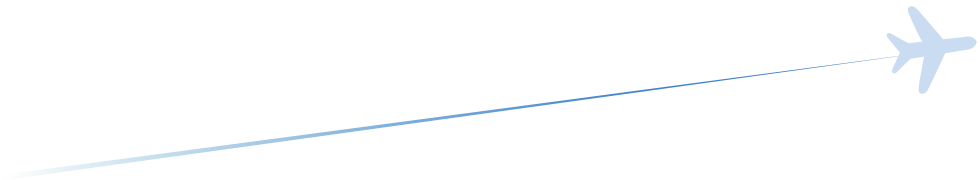

SESAR Solution PJ02-03 SPR/INTEROP-OSED for V3 - Part IV - Human Performance Assessment Report

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EARTH

INCREASED RUNWAY AND AIRPORT THROUGHPUT

This Human Performance Assessment Report is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 731781 under European Union's Horizon 2020 research and innovation programme.

Abstract

This document contains the Human Performance (HP) Assessment Report for the Minimum Pair Separations Based on Required Surveillance Performance concept, in support of a reduction of the in-trail Minimum Radar Separation from 2.5 NM to 2 NM on final approach in order to provide a direct positive impact on runway throughput. The HP Assessment report consists of the HP issues identified at the level of the HP Plan, the results of the activities conducted in order to clarify the identified issues and the HP recommendation and requirements. It corresponds to the completion of the four steps of the HP assessment process, concluding as well on the HP maturity level of the project. The assessment has been performed in order to assess whether the proposed operational concept and the corresponding procedures do not negatively impact, if not improve, human performance compared to current operations, based on the defined HP plan activities.

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1 Executive Summary

The in-trail MRS constraint on final approach is currently typically 3 NM, or can be 2.5 NM under certain conditions as prescribed by international and local regulations. The benefits that can be gained from the wake turbulence separation optimisation concepts for arrivals, including Time Based Separation (TBS), Static Pair Wise Separation (S-PWS) and Time Based Static Pairwise Separation (TB S-PWS), are limited by the in-trail 2.5 NM MRS on final approach. This solution aims to address this issue by facilitating a reduction of the in-trail MRS on final approach to 2 NM.

Application of the in-trail 2 NM MRS on final approach will be dependent on the surveillance service being employed by the controllers responsible for spacing delivery on final approach satisfying the RSP requirements for 2 NM separation. The spacing required between arrival pairs will also be constrained by other factors such as satisfying the Runway Occupancy Time (ROT) requirements for clearance to land, which is being addressed by the Optimised Runway Delivery (ORD) ATC tool support being developed and validated in SESAR Solution PJ02-01.

The RSP requirements for 2 NM separation on final approach will need to be established in such a way such that the requirements can be applied to the changing technological and operational environments of the future and thus are required to be general performance requirements that are disengaged from a specific technological implementation. The proposed approach to establishing these RSP requirements for 2 NM separation is the expert judgement and modelling extrapolation of the RSP requirements that have been set in Europe for the 5 NM and 3 NM horizontal separations.

The proposed application of the in-trail 2 NM MRS on final approach is to be demonstrated as safe in design and in application by the ATCOs responsible for setting up and delivering the arrival aircraft spacing on final approach. The main development needs include establishing the RSP requirements for 2 NM separation on final approach and the validation of the impact of the in-trail 2 NM MRS on the controller delivery of the arrival spacing on final approach, with particular focus on HP.

The Real Time Simulation performed by EUROCONTROL as part of EXE-PJ02-03-V3-RTS02 focused on the application of 2NM MRS on the final approach (AO-0309) with time based pairwise wake turbulence separations based on static aircraft characteristics for arriving aircraft (static Pair Wise Separations - PWS-A -AO-0310) with ORD (AO-0328). Time based PWS-A is the efficient aircraft type pairwise wake separation rules for final approach consisting of both the time based 96 x 96 aircraft type based pairwise wake separation minima and the time based 20-CAT wake category based wake separation minima for arrival pairs involving other aircraft types. The ORD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between arrival pairs on final approach to the runway landing threshold. The Target Distance Indicators takes into consideration operational constraints such as the Wake Turbulence Separation (WT), Minimum Radar Separation (MRS) and Runway Occupancy Time (ROT) for each aircraft pair. The Final Target Indicator presents the most constraining spacing / separation to the controllers on the final approach with the associated compression.

In RTS02 2.0NM MRS with TB PWS and the ORD tool concepts were assessed under segregated mode runway using an environment based on the Vienna airport and final approach. The impact of 2.0NM with PWS-A with ORD on runway throughput, safety and human performance was evaluated and

compared to 2.5NM with PWS-A with ORD plus a reference scenario in which the current wake separation scheme employed at the airport was applied (in the case of Vienna, current operations consist of ICAO wake turbulence separation scheme).

However, exercises were executed in a prototyping session prior to the RTS to investigate the operational feasibility and acceptability of applying 2.0NM MRS instead of 2.5NM MRS with ICAO DBS separations and no tool under nominal conditions in a single approach environment.

Additionally, three different workshops involving ATCOs and pilots have been used in order to close the HP Plan open issues and clarify remaining objectives.

This document concludes on the HP maturity level of the concept, while summing up requirements and recommendations defined following the Interpretation of the data obtained from the prototyping session, real time simulations and the workshops.

The main HP arguments addressed in the exercise were:

- **Arg.1:** The role of the human is consistent with human capabilities and limitations
- **Arg.2:** Technical systems support the human actors in performing their tasks
- **Arg.3:** Team structures & team communication support the human actors in performing their tasks
- **Arg. 4**: Human Performance related transition factors are considered.

With regard to human performance activities, the new operational concept was assessed in terms of situational awareness, workload, trust in the HMI, acceptability of procedures and system, usability and utility of the system and teamwork and communication.

The above activities have been executed by applying the following data collection methods:

- Objective measurements (R/T frequency occupancy, number of clearances, sector load etc.)
- Subjective data (questionnaires, ISA recordings, debrief notes and expert observations)

A total of 85 potential HP issues/ benefits have been identified, on the basis of which 3 HP activities were proposed:

1. Task Analysis and HP issue analysis
2. User workshops (with relevant experts following the Prototyping Sessions- ATCOs and pilots)
3. Prototyping sessions, real time simulations, debriefs

These activities have been defined in order to cover the HP objectives that have been included in the Validation Plan **Error! Reference source not found.**. The output of these activities has been integrated in the list of requirements and recommendation that are described in Chapter 4, and related to:

- The operational concept and related procedures
- The technical system and the design of the HMI
- The training of the end users

Considering the evidence gathered during the HP validation activities, with the respect to HP maturity criteria it can be concluded that the 2NM MRS on the final approach (AO-0309) with time based pairwise wake turbulence separations based on static aircraft characteristics for arriving aircraft (static Pair Wise Separations - PWS-A -AO-0310) with ORD (AO-0328) has completed a V3 level of maturity. The concept of 2.0NM MRS instead of 2.5NM MRS with ICAO DBS separations and no tool under

nominal conditions in a single approach environment, has reached a V3 level of maturity. As a result, the status of the issues and benefits is closed.

