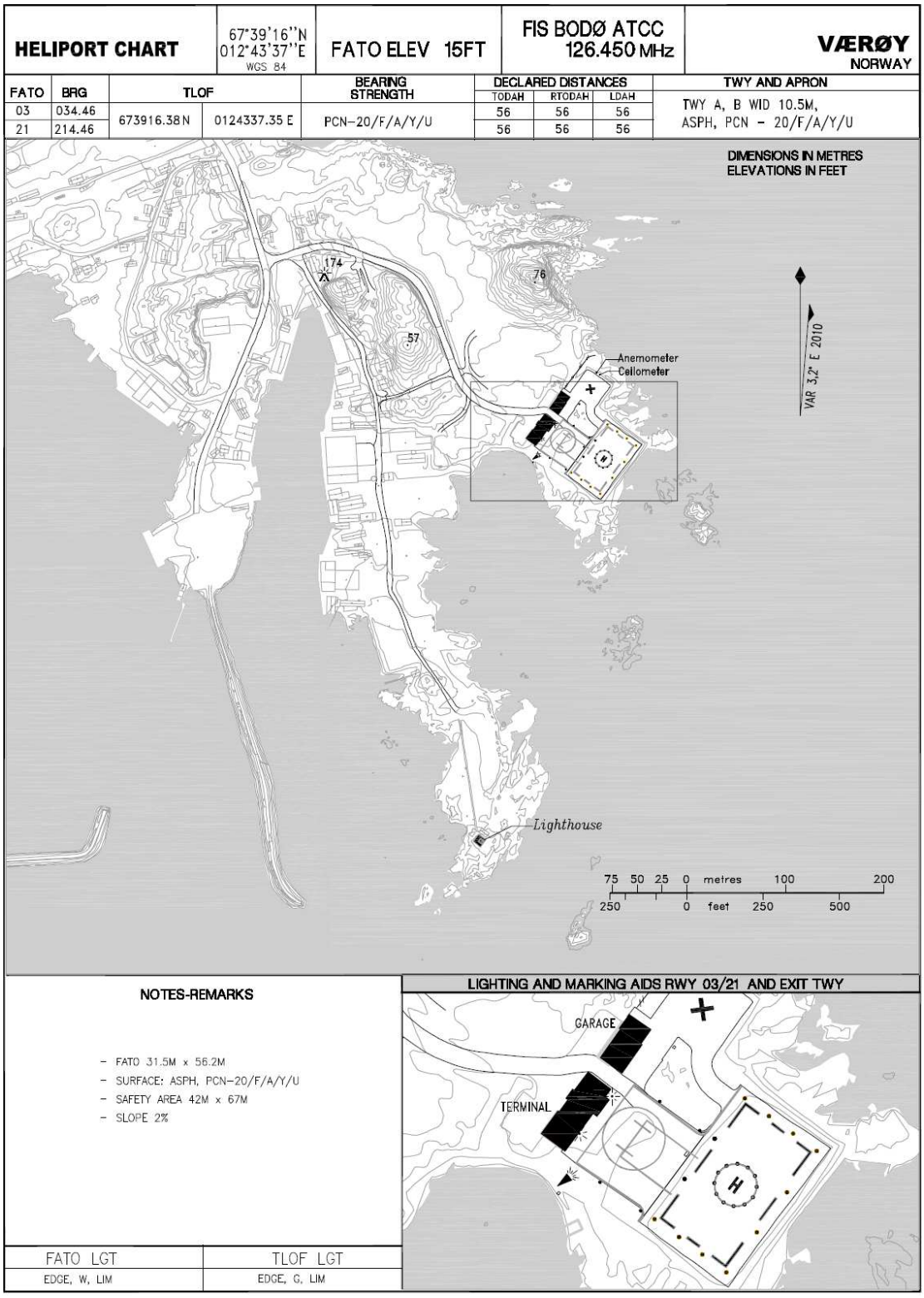

Figure 4 – Værøy Heliport Chart

4.3.1.5.2 Traffic Information

Traffic will be in real operations. The traffic is anticipated as follows:

- One local helicopter performing four daily flights in CTR/below TMA and Værøy TIZ. During test hours, the Remote AFISO will assume responsibility of Værøy TIZ from Bodø ATCC.
- However, occasionally crossing flights through CTR/below TMA/ and into Værøy TIZ can be expected, if accepted in advance by BD ATCC & RTC in cooperation.

More information is given in the following description.

	Time	*Description*	*R. AFISO*	*Bodø TWR*	*Bodø ACC*	*Local AVINOR/ Værøy Staff*	*Pilot*
Arrival Activities	**07:30**	***Begin shift Bodø / Værøy***	Start shift				
	08:00	***Check METAR***					Pilot Check METAR at Værøy
	08:20	***Briefing on objectives for today***	check validation objectives for the day.				
	08:30	***AFISO enters RTC, performs initial checks.***	Perform initial checks				
	08:45	***AFISO issues MET report from RTC***	Issue MET Report from RTC				
	09:00	***Flight departs Bodø***	Call Bodø ACC. Assumes responsibility of Værøy TIZ from Bodø ATCC	CFTO	Receive call from R. AFISO. Transfer responsibility of TIZ to R. AFISO		Receives clearance from TWR. Take Off.
	09:05	***Transfer TWR to ACC***		Transfer to ACC	Establish contact with a/c		Pilot contacts ACC
	09:10	***Verify MET report***	Calls Værøy, to verify MET report			Verifies MET with R. AFISO	
	09:15	***Transfer ACC to R. AFISO***	Establish contact with a/c. Confirms weather with a/c		Transfer control to R. AFISO	Local Staff stand by	Pilot contacts R. AFISO. Gets latest weather (by voice from R. AFISO)