2 Introduction

2.1 Purpose of the document

The purpose of this document[1] is to describe the result of the activities conducted according to the HP reference material [2]. in order to derive the HP Assessment Report for the SESAR SolutionPJ02-03, including requirements and recommendation.

In the same time, the document will conclude on the level of maturity of the concept at this stage of the project, detailing requirements and recommendations based on the findings.

2.2 Intended readership

The intended audience for this document are primarily all the partners involved in SESAR 2020 (PJ02) addressing solution 01 and solution 02.

The intended readership for this document are:

- SESAR Project PJ02 Increased Runway and Airport Throughput project members
- SESAR Project PJ01 Enhanced Arrivals and Departures project members
- SESAR Project PJ04 Total Airport Management project members
- SESAR Project PJ09 Advanced Demand & Capacity Balancing project members
- Related transversal SESAR Projects PJ19 and PJ22, and all impacted and interested stakeholders.

Stakeholders are to be found among:

- ANS providers;
- ATM infrastructure and equipment suppliers.
- Airspace users;
- Airport owners/providers;
- Affected NSA;
- Affected employee unions;

[1] The opinions expressed herein reflect the author's view only. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

2.3 Scope of the document

This document describes the result of the activities conducted to date according to the Human Performance assessment process to derive the Human Performance Report for the Minimum Pair Separations Based on Required Surveillance Performance (RSP) concept, in PJ02-03 (both from EXE-PJ02-03-V3-RTS02 and the prototyping session with 2.0 NM MRS- DBS ICAO no tool).

The HP results have been crosschecked with the input made in the Safety Assessment Report **Error! Reference source not found.**, for ensuring a consolidated view on the findings and harmonised requirements and recommendations.

As the Minimum Pair Separations Based on Required Surveillance Performance (RSP) concept was validated in conjunction with the ORD support tool, the recommendations and requirements relating to the support tools are documented in the PJ02-01 Human Performance Assessment Report **Error! Reference source not found.**.

2.4 Human performance work schedule within the Solution

The Human Performance activities for Pj02-03, EXE-PJ02-03-V3-RTS02, were executed according to the exercise plan that encompassed HP activities as proposed in the HP Plan **Error! Reference source not found.**. The results are thoroughly presented in the VALR **Error! Reference source not found.** and in the OSED **Error! Reference source not found.**, encompassing findings from all transversal areas involved.

2.5 Structure of the document

This document contains 5 chapters.

- Chapter 1 contains an executive summary which gives information about the purpose and scope of the validation exercise, including a reference to results and conclusions, as well as recommendations and recommendations.;
- Chapter 2 describes the purpose and the scope of the document, introducing the intended readership and detailing the HP work schedule within the Solution. It entails a list of acronyms and terminology.
- Chapter 3 provides information with regard to the HP Assessment Process
- Chapter 4- in line with the HP reference material **Error! Reference source not found.**, it describes the 4 steps defined in the HP Assessment Process
    - Step 1: Understand the ATM Concept
    - Step 2: Understand the HP Implications
    - Step 3: Improve and validate the concept
    - Step 4: Collate findings & conclude on transition to the next V-phase.

Chapter 5- is intended to include all relevant reference material as well as additional information in the Appendixes:

- Appendix A: Additional HP activities conducted
- Appendix B: HP recommendations Register

- Appendix C: HP Recommendations Register
- Appendix D: empty, as it was considered the Word documentation is sufficient for the development of both the HP Plan and the HP Assessment Report, for PJ02-03.

2.6 Acronyms and Terminology

Term	Description
a/c	Aircraft
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATS	Air Traffic Services
EARTH	Enhanced Runway Throughput
EFPS	Electronic Flight Progress Strips
HMI	Human Machine Interface
HPAP	Human Performance Assessment Plan
HPAR	Human Performance Assessment Report
LOS	Loss of Separation
MRS	Minimum Radar Separation
N/A	Not applicable/ Not Available
Nm	Nautical Mile
OBJ	Objectives
OI	Operational Improvement
ORD	Optimised Runway Delivery
OSD	Optimised Separation Delivery
OSED	The Operational Service and Environment Definition
PJ	Project
PWS-A	Pair-Wise Separation on Arrivals

PWS-D	Pair-Wise Separation on Departure
RSVA	Reduced Separation in the Vicinity of an Airfield
RTS	Real Time Simulation
RWY	Runway
SESAR	Single European Sky ATM Research
SID	Standard Instrument Departure
SPR	Safety and Performance Requirements
TBD	To be Defined
TEAM	Tactically Enhanced Arrivals Mode
TMA	Terminal Manoeuvring Area
TWR	Tower
VALP	Validation Plan
WSTOT	Wake Separation Take-Off Time
WV	Wake Vortex
Human Factors (HF)	HF is used to denote aspects that influence a human's capability to accomplish tasks and meet job requirements. These can be external to the human (e.g. light & noise conditions at the work place) or internal (e.g. fatigue). In this way, "Human Factors" can be considered as *focussing on the variables that determine Human Performance*.
Human Performance (HP)	HP is used to denote the human capability to successfully accomplish tasks and meet job requirements. In this way, "Human Performance" can be considered *as focussing on the observable result of human activity in a work context*. Human Performance is a function of Human Factors (see above). It also depends on aspects related to Recruitment, Training, Competence, and Staffing (RTCS) as well as Social Factors and Change Management.
HP activity	An HP activity is an evidence-gathering activity carried out as part of Step 3 of the HP assessment process. An HP activity can relate to, among others, task analyses, cognitive walkthroughs, and experimental studies.
HP argument	An HP argument is an HP claim that needs to be proven through the HP Assessment Process.

HP assessment	An HP assessment is the documented result of applying the HP assessment process to the SESAR Solution-level. HP assessments provide the input for the HP case.
HP assessment process	The HP assessment process is the process by which HP aspects related to the proposed changes in SESAR are identified and addressed. The development of this process constitutes the scope of Project 16.04.01. It covers the conduct of HP assessments on the Solution-level as well as the HP case building over larger clusters of Solutions.
HP benefit	An HP benefit relates to those aspects of the proposed ATM concept that are likely to have a positive impact on human performance.
HP case	An HP case is the documented result of combining HP assessments from Solutions into larger clusters (SESAR Projects, deployment packages) in SESAR.
HP issue	An HP issue relates to those aspects in the ATM concept that need to be resolved before the proposed change can deliver the intended positive effects on Human Performance.
HP impact	An HP impact relates to the effect of the proposed solution on the human operator. Impacts can be positive (i.e. leading to an increase in Human Performance) or negative (leading to a decrease in Human Performance).
HP recommendations	HP recommendations propose means for mitigating HP issues related to a specific operational or technical change. HF recommendations are proposals that require additional analysis (i.e. refinement and validation). Once this additional analysis is performed, HF recommendations may be transformed into HF requirements.
HP requirements	HP requirements are statements that specify required characteristics of a solution from an HF point of view. HP requirements should be integrated into the DOD, OSED, SPR, or specifications. HF requirements can be seen as the stable result of the HF contribution to the Solution, leading to a redefinition of the operational concept or the specification of the technical solution.

Table 1: Acronyms and terminology

3 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process described in detail in the Reference Material **Error! Reference source not found.** is to ensure that HP aspects related to SESAR technical and operational developments are systematically identified and managed. The SESAR HP assessment process uses an 'argument' and 'evidence' approach. An HP argument is an 'HP claim that needs to be proven'. The aim of the HP assessment is to provide the necessary 'evidence' to show that the HP arguments impacted have been considered and satisfied by the HP assessment process. This includes the identification of HP requirements and recommendations to support the design and development of the concept.

The HP assessment process is a four-step process. REF _Ref512330465 \h * MERGEFORMAT Figure 1 provides an overview of these four steps with the tasks to be carried out and the two main outputs (i.e. HP plan and HP assessment report). In addition, an HP Log is maintained throughout the lifecycle of the Solution in which all the data/ information obtained from all HP activities conducted as part of the HP assessment is documented.

Figure 1: Steps of the HP assessment process

4 Human Performance Assessment

4.1 Step 1 Understand the ATM concept

4.1.1 Description of reference scenario

For a detailed description of the reference scenario, please consult the OSED **Error! Reference source not found.**.

4.1.2 Description of solution scenario

For a detailed description of the reference scenario, please consult the VALP-Chapter 5 **Error! Reference source not found.**.

4.1.3 Consolidated list of assumptions

For a detailed description of the validation assumptions please consult the VALP- Chapter 4.4 **Error! Reference source not found.** .

4.1.4 List of related SESAR Solutions to be considered in the HP assessment

- SESAR Project PJ02 Increased Runway and Airport Throughput project members
- SESAR Project PJ01 Enhanced Arrivals and Departures project members
- SESAR Project PJ04 Total Airport Management project members
- SESAR Project PJ09 Advanced Demand & Capacity Balancing project members

4.1.5 Identification of the nature of the change

The following table is used to help systematically identify and capture the nature of the change that may result due to the introduction of the concept(s) under investigation in terms of, the ATM actors impacted as well as the potential changes to their work.

The HP argument branches of the table cover the second level of HP arguments in Appendix A of **Error! Reference source not found.** and so it is not only used to help identify and capture changes to ATM actors work but can also be used to help screen and scope the HP assessment. Therefore, the table helps narrow down and focus the list of HP arguments that need to be investigated in the next step of the HP assessment. Furthermore, if there are no changes identified that relate to any of the HP argument branches in the table then no HP assessment is required on the Solution.

Note: the numbering of the argument branches in the table is in line with the numbering of the HP arguments in Appendix A of **Error! Reference source not found.**.

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	No changes currently foreseen ;
1.2 OPERATING METHODS	The scope of the proposed application of the 2 NM MRS on final approach is as follows: • From the lead a/c crossing the DF (typically 4-6 NM from the runway landing threshold). This is so as to extend being able to deliver spacing below the current 2.5 NM MRS inside of the DF (deceleration fix) in visual conditions when IFR procedures are required to be applied inside the DF. This will provide benefits when the headwind conditions are such that unneeded additional spacing is delivered when applying the current 2.5 NM MRS to the runway landing threshold and the visual conditions are such that RSVA cannot be applied. • From both the lead and follower a/c established on the final approach extended runway centre line inside of 10 NM from the runway threshold. This is so as to extend being able to deliver spacing below the current 2.5 NM MRS in moderate and strong headwind conditions on final approach outside of the DF. This will provide benefits In moderate and strong headwind conditions outside of the DF when unwanted additional spacing is delivered to the runway landing threshold when applying the current 2.5 NM MRS to the DF. • From both the lead and follower a/c established on the final approach extended runway centre-line beyond 10 NM from the runway threshold and potentially out to 20 NM from the runway landing threshold depending on local procedures. This is so as to extend being able to deliver spacing below the current 2.5 NM MRS in strong headwind conditions outside of 10 NM when this will result in unwanted additional spacing is delivered to the runway landing threshold when applying the current 3 NM or 2.5 NM

MRS to 10 NM from the runway landing threshold depending on local procedures.

- From the lead a/c established on the final approach extended runway centre-line and the follower a/c established on a stable intercept for merging on to the extended runway centre-line. This is as to further enable more efficient delivery to a required spacing below 2.5 NM across the DF in wind conditions on final approach when there is pull-away or no or little distance spacing compression after the follower aircraft has merged onto the final approach extended runway centre-line.

The approach procedures where the in-trail 2 NM MRS is required to be applied include the ILS / MLS precision approach procedures, the GBAS approach procedures and the RNAV/GNSS non-precision approach procedures.

In the case of the ILS / MLS precision approach procedures it is anticipated that the 2 NM MRS can be applied from the lead a/c established on the localiser along the final approach extended runway centre-line and the follower a/c established on a stable intercept for merging on to the extended runway centre-line.

In the case of GBAS approach procedures it is anticipated that the 2 NM MRS can be applied from the lead a/c established on the GBAS approach path along the extended runway centre-line and the follower a/c established on a stable intercept for merging on to the extended runway centre-line.

In the case of the RNAV/GNSS non-precision approach procedures it is anticipated that the 2 NM MRS can only be applied once both lead and follower a/c are established on the RNAV/GNSS approach path along the extended runway centre-line, which is after the Intermediate Fix of the RNAV/GNSS approach procedure. This is due to the uncertainties in the approach path being employed in an RNAV/GNSS non-precision approach until the aircraft has merged on to the extended runway centre-line at the Intermediate Fix. The Intermediate Fix is typically at or inside of 10 NM from the runway landing threshold depending on local procedures. The final approach ATCO will be able to apply smaller separations than current day procedures allow (i.e. 2NM instead of 2.5NM) under

	certain conditions (e.g. meteorological conditions- strong headwind and good visibility, runway occupancy time etc). This could mean that the number of a/c handled per unit of time is increased and hence ATCO workload could be impacted as in peak hours they will be able to handle more aircraft per unit time. Likewise the runway tower ATCO workload may also be impacted. If 2.0NM separation is allowed, the intermediate ATCO (or initial ATCO in CDG) will also have to deliver aircraft to the final approach ATCO with less spacing between aircraft pairs. This could impact in-turn the workload and complexity of their tasks. The use of the ORD tool is expected to positively support the ATCOs with regard to workload. If ROT is a constraint, the workload of the TWR ATCO will increase, as they have to closely monitor the a/c pair and instruct a go-around if needed. This would increase workload and stress levels due to the time pressure given by the shorter separations that do not allow a lot of buffer. If the go-around is instructed at 50 feet instead of 200 feet, this might bring unreasonable risks. If ROT is a constraint, the aforementioned time pressure and corresponding stress applies for the pilot as well. R/T occupancy might increase as well, in case more speed adjustments are needed on the final. 2.0NM separation on the final may impact runway operation procedures as it may mean that HIRO procedures have to be implemented to ensure efficient ROTs when 2.0NM is used as an MRS - to be investigated. In case ROT is not a constraint, no increase in workload is foreseen for the TWR ATCO or pilot. The ROT Spacing requirements for each arrival pair should be managed by the ORD tool and reflected in the FTD and ITD Indicators. It is not intended that the application of a 2NM MRS on final approach results in undesirable extra pressure on the Tower Runway Controllers or the Flight Crew with respect to the lead aircraft being clear of the runway for the follower aircraft to be given clearance to land or for the follower aircraft to proceed to land. Ultimately, the ROT Spacing requirements should be defined such that the nominal scenario is that of acceptable pressure on the Tower Runway Controller and the Flight Crew, for example with the lead aircraft being clear of the