	09:25	***Heli lands Værøy***	Scan FATO for birds/fish/etc. Report "FATO Free" to a/c. Issue landing time (write on strip). FATO lights on		Observes Landing time on strip	Local Staff stand by	Receive FATO Free report from R.AFISO
	09:25 on…	***Heli on FATO***	Monitor Area. Scans, weather, updates…etc			Local Staff stand by	

	Time	***Description***	***R. AFISO***	***Bodø TWR***	***Bodø ACC***	***Local AVINOR/ Værøy Staff***	***Pilot***
Activities between Arrival & Departure	**9:25 - 9:40**	***a/c #2 wants to enter delegated TIZ***	Decides if they are happy to accept a/c #2. If no, R. AFISO requests Bodø ACC to deny entry to TIZ. If yes, R. AFISO reports able to Bodø ACC		Bodø ACC asks R. AFISO if they wish to take another a/c. If yes, transfer a/c #2 to R. AFISO	Local Staff stand by	
		a/c #2 in zone	R.AFISO provides FIS and MET to a/c #2 as well as a/c #1.			Local Staff stand by	
		a/c #2 leaves delegated TIZ	R. AFISO transfers back to Bodø ACC (VFR) or asks for clearance from Bodø and relays to a/c (IFR). Relay clearance (on behalf of Bodø ACC) and transfer.			Local Staff stand by	

	Time	Description	R. AFISO	Bodø TWR	Bodø ACC	Local AVINOR/ Værøy Staff	Pilot
Departure Activities	09:40	*Start-up Info*	Issue wind/temp/ QNH/etc to a/c #1 Call Bodø, report Start Up info for a/c #1,			Local Staff stand by	Inform R. AFISO that a/c #1 is starting up. Receive wind/ temp/QNH/etc.
	09:45	*Heli departs*	Receive clearance from Bodø ACC. Give ATC clearance to a/c on behalf of Bodø ACC Report FATO Free		Issue clearance to R. AFISO	Local Staff stand by	Receive clearance from R. AFISO (on behalf of Bodø ACC). Taxi/TO
	09:47	*Transfer R.AFISO to ACC*	Issue departure time to a/c. Transfer to Bodø ACC.FATO Lights off.		Establish contact with a/c	Local Staff stand by	Pilot contacts ACC
	09:47-10:05	*Heli En-Route*	Standing by (in case a/c has to return).		control of a/c	Local Staff stand by	
	10:05	*Transfer ACC to TWR*	Standing by (in case a/c has to return).	Establish contact with a/c #1	Transfer to TWR		Pilot contacts TWR
	10:10	*Heli lands Bodø*		Clear to Land			Receive clearance
	10:10 on…	*Opportunity to handle other a/c*	Decides if they are happy to accept a/c #n. If no, R. AFISO requests Bodø ACC to deny entry to restricted zone. If yes, R. AFISO reports able to Bodø ACC		Bodø ACC asks R. AFISO if they wish to take another a/c. If yes, transfer a/c #n to R. AFISO		

	12:00	***Transfer Responsibility of TIZ***	Call Bodø ACC, transfer responsibility of Værøy TIZ back to Bodø ACC		Resume Control/FIS of (close Værøy TIZ)		
	12:01	***End of Shift at Værøy***	AFISO performs final checks and leaves RTC for break.				
		Questionnaires	Questionnaires and Debrief				

4.3.1.5.3 Additional Information

None.

4.3.1.6 Exercise Assumptions

None.

4.3.1.7 Exercise Tool, Validation Technique and/or Platform

The Validation Technique will be Passive Shadow Mode firstly and Advanced Shadow Mode upon approval.

As stated in the E-OCVM, this is a validation technique in which the new system is given live feeds in the operational environment and runs in parallel to the operational system. The new system will be non-interfering and will not play an active part in the ATM system.

The AFISO will follow the Værøy traffic from the RTC CWP in Bodø.

4.3.1.8 Entrance Criteria - Passive Shadow Mode

The following are the entrance criteria for the Passive Shadow Mode trial:

- The full number and rating of requested AFISO are available;
- Approval for the trial has been granted by the local service provider;
- The platform is tested, fully working and accepted.

4.3.1.9 Exit Criteria - Passive Shadow Mode

The Passive Shadow Mode part of the trial will be deemed to be complete when:

- Full test period of Passive Shadow mode service have been completed;
- A sufficient range of evidence and data has been collected;
- The decision has been taken to continue the second part of the validation in Advanced Shadow Mode.
- Acceptance from the Norwegian CAA has been received to start validating the Advanced Shadow Mode.

4.3.1.10 Entrance criteria - Advanced Shadow Mode

The entrance criteria for the Advanced Shadow Mode trial are described in the Exit Criteria for Passive Shadow Mode.