	runway when the follower aircraft is at the DH of 200ft or 0.5NM from the runway landing threshold. The tower and approach supervisor shall check if the conditions for the application of 2.0NM MRS are met and agree on the use of 2.0NM as the MRS and communicate it to the ATCOs.
1.3 TASKS	Supervisor : Tower supervisor and approach supervisor coordinate when and for how long the Spacing Minimum is applied No tasks changes are foreseen for the ATCOs.
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	It is considered that the application of TBS or PWS without a support tool is not feasible. The support tool, the ORD tool, will calculate the required separation / spacing (including the compression) on the final approach to ensure the separation/ spacing is achieved at the separation delivery point (runway threshold). In order to determine the required spacing and separation the ORD tool will take into consideration the WV category, aircraft type and wind (i.e. compression) ,as well as the ROT of the lead and follower aircraft on the final approach. The Final Approach ATCO requires a support tool for the application of reduced separation on the final approach for TBS or PWS (to be determined for Distance Based) - i.e. 2.5NM to 2.0NM for MRS. A tool is needed to enhance the accuracy of separation delivery as the margins for error are reduced and also will give the ATCO more confidence in applying such reduced separations. The tool proposed to support the final approach ATCO apply a MRS of 2.0NM is the ORD tool developed in PJ02-01. The STCA parameters will have to be adapted for the new concept, synchronized with the ORD tool. It should be noted that the ORD tool will be required if TB separations and / or PWS are being applied on the final approach.
2.2 PERFORMANCE OF TECHNICAL SYSTEM	The refresh rate for the surveillance service will have to able to meet the RSP for 2.0NM MRS on the final. Based on SESAR I assumptions, the refresh rate should be set for 3.5 or 4 seconds, so that the ATCOs have a reliable and timely updated display of the traffic.

	The ORD tool will take into account a/c pairs and WV categories, ensuring the separation is correctly applied. A separation infringement alert is considered to be necessary in order to support controllers in the application of 2.0NM MRS and ensure that ATCOs can timely intervene in case of possible and actual separation infringements do not occur. Furthermore, the existing STCA may be impacted and parameters of the STCA may need to be modified to accommodate the reduced separation of 2.0NM or alternatively the STCA may not be necessary if another separation alert is available. If the STCA is required, the HMI of the STCA may need to be modified. The STCA parameters will have to be fine-tune in accordance with the ORD tool. The TCAS parameters will not need to be refined.
2.3 HUMAN – MACHINE INTERFACE	The ORD tool computes Target Distance Indicators (TDIs) for each aircraft pair when the required criteria are met and these are displayed on both the Approach and Tower working positions. In addition the ORD tool could include a Sequencing Tool which is displayed on the HMI of the Approach working positions which allows tactical modifications to be made to the sequence by the ATCOs. Sequence modifications are then fed back into the Separation Delivery Tool allowing Target Distance Indicators (TDIs) updates to be displayed. Another approach would be the implementation of an Auto-Sequence function that automatically populates the sequence order with auto suppression until there is sufficient certainty of the sequence order and auto correction (if required) once aircraft have turned on to the base/ intercept legs or established on the straight-in approach path. Alternatively the EFPS order of the Final Approach Controller may be used to provide the intended final approach sequence order from aircraft on downwind handed over by the Intermediate Approach Controllers. The TDIs consist of a Final Target Distance indicator (FTD) and an Initial Target Distance indicator (ITD). The FTD calculation represents the minimum required separation or spacing depending on the most constraining factor (e.g. WT separation, MRS, ROT or a gap inserted by the final approach ATCO) to be applied

at the point of separation delivery (in this case the runway threshold).

The ITD calculation includes the additional buffer required on top of the FTD to take into account the effect of compression due to aircrafts deceleration to landing stabilisation speed in order to meet the FTD at the separation delivery point.

In the final approach position the most relevant indicator is the ITD as it displays the spacing required on the final approach to ensure the separation minimum is not infringed at the separation delivery point. Therefore, only the ITD is permanently displayed on the final approach CWP HMI. However, the final approach ATCO can display the FTD associated with each aircraft on selection of that aircraft. Furthermore, if an aircraft passes the ITD (i.e. infringement of the initial target distance to be applied), the FTD will automatically be displayed so the ATCO can judge what action needs to be taken to avoid a subsequent "infringement" of the final target distance. In addition to prevent an infringement scenario where there is little or no predicted compression, the FTD will also be automatically displayed if the aircraft passes a predefined distance from the FTD (a distance of 0.3Nm from the FTD was implemented in previous simulations).

The relevant TDI for the tower controller is the FTD as it displays the separation minimum that shall not be infringed; therefore the only the FTD is constantly displayed on the tower runway CWP HMI. The ITD is still available and can be displayed on a 'need to know basis' on selection.

In addition, three alerts are proposed: a sequencing alert, speed conformance alert and catch-up alert as follows:

The sequencing alert is triggered for aircraft when the lead aircraft as defined in the sequencing tool is behind follower aircraft (per aircraft pair) on the final approach. The sequencing alert consists of sequence number (displayed above the call-sign), changing colour from black to yellow when the alert is triggered. Conversely the Auto-Sequence function could automatically populate the sequence order with auto suppression until there is sufficient certainty of the sequence order and auto correction (if required) once

	aircraft have turned on to base/ intercept legs or established on the straight-in approach path. The catch-up alert proposed is triggered when there is 12kts difference between the calculated speed of the ITD and the speed of the follower aircraft (this 12kts difference is only relevant when lead is before the deceleration fix, as due to the compression effect the ITD is faster than its leader following the deceleration fix as it is merging into the FTD) plus a catch-up time limit of 60 seconds (i.e. the minimum time allowed for a follower aircraft to infringe the initial target distance). The catch-up alert is depicted at the top of the aircraft label of the follower aircraft with "CATCHUP'' written in yellow text, and cannot be triggered once the lead aircraft passes the deceleration point. The speed conformance alert-addressing known human error scenarios on approach where wither the ATCO forgets to issue a speed reduction instruction or the flight crew fail to follow a speed reduction instruction- is triggered when an aircraft exceeds 160knots plus 20knots (i.e. 180knots) within the last 10NM from the threshold. The speed conformance alert is illustrated with the IAS speed in the aircraft label being highlighted in yellow The STCA is a ground-based safety net intended to assist the ATCO in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima. The current parameters that are intended to flag an infringement of 2.5NM MRS, will have to be recalibrated (in accordance with the ORD tool parameters) for 2.0NM MRS.
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No change
3.2 ALLOCATION OF TASKS	This will depend on the current organisation in the local environment– if the workload of one or more of the ATCOs e.g. tower ATCO, final approach ATCO, intermediate and / or initial controller, increases beyond acceptable levels during peak levels of traffic – there may be a slight redistribution of tasks between

	the ATCOs or even additional ATCOs needed. To be investigated.
3.3 COMMUNICATION	The final approach ATCO could be required to inform the pilots that MRS is 2.0NM or the information might only be available via the AIP/ flight crew briefing notes for the destination airport. It is recommended that this information is available to the pilots through the AIP, as the RT load is considered to be already high and hence an additional exchange might be increasing workload. At the moment, in certain aerodromes, for 2.5 NM MRS, a visual separation between a/c is mandatory, under the responsibility of the pilot, which requires "heavy phraseology", as described by the ATCOs. In these cases, the procedure is rarely applied. If the 2.0NM MRS can only be applied under certain conditions, the approach ATCO must check that the tower conditions are met and confirm with the tower ATCO. Both the tower and the approach ATCOs must agree on the use of 2.0NM MRS. Phraseology should be considered. – this would be the supervisors responsibility. MRS can only take place under certain conditions and the both supervisors – approach and tower have to coordinate and decide if and for how long MRS will be in place.
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	The 2NM MRS concept may affect ATCO acceptance of the new procedures, due to the potential increase in ATCO workload, as a result of reduced separations, as well as the potential de-skilling with regard to their ability to judge a/c separations by eye and to calculate / determine the required separation between a/c pairs mentally. Hence, the ATCOs might not feel comfortable applying the 2.0NM MRS without the tool. In the same time, Pilots may not accept the 2.0NM MRS under certain conditions.
4.2 COMPETENCE REQUIREMENTS	ATCOs working with the target distance indicators, may lose the skills they currently possess to determine the appropriate spacing between a/c pairs. The presence of the target indications means that under normal operating conditions ATCOs will not need to use to the same extent their knowledge of a/c performance together with the changing glideslope wind speed & direction profile, and the position of lead

	a/c, to judge what spacing is required between each a/c pair as this will be presented to them on the HMI. However, it is expected that under certain contingency procedures in abnormal conditions or degraded modes of operations this expertise and knowledge will still be needed.
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	This will depend on the current organisation in the local environment– if the workload of one or more of the ATCOs e.g. tower ATCO, final approach ATCO, intermediate and / or initial controller increases beyond acceptable levels during peak levels of traffic – there may be a need for additional controllers to support the sector(s) impacted
4.4. TRAINING	The approach ATCOs and tower ATCOs must be trained to work with the ORD tool and any other support tools proposed (e.g. adapted STCA, if applicable), in order to apply 2.0NM MRS.

Table 2: Description of the change

4.2 Step 2 Understand the HP implications

4.2.1 Identification of relevant arguments, HP issues & benefits and HP activities

The relevant arguments, HP issues and benefits identified and the corresponding HP activities have been detailed in the HP Plan (Part IV of the VALP) **Error! Reference source not found.**.Three HP activities were proposed in order to clarify the HP issues: task analysis, workshops and validation exercise.

4.3 Step 3 Improve and validate the concept

4.3.1 Description of HP activities conducted

HP activity	By when
Task analysis/ HP Issue Analysis	By July 2018
Workshop	This can be split in more than one workshop or meetings: - November 2018 (ECTL/NATS) - January 2018 – pilot/ATCO workshop (ECTL)

	- March 2019 (ECTL/ NATS)
Prototyping session RTS	Autumn 2018

Table 3: Table of proposed HP activities and their priority

ACTIVITY 1.	Task analysis and HP issue analysis
Description	Task analysis is the systematic breakdown of ATCO work into its various tasks, subtasks and activities. Complementary information can also be included in a task analysis such as the information and control devices needed to support ATCO perform their tasks, etc. Only normal operating conditions situations will be included in the task analysis. (Abnormal events will be dealt with in the safety assessment process). The HP issue analysis is based on the task analysis. Issues that have an impact on the human performance due to the proposed change and the new concept are identified.
Arguments & issues to be addressed	ARG. 2.1.1-1; 2.3.2-1
HP OBJECTIVES	OBJ-02.03-V2-VALP-HP2.1.1-001 - Ensure the task allocation between human and machine (e.g. Sequencing tool, TDIs) is consistent with HP guidelines for automation support and / or other automation guidelines OBJ-02.03-V2-VALP-HP2.3.2-001 - Assess ability to input constraints (changes such as departure insertion or runway inspection) into the TDI (i.e. usability of input mechanism). Ensure HF design principles are applied. Ensure the task allocation between human and machine (e.g. Sequencing tool, TDIs) is consistent with HP guidelines for automation support and / or other automation guidelines OBJ-02.03-V2-VALP-HP2.1.1-001Ensure the task allocation between human and machine (e.g. Sequencing tool, TDIs) is consistent with HP guidelines for automation support and / or other automation guidelines Ensure the task allocation between human and machine (e.g. Sequencing tool, TDIs) is consistent with HP guidelines for automation support and / or other automation guidelines Ensure the task allocation between human and machine (e.g. Sequencing tool, TDIs) is consistent with HP guidelines for automation support and / or other automation guidelines
Required Evidence	Check HP log Information
Tool selected out of the HP repository	HP Assessment Process**Error! Reference source not found.**

Planning and Approach	To be reviewed until one week before the first RTS takes place
resources	HP and Validation experts
timeline	December 2017→ July 2018

Table 4: Description of Activity 1

ACTIVITY 2	User- Workshop (or equivalent activity with relevant experts)
Description	Workshops on several topics (combined or separate) with end-users (ATCOs, supervisors, pilots) technical staff, training and licensing experts etc.,
Arguments & issues to be addressed	Arguments: 1.2.1-1; 1.2.1-2; 1.2.2-1; 1.2.3-1; 1.2.3-2; 1.2.4-1; 1.2.4-3; 1.2.5-1; 1.2.5-3; 1.2.5-4; 1.2.5-5; 1.3.1-2; 1.3.1-3; 1.3.2-1; 1.3.2-4; 1.3.2-6; 1.3.3-4; 1.3.4-1; 1.3.4-2; 2.2.1-2; 2.3.1-1; 2.3.1-3; 2.3.1-4; 2.3.1-5; 4.1.2-1; 4.3.1-1; 4.3.1-2
HP OBJECTIVES	OBJ-02.03-V2-VALP-HP1.2.1-001 - Identify situations that require HIRO procedures; Design HIRO procedures if needed due to MRS OBJ-02.03-V2-VALP-HP1.2.1-002 - Design go-around procedures considering arriving aircraft on MRS OBJ-02.03-V2-VALP-HP1.2.2-001- Design procedures for wind change (other abnormal conditions) OBJ-02.03-V2-VALP-HP1.2.3-001- Identify and design procedures for degraded modes OBJ-02.03-V2-VALP-HP1.2.3-002- Conduct scenarios for degraded modes of operation during validation to assess impact on ATCO & assess suitability, acceptability & usability of procedures, including the impact on ATCO task performance/error, workload, situational awareness and error identification and resolution OBJ-02.03-V2-VALP-HP1.2.4-001- Ensure end users are involved in the development and review procedures for normal, abnormal and degraded modes of operations OBJ-02.03-V2-VALP-HP1.2.4-003- Develop procedures to ensure it is clear for the Supervisors when to transition, in case of reported WT encounters, by the pilots. OBJ-02.03-V2-VALP-HP1.2.5-001- Develop procedures to ensure the transition from 2.5 NM MRS to 2.0NM MRS and vice versa is easy to implement and does not negatively impact human performance

OBJ-02.03-V2-VALP-HP1.2.5-003- Assess acceptability and usability of the procedures by ATCOs in prototyping sessions to ensure they can be executed accurately, efficiently and in a timely manner

OBJ-02.03-V2-VALP-HP1.2.5-004- Assess acceptability and usability of the procedures by Supervisors in to ensure they can be executed accurately, efficiently and in a timely manner

OBJ-02.03-V2-VALP-HP1.2.5-005- Assess acceptability and usability of the procedures by pilots/ airline operators to ensure they can be executed accurately, efficiently and in a timely manner

OBJ-02.03-V2-VALP-HP1.3.1-002- Ensure that the HMI is designed so that ATCOs are always aware of the mode of operation under which they are operating (i.e. the MRS values).