4.3.1.11 Exit Criteria - Advanced Shadow Mode

The trial will be deemed to be complete when:

- Full test period of advanced mode service have been completed;
- A sufficient range of evidence and data has been collected.

However, the equipment at Værøy will still be available, if more tests are necessary.

4.3.1.12 Validation Requirements

4.3.1.12.1 Validation System Under Test Requirements

The top level Validation SUT Requirements are listed in Section 3 and apply to VP-057.

4.3.1.12.2 Other Validation Requirements

None.

4.3.1.13 Platform Configuration

The visual reproduction from the fourteen cameras, situated on top of the Værøy tower, will be displayed on 50 inches monitors at the RTC, giving a 360-degree view. A Pan Tilt Zoom Camera and an IR-camera will be mounted on top of the camera house. Ambient noise from the airport will come from two microphones fitted at the video tower, feeding two loudspeakers at the RTC. The controller working position will be situated about 2m from the monitors, allowing a 2.5m radius needed for the CWP.

A separate visitors room will be built relaying a live camera feed of the RTC. This will enable the trial environment to be kept “sterile” – particularly important during Advanced Shadow Mode.

4.3.1.14 Links to other Validation Exercises

As stated in Section 3.1 (Validation Overview) the validation strategy is based on a number of integrated, incremental, steps. The building of the overall concept is stepwise in that the concepts and technical enablers are initially established in the Single Remote Tower environment, before being used in Contingency/Multiple Tower environments. The development of the technical enablers is also step-wise.

Therefore, this validation exercise is one of the Single Tower validations amongst other P06.09.03 Validation activities. This activity builds upon some of the components developed in previous trials.

4.3.1.15 Dependent and Independent variables

None.

4.3.2 Exercises Planning and management

4.3.2.1 Activities

4.3.2.1.1 Preparatory activities

In line with the general milestone identified in Section 3.9, the milestones relevant for this trial are:

Milestone	Milestone Date	Delivering Project	Deliverable or Task ID
Approval from CAA		Avinor	-
Meeting with Operators	Week 48-50	P06.09.03	-
LoA with Bodø	01/10/2012	P06.09.03	-

ATCC			
Local procedures meeting	Week 48-50	P06.09.03	-
FHA		P06.09.03	-
Platform delivered	Week 39-44	P12.04.07	-
Platform SAT	Week 49	P12.04.07	-
Training on platform	Week 45-52	P06.09.03	-
Dry Run	Week 48-51	P12.04.07 P06.09.03	-
Conduct (Passive Shadow Mode)	1st December 2012 - 31st December 2012	P06.09.03	-
Conduct (Advanced Shadow Mode)	7th January 2013 – 15th March 2013	P06.09.03	-

4.3.2.1.2 Execution activities

The trial will run in Passive Mode from 1st of till 31st of December 2012. The Advanced Mode trial is planned to run from 1st of January until 15th of March 2013. After the Shadow Passive mode there will be a short delay in the start of the Advanced Shadow Mode, due to the requirement of an approval from the CAA.

4.3.2.1.3 Post execution activities

Following the trial, the main focus will be on analysis and reporting of the trial. The main trial report is foreseen for delivery in Q2 2013. It is anticipated that a mini-report will be made available immediately following the Passive Shadow Mode element of the trial in order that it can be delivered to the Norwegian CAA to assist in the approval process.

Post-trial workshops may be organised to discuss main findings with the participants.

A post-trial visitor day will also take place.

4.3.2.2 Responsibilities in the exercise

The following table shows the different teams involved in the experiment, their responsibilities, and names for participants in the different teams. Underlined names are team leaders.

Actor	Role/responsibility	Name(s)
Tower AFISO with ENVR rating	RTC AFISO during Passive/Advanced shadow mode	Ann Mari Hilstad, AFIS operator Stein Nielsen Operational responsibility (Safety Coordinator)
Validation Leader	Coordination of trial on day-to-day basis. Liaison with visitors.	Stein Nielsen Operational responsibility (Safety Coordinator)
Validation team	Validation Analysis and reporting	Conor Mullan, NORACON
Safety Team	Specific Safety Assessments and report contributions.	Marta Llobet Lopez, ECTL
HP Team	Specific Human Performance Assessments and report contributions.	Catherine Chalon Morgan, ECTL
Trial team, technical	Validation technical support	Erik Vaage, Avinor Mattias Johansson, NATMIG Frequentis

Verification team	Platform evaluation and Platform verification	Bengt-Arne Skoog, NATMIG Lars Lundqvist, NATMIG Frequentis Erik Vaage, Avinor

4.3.2.3 Training

A single AFISO has been formally trained during 2012 to be the Remote AFISO during the trial. Other participants/stakeholders will be briefed before and during the trial on the trial procedures and objectives.

4.3.2.4 Time planning

The detailed time planning is shown in

Week	Beginning	M	T	W	T	F	S	S
48	26-Nov	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM		
49	03-Dec	PM	AM/PM	AM/PM	AM/PM	AM		
50	10-Dec	PM	AM/PM	AM/PM	AM/PM	AM		
51	17-Dec	PM	AM/PM	AM/PM	AM/PM	AM		
52	24-Dec							
1	31-Dec							
2	07-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
3	14-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
4	21-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
5	28-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
6	04-Feb							
7	11-Feb	PM	AM/PM	AM/PM	AM/PM	AM		
8	18-Feb	PM	AM/PM	AM/PM	AM/PM	AM		
9	25-Feb	PM	AM/PM	AM/PM	AM/PM	AM		
10	04-Mar	PM	AM/PM	AM/PM	AM/PM	AM		
11	11-Mar	PM	AM/PM	AM/PM	AM/PM	AM		

Dry Run
Passive
Advanced
Closed

Notes:

1. *A dry Run period will be conducted prior to the trial start.*
2. *Each day can be divided into 2 sessions, according to the traffic. An AM session for the morning flight, and a PM one for the afternoon flight.*
3. *The first session each week will not be measured and will be used for any technical configuration and/or testing/assurance.*
4. *The last session each week will not be measured and will be used for other trial tasks such as admin, catching up on questionnaires, debriefs etc*
5. *Initially, 2 sessions will be planned each Tuesday, Wednesday and Thursday. This will be reviewed in January.*

Table 6 overleaf. To date, the planning for visitors during the Passive Shadow Mode period has been done but the planning for the Active Shadow Mode element has not yet been done. It is expected that a detailed time planning for Advanced Shadow Mode will be developed during the Passive Shadow Mode element to reflect latest known information and lessons learned.

4.3.2.5 Risks

4.3.2.5.1 General

The main risk to the trial is that there is only one AFISO trained to provide ATS in a live environment. If that AFISO were to be unavailable for any reason, there are no replacements available in the short term.

4.3.2.5.2 Passive Mode

There are no specific risks to this trial. The general risks are those that apply for any Passive mode trial and are:

1. The Passive Mode will not require the AFISO to be actively engaged in providing information to aircraft and can therefore give a false sense of confidence in the system.
2. The AFISO does not feel able to give opinion, not having used the system for actual advice.
3. The CAA might decide not to approve the concept to start the Advanced Shadow Mode.

4.3.2.5.3 Advanced Mode

1. The Advanced Mode will require of the AFISO to be actively engaged in providing information to aircraft.
2. The AFISO might not be able to assess the weather accurately and as a consequence provide false information to aircraft.
3. The AFISO will be remotely located from the Heliport in Værøy, and therefore could have a consequence on the following:
    a. The communication efficiency internally and externally between Bodø and Værøy staff, including the pilot. This might particularly be a concern during emergency situations.
    b. The social considerations for the AFISO while operating remotely.

4.3.2.6 Errors and Observation handling

N/A

Week	Beginning	M	T	W	T	F	S	S
48	26-Nov	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM		
49	03-Dec	PM	AM/PM	AM/PM	AM/PM	AM		
50	10-Dec	PM	AM/PM	AM/PM	AM/PM	AM		
51	17-Dec	PM	AM/PM	AM/PM	AM/PM	AM		
52	24-Dec							
1	31-Dec							
2	07-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
3	14-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
4	21-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
5	28-Jan	PM	AM/PM	AM/PM	AM/PM	AM		
6	04-Feb							
7	11-Feb	PM	AM/PM	AM/PM	AM/PM	AM		
8	18-Feb	PM	AM/PM	AM/PM	AM/PM	AM		
9	25-Feb	PM	AM/PM	AM/PM	AM/PM	AM		
10	04-Mar	PM	AM/PM	AM/PM	AM/PM	AM		
11	11-Mar	PM	AM/PM	AM/PM	AM/PM	AM		

Dry Run
Passive
Advanced
Closed

Notes:

6. *A dry Run period will be conducted prior to the trial start.*
7. *Each day can be divided into 2 sessions, according to the traffic. An AM session for the morning flight, and a PM one for the afternoon flight.*
8. *The first session each week will not be measured and will be used for any technical configuration and/or testing/assurance.*
9. *The last session each week will not be measured and will be used for other trial tasks such as admin, catching up on questionnaires, debriefs etc*
10. *Initially, 2 sessions will be planned each Tuesday, Wednesday and Thursday. This will be reviewed in January.*

Table 6 - Time planning

4.3.3 Analysis Specification

The collected data will be both quantitative and qualitative in nature, describing the participating AFISO's notions and feedback concerning the validation objectives. The quantitative data will be collected on either an online platform or by pen and paper and afterwards inputted in an online platform. The qualitative data will be collected in the same way, only the questions will be open rather than multiple choices.

The following assessment methods and techniques will be used:

1. Observation during the trial
2. Questionnaires and debriefing

A Validation leader/ observers will document how operators are solving their tasks, especially for critical situations and also keep track of the questionnaires being filled in.

Furthermore, the analysis will be drawn in a short report immediately after the Passive Mode and sent to the CAA to gain their feedback and approval to start validating the concept in Advanced Shadow Mode. This report will have the results from the Passive Mode with some analysis (a complete analysis will not be possible to be drawn in such a short amount of time). A full analysis and report on the results will follow after completing the Advanced Shadow Mode.

4.3.3.1 Data collection methods

The inputs to the analysis will be the simulation objectives, the metrics, questionnaire responses, debrief feedback and observations.