OBJ-02.03-V2-VALP-HP1.3.1-003- Assess the potential for human error (where ATCO may miss-identify which a/c is the first in the sequence where a reduced MRS of 2.0NM applies)

OBJ-02.03-V2-VALP-HP1.3.2-001- The controller shall communicate to the pilot that MRS is in place but that would increase the communication load and therefore the workload. The information should be on the AIP .Assess how the information should be formulated and transmitted that it is acceptable for pilots

OBJ-02.03-V2-VALP-HP1.3.2-004- Assess feedback of pilots with regard to RT load

OBJ-02.03-V2-VALP-HP1.3.2-006- Assess whether Supervisors are able to carry out their tasks for the activation of 2.0NM MRS or reversion to 2.5NM MRS in a timely manner

OBJ-02.03-V2-VALP-HP1.3.3-004- Assess the impact of the operating methods changes on human performance in RTS compared to a reference, in terms of pilot workload/taskload (go-around procedures, speed adjustment etc.)

OBJ-02.03-V2-VALP-HP1.3.4-001- Assess ATCOs level of trust in the operating methods related to 2.0NM MRS. In particular trust in the ITD indication, MET information.

OBJ-02.03-V2-VALP-HP1.3.4-002- Ensure pilots are informed about reduced MRS procedures prior to implementation using training / information campaigns to ensure they execute ATCO clearances / instructions accurately and consistently in a timely manner. Clarify responsibilities between controllers and pilots for conformance to speed instructions.

OBJ-02.03-V2-VALP-HP2.2.1-002 - Identify the requirements to set the appropriate parameters for the STCA

	OBJ-02.03-V2-VALP-HP2.3.1-001- Identify the conditions when the STCA has to adapt to the conventional parameters again OBJ-02.03-V2-VALP-HP2.3.1-002- Identify requirements for a new alert tool OBJ-02.03-V2-VALP-HP2.3.1-003- Identify the requirements for the tool to be able to switch immediately with the first aircraft that has to apply a bigger separation OBJ-02.03-V2-VALP-HP2.3.1-004- Identity pilot information requirements relating to the monitoring of 2.0NM MRS separation by aircrew. OBJ-02.03-V2-VALP-HP2.3.1-005- Assess that the type of information provided on the HMI satisfies the information requirements of the pilot (regarding the a/c position with respect to the a/c ahead on final approach). OBJ-02.03-V2-VALP-HP4.1.2-001- Assess acceptability and job satisfaction OBJ-02.03-V2-VALP-HP4.3.1-001- Identify the need for extra staff under certain conditions OBJ-02.03-V2-VALP-HP4.3.1-002- Assess staffing requirements after assessing the workload levels in a realistic environment
Required Evidence	Check HP Log information
Tool selected out of the HP repository	N/A
Planning and Approach	One workshop held before the RTS to discuss procedures, and one workshop after the RTS to gain the final feedback and clarifications.
resources	10 days
timeline	Before and after RTS

Table 5: Description of Activity 2- Workshops

ACTIVITY 3	Validation exercises /Prototyping sessions/ RTS/ cockpit simulations
Description	A Real time Simulation is used to validate complex airspace configurations, new tools or concepts in a realistic simulated Air Traffic Management environment.

	The simulator is replaying real traffic data and the ATCO works as he would work in real life. The indicators measured and data collected are: • Workload measurements (subjective) • Task performance • Situational Awareness (subjective) • Task Load (simulator recording) • Trust • Usability • Acceptability
Arguments & issues to be addressed	Arguments: 1.2.2-2; 1.2.3-2; 1.2.3-3; 1.2.4-3; 1.2.5-1; 1.2.5-2; 1.2.5-3; 1.2.5-4; 1.2.5-5; 1.3.1-1; 1.3.1-2; 1.3.1-3; 1.3.2-2; 1.3.2-3; 1.3.2-5; 1.3.2-6; 1.3.3-1; 1.3.3-2; 1.3.3.-3; 1.3.3-4; 1.3.3-5; 1.3.3-6; 1.3.3-7; 1.3.3-8; 1.3.3-9; 1.3.4-1; 1.3.4-2; 1.3.4-3; 1.3.4-4; 1.3.5-1; 1.3.5-2; 1.3.5-3; 1.3.5-4; 2.1.1-1; 2.1.2-1; 2.1.2-2; 2.1.6-1; 2.2.1-1; 2.2.1-3; 2.2.1-4; 2.2.2-1; 2.2.2-2; 2.3.2-1; 2.3.2-2; 2.3.3-1; 2.3.3-2; 2.3.3-3; 2.3.4-1; 2.3.4-2; 2.3.6-1; 2.3.6-2; 2.3.6-3; 2.3.7-1; 2.3.7-2; 2.3.7-3; 2.3.8-1; 2.3.8-2; 2.3.8-3; 2.3.9-1; 3.2.1-1; 3.2.2-1; 3.2.3-1; 3.2.4-1; 3.3.1-1; 3.3.1-2; 3.3.2-1; 3.3.4-1; 3.3.5-2; 4.1.1-1; 4.1.1-2l 4.1.2-1; 4.2.1-1; 4.3.1-2
HP objectives	OBJ-02.03-V2-VALP-HP1.2.2-002- Conduct scenarios for abnormal modes of operation during validation to assess impact on ATCO & assess suitability, acceptability & usability of procedures, including the impact on ATCO task performance/error, workload, situational awareness and error identification and resolution OBJ-02.03-V2-VALP-HP1.2.3-002- Conduct scenarios for degraded modes of operation during validation to assess impact on ATCO & assess suitability, acceptability & usability of procedures, including the impact on ATCO task performance/error, workload, situational awareness and error identification and resolution OBJ-02.03-V2-VALP-HP1.2.3-003- Assess the procedures for successive go arounds OBJ-02.03-V2-VALP-HP1.2.4-002- Ensure the ATCOs in the TMA are able to adapt the throughput capacity when the transition to 2.0NM MRS is implemented by the supervisors. Supervisors have clear procedures in place

	that ensure the coordination between the TWR and APP takes into account traffic levels. OBJ-02.03-V2-VALP-HP1.2.4-003- Develop procedures to ensure it is clear for the Supervisors when to transition, in case of reported WT encounters, by the pilots. OBJ-02.03-V2-VALP-HP1.2.5-001- Develop procedures to ensure the transition from 2.5 NM MRS to 2.0NM MRS and vice versa is easy to implement and does not negatively impact human performance OBJ-02.03-V2-VALP-HP1.2.5-002- Assess the accuracy and efficiency with which the ATCOs can perform the transition OBJ-02.03-V2-VALP-HP1.2.5-003- Assess acceptability and usability of the procedures by ATCOs in prototyping sessions to ensure they can be executed accurately, efficiently and in a timely manner OBJ-02.03-V2-VALP-HP1.2.5-004- Assess acceptability and usability of the procedures by Supervisors in to ensure they can be executed accurately, efficiently and in a timely manner OBJ-02.03-V2-VALP-HP1.2.5-005- Assess acceptability and usability of the procedures by pilots/ airline operators to ensure they can be executed accurately, efficiently and in a timely manner OBJ-02.03-V2-VALP-HP1.3.1-001- Assess errors and recovery means OBJ-02.03-V2-VALP-HP1.3.1-002- Ensure that the HMI is designed so that ATCOs are always aware of the mode of operation under which they are operating (i.e. the MRS values). OBJ-02.03-V2-VALP-HP1.3.1-003 - Assess the potential for human error (where ATCO may mis-identify which a/c is the first in the sequence where a reduced MRS of 2.0NM applies) OBJ-02.03-V2-VALP-HP1.3.2-002- Assess the procedures for the tower controller and approach controller (will visual separation be allowed under which circumstances?) OBJ-02.03-V2-VALP-HP1.3.2-003- Assess Approach controller's task load (RT) and workload OBJ-02.03-V2-VALP-HP1.3.2-005- Assess acceptability of the MRS procedures OBJ-02.03-V2-VALP-HP1.3.2-006- Assess whether Supervisors are able to carry out their tasks for the activation of 2.0NM MRS or reversion to 2.5NM MRS in a timely manner

	OBJ-02.03-V2-VALP-HP1.3.3-001- Assess the workload of the approach controller OBJ-02.03-V2-VALP-HP1.3.3-002- Assess the workload of the tower controller OBJ-02.03-V2-VALP-HP1.3.3-003 - Assess the impact of the operating methods changes on human performance in RTS compared to a reference, in terms of: Supervisor workload/taskload OBJ-02.03-V2-VALP-HP1.3.3-004- Assess the impact of the operating methods changes on human performance in RTS compared to a reference, in terms of pilot workload/taskload (go-around procedures, speed adjustment etc) OBJ-02.03-V2-VALP-HP1.3.3-005- Assess the impact of 2.0NM MRS on the variability of the ATCO workload over time (compared to reference scenario) in RTS e.g. subjective WL, amount and variability of holding traffic and go-arounds should be at least at the same level (taskload). OBJ-02.03-V2-VALP-HP1.3.3-006- Assess the impact of workload on APP (INT, FIN) and TOWER controllers to ensure that the distribution of workload remains equitable and manageable under all MRS operational conditions in normal, abnormal and degraded modes of operation. OBJ-02.03-V2-VALP-HP1.3.3-007- Assess the impact on ATCO workload for issuing more speed instructions using the TDIs and checking speed conformance more often through the HMI OBJ-02.03-V2-VALP-HP1.3.3-008- Assess the workload and communication load under a continuous flow 2nm arrival with VFR traffic OBJ-02.03-V2-VALP-HP1.3.3-009- Assess tower workload under ROT conditions OBJ-02.03-V2-VALP-HP1.3.4-001- Assess ATCOs level of trust in the operating methods related to 2.0NM MRS. In particular trust in the ITD indication, MET information. OBJ-02.03-V2-VALP-HP1.3.4-002- Ensure pilots are informed about reduced MRS procedures prior to implementation using training / information campaigns to ensure they execute ATCO clearances / instructions accurately and consistently in a timely manner. Clarify responsibilities between controllers and pilots for conformance to speed instructions. OBJ-02.03-V2-VALP-HP1.3.4-003- Assess the level of ATCO trust in the ITD indication OBJ-02.03-V2-VALP-HP1.3.4-004- Assess the level of ATCO trust in the automated functions when transitioning from 2.5NM MRS to 2.0NM MRS.

	OBJ-02.03-V2-VALP-HP1.3.5-001- Assess SA (in relation to pilot indented speed change) OBJ-02.03-V2-VALP-HP1.3.5-002- Assess SA OBJ-02.03-V2-VALP-HP1.3.5-003- Assess SA in relation to the wake category/ a/c type OBJ-02.03-V2-VALP-HP1.3.5-004- Assess the impact on ATCO's SA (and on their other controlling tasks) of focussing too much on the TDIs. OBJ-02.03-V2-VALP-HP2.1.1-001- Ensure the task allocation between human and machine (e.g. Sequencing tool, TDIs) is consistent with HP guidelines for automation support and / or other automation guidelines (for automated tasks OBJ-02.03-V2-VALP-HP2.1.2-001- Assess the ORD usability for MRS OBJ-02.03-V2-VALP-HP2.1.2-002- Assess the impact of the changes to task allocation between the ATCOs and the system on human performance, OBJ-02.03-V2-VALP-HP2.1.4-001- Assess the impact of the TDIs on ATCOs workload OBJ-02.03-V2-VALP-HP2.1.4-002- Assess APP ATCO workload without the sequencing tool, under the same traffic pressure OBJ-02.03-V2-VALP-HP2.1.6-001- Assess ATCO’s trust into the tool OBJ-02.03-V2-VALP-HP2.2.1-001- Assess the tool and if it takes the Wake categories into account not allowing for MRS when not possible OBJ-02.03-V2-VALP-HP2.2.1-003- Assess the impact of the parameters set in STCA OBJ-02.03-V2-VALP-HP2.2.1-004- Assess the accuracy of the tool parameters when MRS variations apply OBJ-02.03-V2-VALP-HP2.2.2-001- Assess the timeliness of the tool input when MRS variations apply OBJ-02.03-V2-VALP-HP2.2.2-002- Assess the most suitable point to start/stop displaying the TDIs. OBJ-02.03-V2-VALP-HP2.3.2-001- Assess ability to input constraints (changes such as departure insertion or runway inspection) into the TDI (i.e. usability of input mechanism). OBJ-02.03-V2-VALP-HP2.3.2-002- Ensure that input devices used for acknowledging the activation of a 2.0NM MRS (and reversion 2.5NM MRS) on the CWP HMI need to correspond to HF principles.