Given the scope and design of the analysis, data will be subjective in nature, i.e. based on the AFISOs' opinion. Automated data collection and/or on-line questionnaires will be used where possible in order to expedite the collation of data during the trial period.

Data quantity will be checked on a regular basis to ensure the collection methods are working over the trial period. Data quality will also be checked with mid-trial analysis conducted at a high level to highlight any issues and feed back into trial design if necessary.

AVINOR personnel will observe, and one AFISO is authorized to handle traffic.

All visitors will be asked to contribute and fill in questionnaires. This includes ATCO's from Bodø ATCC, pilots operating on routes in the area (in particular Lufttransport, Wideroes and RNoAF), staff unions and national authorities.

5 References

5.1 Applicable Documents

[1] SESAR V&V Strategy

[2] SESAR SEMP v2.0

[3] Ops 6.2 DOD

[4] Template Toolbox Latest version

[5] Requirements and V&V Guidelines Latest version

[6] Toolbox User Manual Latest version

[7] European Operational Concept Validation Methodology (E-OCVM), V3.0, 2010

5.2 Reference Documents

The following documents provide input/guidance/further information/other:

[8] P06.09.03 Operational Services and Environment Description (OSED), DEL-693-WA-A-OSED-Part3-00.01.01, NORACON, 15th July 2011

[9] SESAR P06.09.03 Project Initiation Report, Remote & Virtual Towers, Edition 00.00.06, April 2010

[10]ROT Project Final Report v1.00, D-LFV2009-053075, LFV, 23/11/2009,

[11]ART Project Validation Report Revision 1, ART WP3.4 D3.4.1, 17/03/2010

Appendix A Safety Plan

The sections of the HP Assessment Plan relevant to these trials are included below.

As per the safety approach to be applied in SESAR (described in the SESAR Safety Reference Material – SRM), the Safety Case (PAC06) addressing the Remote and Virtual Tower concept is to be developed in the frame of the safety transversal activity WP16.6.1.

At the level of the corresponding Operational Focus Area – OFA (which encompasses WP6.9.3 and WP12.4.6, WP12.4.7 and WP12.4.8), a Safety Assessment is to be carried out in order to develop a complete and correct set of safety requirements, and more generically to provide necessary and sufficient evidence and information to support the production of this PAC06 Safety Case.

The Safety Assessment for Single Remote Tower is structured in 3 main "interactive" phases, and for each of them evidence are to be provided to satisfy specific principles (see section 3.5.1 in the Validation Strategy for more detail). These phases are the following ones:

- Definition phase
- Design & Validation phase
- Prototype Implementation

The Safety Plan provides, inter alia, all the safety assurance activities to be carried out in the safety assessment to provide evidence and thus supporting the validation from a safety viewpoint of the Single Remote Tower concept. Detailed information on techniques and tools to be used in these activities is also provided in the Safety Plan.

Shadow mode trials are part of these techniques, in particular for activities related to principles P5P6 (in the Design and Validation phase) and P7 (in the Prototype Implementation). The results from these exercises will *a priori* provide evidence to show that Remote Tower system design operates correctly in a dynamic sense, under all normal and abnormal conditions, and that it can safely operate under, and recover from, all degraded modes of operations. Some evidence on the capability of safety requirements to be satisfied and tested is also expected from these activities. See more detail in section A.2.

A.1 Safety Validation objectives and hypothesis

The aim of this safety assessment is to support the validation of the Remote Tower concept by showing that providing ATC/AFIS services remotely for one low density airport is as safe as, if not better than, providing them locally.

For that, evidences will be provided ensuring that the Single Remote Tower functional system[2]:

- has sufficient safety functionality and performance
- works properly under all normal conditions of the operational environment that it is likely to encounter,
- can safely continue to operate under any external abnormal condition that it may exceptionally encounter,
- can safely operate under, and recover from, all degraded modes of operations,
- and that the safety requirements specifying it (and ensuring precedent statements) are realistic, i.e. a system can be built to deliver them.

The safety related Validation Objectives in Section 3.6 are derived from these goals.

The 'acceptable' level of safety is defined by the Safety Acceptance Criteria (SAC) in terms of risk associated to several hazardous situations. The list of SAC is provided in section 2.4 of the Preliminary Safety Assessment Report (Ref).

[2] 'functional system' shall mean a combination of equipment, procedures and human resources organised to perform a function within the context of air navigation services (as per Safety Reference Material [ref] definition).

Safety criteria are considered in equivalent conditions of traffic (in terms of capacity and movements) and operational environment than in current operations, i.e. impact on the movement rate during Low Visual Conditions using enhanced visualisation features has been taken into account.

A.2 Direct Links to Validation Trials

The several validation exercises (shadow mode trials) are expected to provide evidence (in more or less extend) for the following safety assurance activities (see more detail of each referenced "safety assurance activity" in the Safety Plan):

a. Check that the Remote Tower design operates correctly in a dynamic sense, under all normal conditions (P5P6-AO2-a3)

b. Check that the Remote Tower design operates in a way that does not have a negative effect on other ATM functions or elements the operation of related ground-based and airborne safety nets other ATM functions or elements (P5P6-AO2-a4)

c. Assess whether the Remote Tower design operates correctly in a dynamic sense, under all abnormal conditions (P5P6-AO3-a4)

d. Check that the system design operates in a way that does not have a negative effect on other ATM functions or elements (ground-based and airborne safety nets, airspace design, external entities, …) (P5P6-AO3-a5)

e. Check that the system can actually operate safely under, and recover from, all foreseen degraded modes of operation (P5P6-AO5-a4)

f. Show that all Safety Requirements are capable of being satisfied in the physical system comprising hardware, software, people and procedures (P5P6-AO8-a2)

g. Show that all Assumptions that have been made in the Definition and Design & Validation phases, on which the Safety Requirements depend, are necessary and valid (P5P6-AO8-a3)

h. Show that the satisfaction of all Safety Requirements in the physical system can be demonstrated with the appropriate degree of confidence (P5P6-AO9-a1)

i. Show that all new, expanded or refined ATC/flight crew procedures requirements are necessary the operation of the Technical System under all *normal* operating conditions (P7-AO1-a12)

j. Show new ATC/flight crew procedures requirements are sufficient to ensure the safest operation of the Technical System under all *abnormal* operating conditions, and recovery from those conditions (P7-AO1-a13)

k. Show that non-safety elements of the physical design do not adversely affect safety (P7-AO2-a1)

Safety expectations for each particular trial are specified in each corresponding Exercise Validation Plan (Section 4). A specific Task is defined in the Safety Plan [Ref] to support the preparation of each validation exercises for Single Remote Tower and to ensure that necessary and sufficient evidence is obtained from them from a safety point of view:

ST2.1	**Safety work for each validation exercise:** to determine the safety related objectives and elements to be validated (to be part of the trial validation plan) and analyse the collected results (to be reported in the trial validation report). Some other safety support may also be provided, as trial safety risk assessments (see the detail on the Safety Assurance Activities to be done).

The main activities to be carried out in this task are listed here after (for more detail see section 5 of the Safety Plan [Ref]):

- Identify safety related elements to be validated
- Show that the prototype has been fully prepared for the trial

- Show that the corresponding procedures have been fully prepared for the trial
- Show that the necessary training has been fully prepared for the trial
- Ensure that the corresponding assumptions are valid for the trial
- Ensure that the risk during trial (and during transition to/from trial conditions) has been reduced as far as reasonably practicable
- Collect and report results from the trial.

Appendix B Security Plan

Not applicable

Appendix C Environment Plan

Not applicable

Appendix D Human Performance Assessment Plan

The sections of the HP Assessment Plan relevant to these trials are included below.

The HP Assessments will cover, where possible, the entire concept being addressed in Remote Provision of ATS to a Single Aerodrome as stated in the OSED and assessed in the trials.

D.1 Human Performance Validation objectives

The overall aim of the HP assessment is to demonstrate that the remote tower concept for single remote aerodrome does not negatively impact, if not improves, human performance compared to current operations. Thus the remote tower concept for single aerodromes must adhere to two fundamental HP principles, that is:

- The role of the human actors in the system is consistent with human capabilities and characteristics
- The contribution of the human within the system supports the expected system performance and behaviour

The HP objectives were identified from the issue and impact analysis conducted as part of the HP assessment (See Annex 1). From this, it was determined that the HP objectives for the trials were:

1. To support the design and development of the HMI (for both the CWP and 3D LCD panoramic screens)
2. To support the development of procedures for both nominal and non-nominal situations / events
3. To ensure task allocation and responsibilities are clear and appropriate between personnel onsite at the aerodrome and at the remote tower
4. To assess the remote tower concept of operations for single aerodromes on human performance in terms of:
    I. Situation awareness
    II. Human error / performance
    III. Acceptability
    IV. Trust
    V. Workload

D.2 Direct Links to Validation Trials

Four activities were recommended in the human performance assessment plan to ensure that the objectives identified are adequately addressed and the necessary evidence is gathered from the HP assessment. One of the four recommended activities was shadow mode trials. The following table describes the objectives of the trials from the perspective of the human performance assessment:

	Trials
Objective	The aim of the shadow mode trials is to enable ATCO/AFISOs to judge the concept in a realistic environment with real live traffic in order to assess the impact of the remote tower concept of operations on human performance. Both ATCO/AFISO feedback and observation data will be obtained to assess human performance. The main objective of the shadow mode trials is to assess the impact of the remote tower concept of operations on ATCO/AFISO human performance in terms of: • Situation awareness • Human error / performance • Acceptability • Trust

	• Workload Also, if possible, feedback from the aircrew and other stakeholder e.g. onsite personnel that participated in the trial will be gained relating to trust and acceptability. The trials would also be used to verify the impact of the remote tower concept of operations on ATCO/AFISOs tasks and activities in order to update the task analysis.
Benefits	The benefit of the trials is that they enable the ATCO/AFISOs to judge the concept and gain hands-on experience using the remote tower platform with real traffic in a live real world environment. Also feedback can be gained from other stakeholders e.g. aircrew that have been direct involved in the trials.
Input	Operational procedures for nominal and those non-nominal events that can be tested in shadow mode trials; HP objectives for the live trials and hypotheses derived from the HP issues identified to date; validation exercise plan for the life trials; questionnaires, metrics and measures required address HP objectives and hypotheses.
Output	The HP findings from the shadow mode trials will be documented in the trial validation reports produced for each trial. In addition a summary of the main findings of the trials will be reported in the HP Assessment report developed for single aerodrome operations.

Appendix E Benefit Mechanisms

E.1 Cost Effectiveness

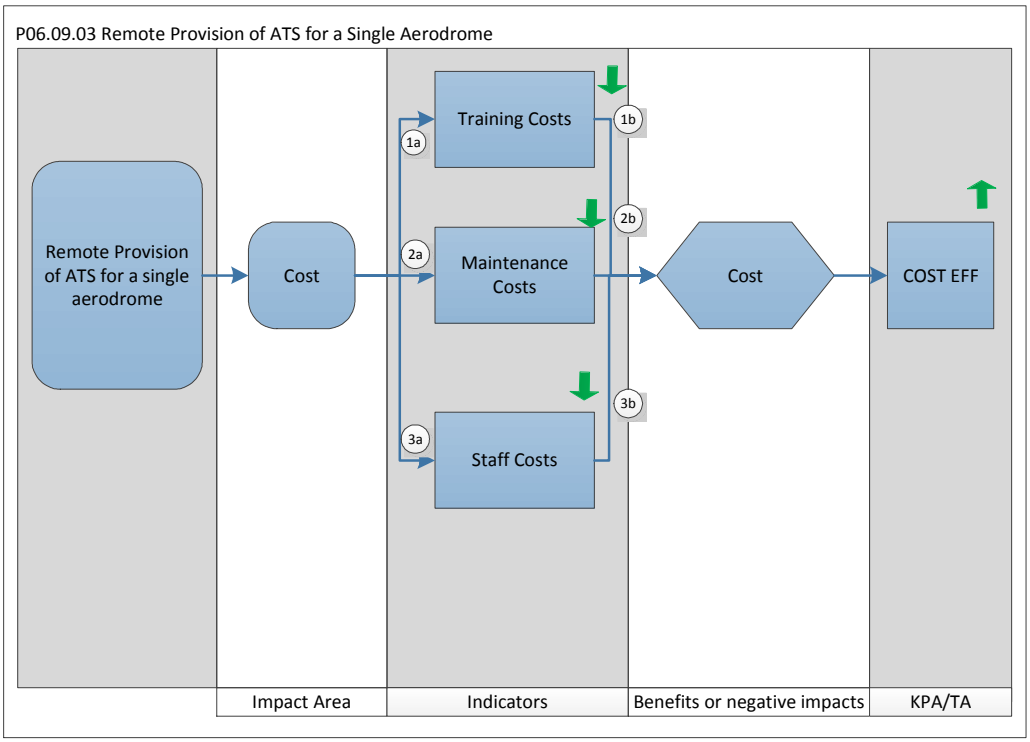

Figure 5 - Cost Effectiveness Benefit Mechanism

Feature Description: Remote Provision of ATS for a single aerodrome

Mechanisms:

(1a) Centralised provision of ATS (through co-located Single Remote facilities) will enable centralised training on standard equipment.

(1b) This will reduce the cost of initial and recurrent training by large scale effects and economies of scale, leading to more Cost Effective training.

(2a) Remote facilities will built, equipped and maintained in place of local airport towers. Replacement towers will not have to be built.

(2b) The remote facilities will be cheaper to build and maintain, leading to more Cost Effective facilities.

(3a) Co-located facilities should reduce the need for extra, local, reserve staff. Staffing numbers can be reduced.

(3b) Lower staff costs will lead to more Cost Effective service provision.

Impacted Stakeholders:

ANSP, Airport Operators, Airspace Users

Data Sources:

Training Costs (Basic Training and Recurrent Training): Cost Analysis of Training Costs

Maintenance Costs: Cost Analysis of Maintenance Costs of Local Tower

Staff Costs: Cost of staffing facility including reserve staff

E.2 Flexibility and Capacity

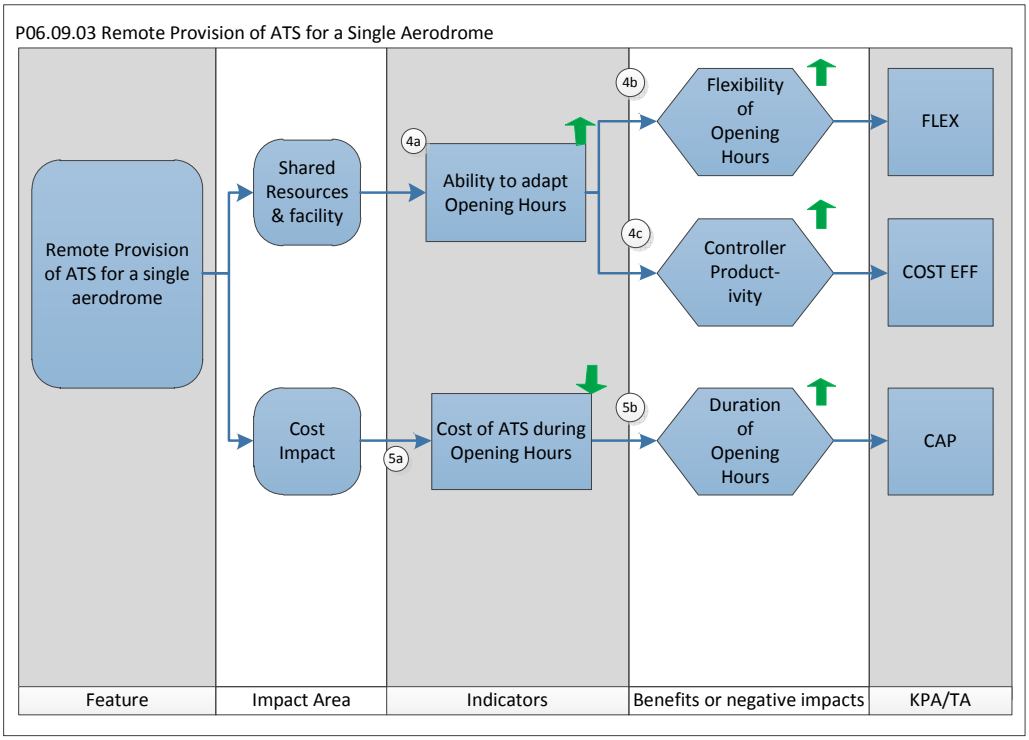

Figure 6 – Flexibility and Capacity Benefit Mechanism

Feature Description: Remote Provision of ATS for a single aerodrome

Mechanisms:

(4a) A centralised facility will allow for use of shared resources to any aerodrome. This will increase the ability to be more flexible with regards changes to opening hours.

(4b) Ability to change opening hours according to demand will increase the flexibility of the opening hours, impacting **Flexibility**.

(4c) More flexible opening hours will make more use of existing controllers (e.g. during quiet periods at aerodromes) leading to an increase in Controller Productivity. This will have a positive impact on Cost Effectiveness.

(5a) With the possibility for centralised/shared resources (human and technical) it may be possible to operate from an RTC for longer periods (and at lower costs) throughout the day.

(5b) If the RTC is operating for longer hours then traffic could be increased which links to **Capacity.**

Impacted Stakeholders:

ANSP, Airport Operators, Airspace Users

Data Sources:

Number of hours the RTC is in operation

E.3 Safety and Capacity

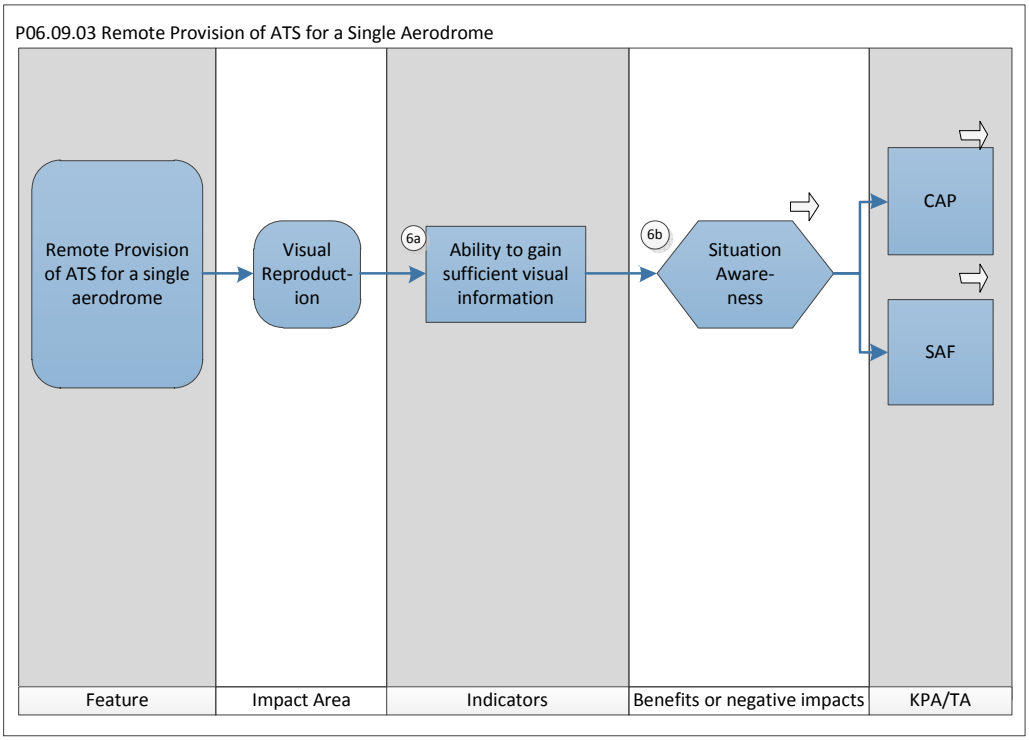

Figure 7 – Safety and Capacity Benefit Mechanism

Feature Description: Remote Provision of ATS for a single aerodrome

Mechanisms:

(6a) The ATCO must be able to gain sufficient information from the visual reproduction in order to make their decisions and provide their services. Their ability in this regard is not yet known and will be a subject of validation.

(6b) Situational Awareness of the controller may change. This may have an impact on **Safety** and **Capacity**.

Impacted Stakeholders:

ANSP, Airport Operators, Airspace Users, Regulators

Data Sources:

Situational Awareness: Human Performance Assessment of the ATCO.

-END OF DOCUMENT-