	OBJ-02.03-V2-VALP-HP2.3.3-001- Assess information requirements with regard to the visual display of the MRS value and mode of operations OBJ-02.03-V2-VALP-HP2.3.3-002- Assess the usability, utility and acceptability of the visual displays OBJ-02.03-V2-VALP-HP2.3.3-003- Assess the usability of the different TDI colours/symbols when they are defined on the basis of MRS, WT, ROT, departure spacing or other spacing. OBJ-02.03-V2-VALP-HP2.3.4-001- Assess the usability and accuracy of alerts and alarms OBJ-02.03-V2-VALP-HP2.3.4-002- Assess the utility/usability of an alert for when wind forecasting is not functioning (as ATCOs may not notice this). OBJ-02.03-V2-VALP-HP2.3.6-001- Assess the usability of the support tool OBJ-02.03-V2-VALP-HP2.3.6-002- Assess pressure on ATCOs to over perform using the target distance indicators. OBJ-02.03-V2-VALP-HP2.3.6-003- Assess the pressure felt by ATCOs to over perform OBJ-02.03-V2-VALP-HP2.3.5-001- Assess error management with the support tool OBJ-02.03-V2-VALP-HP2.3.5-002- Assess errors of mis-identification of FTD indications with other information on the HMI. OBJ-02.03-V2-VALP-HP2.3.5-003- Identify the impact of the FTD/ITD indicators on the number of separation infringements OBJ-02.03-V2-VALP-HP2.3.8-001- Assess SA in relation to the aircraft pair OBJ-02.03-V2-VALP-HP2.3.8-002- Assess (team)SA OBJ-02.03-V2-VALP-HP2.3.8-003- Assess the ability of controllers to monitor separation and wake vortex spacing with the FTD indication and their ability to act to identify and restore losses of separation and/or spacing, on downwind, base leg and the axis OBJ-02.03-V2-VALP-HP2.3.9-001- Assess the user interface design with regard to the team situational awareness OBJ-02.03-V2-VALP-HP3.2.1-001- Assess the distribution of tasks of APP and TWR ATCOs during peak hours when a reduced MRS of 2.0NM applies OBJ-02.03-V2-VALP-HP3.2.2-001- Assess the HMI support in case a redistribution of tasks in needed (e.g. peak hours).

	OBJ-02.03-V2-VALP-HP3.2.3-001- Identify the types and numbers of errors that occur due to the removal of FTD/ITD indications (HAZID could also be used) OBJ-02.03-V2-VALP-HP3.2.4-001- Assess if team tasks can be achieved in a timely and efficient manner OBJ-02.03-V2-VALP-HP3.3.1-001- Support the development of clear procedures for transitioning to a reduced or increased MRS for APP and TWR supervisors and ATCOs OBJ-02.03-V2-VALP-HP3.2.1-002- Monitor R/T usage and ATCOS & pilot workload OBJ-02.03-V2-VALP-HP3.3.2-001- Evaluate if the phraseology is clear between ATCOS and pilots for communicating their position in relation to the a/c ahead on final approach (confirm to follower a/c their position with respect to the a/c ahead on final approach) for 2.0NM MRS procedures. Investigate whether current phraseology (ATCO to aircrew) is clear and does not overload the R/T OBJ-02.03-V2-VALP-HP3.3.4-001- Evaluate if the impact of 2.0NM MRS on R/T utilisation is acceptable for normal, abnormal & degraded modes of operation. OBJ-02.03-V2-VALP-HP3.3.5-001- Identify factors that will impact team situational awareness (ATCOs and pilots) OBJ-02.03-V2-VALP-HP4.1.1-001- Assess the pilot acceptability of the solution OBJ-02.03-V2-VALP-HP4.1.2-001- Assess acceptability and job satisfaction OBJ-02.03-V2-VALP-HP4.2.1-001- Assess the feedback on working with the tool and eventual switching back to not working with the tool received by controllers OBJ-02.03-V2-VALP-HP4.3.1-002- Assess staffing requirements after assessing the workload levels in a realistic environment
Required Evidence	Check HP Log Information
Tool selected out of the HP repository	Simulation recordings (data recorded by the system) Standardised questionnaires (SASHA, AIM, SATI China Lakes; Bedford workload scale etc.) Debriefs & observation Cockpit Simulations/ Flight trials
Planning and Approach	Simulation recordings (data recorded by the system) Standardised questionnaires (SASHA, AIM, SATI China Lakes; Bedford workload scale)

	Debriefs & observation Cockpit simulations
resources	20 days
timeline	The initial HP plan will be delivered in February 2018; The objectives will be fed into the validation plan The data will be collected through the RTS The HP report will be finalised 3 months after the simulation

Table 6: Description of Activity 3 -RTS

4.4 Step 4 Collate findings & conclude on transition to next V-phase

4.4.1 Summary of HP activities results & recommendations / requirements

Note: The HP recommendations and requirements have been formulated only once, although they apply to other closed issues as well. The full list of recommendations and requirements are to be found in the Appendix and in the HPAR for PJ02-01 (for the conditional application of reduced separations and for the ORD tool).

Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	activity conducted	results / evidence	recommendations	requirements
Arg. 1.2.1: Operating methods cover operations in normal operating conditions.							
1.2.1-1	Operating methods do not cover all normal operating conditions: MRS might ask for HIRO procedures- to ensure efficient ROT;	Closed	OBJ-02.03-V2-VALP-HP1.2.1-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session	The proposed operating procedures (both DBS-no tool/TBS-ORD tool-operations) as part of the RTS were seen as acceptable and clear by all ATCOs, both in APP and TWR, with no increase in the potential for human error and safety.		**REQ_HP_MRS_01:** A set of working methods/guidelines to cover the 2 NM MRS concept and the related normal operating procedures (and associated tools) shall be locally defined.

1.2.1-2	MRS might ask for specific go-around procedures	Closed	OBJ-02.03-V2-VALP-HP1.2.1-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	In both the prototyping session (DBS-ICAO with no tool) and the RTS (TBS with ORD tool) no increase in the number of go-arounds was observed. In time-based separations the wind conditions would "increase" the time that would eventually correspond to the reduced separation with 0.5nm, having therefore no change as compared to the go-around procedures applicable in 2.5 nm MRS. For distance based separation, the Vienna ATCOs explained that with a steady inbound of 2 nm, there is a need of a ATCO taking care only	**REC_HP_MRS_01:** A second ATCO on the final approach position should be available in distance-based operations when 2nm MRS is applied in peak times (in highly complex environment), in order to ensure availability for go-around instructions while allowing the main ATCO to coordinate a steady inbound flow.	

					of the arrivals- avoiding VFR calls. This would be required because with 2.0nm MRS applied in distance based- the reactions must be quicker in order to avoid a go-around. The AF pilots used the example of the RRSM (RWY Reduced Separation Minima) in the US, where for very complex environments a second ATCOs is dedicated for monitoring and instructing go-arounds (in case the 2400 m wrt to the Leader are not met by the time the Follower attempts landing). In this case, 2nd frequency with a different ATCO needs to be monitored by pilots on final approach, in		

					case a go-around is required. Ideally, the introduction of the Mode-S datalink would resolve this issue in the future.		
Arg. 1.2.2: Operating methods cover operations in abnormal operating conditions.							
1.2.2-1	Operating methods do not cover all abnormal procedures	Open	OBJ-02.03-V2-VALP-HP1.2.2-001	• EXE-PJ02-03-V3-RTS02 • Workshops	• See VALR EXE-PJ02-03-V3-RTS02 and Safety Assessment Report		**REQ_HO_MRS_02:** A set of working methods/guidelines to cover the 2 NM MRS concept and the related abnormal/degraded operating procedures shall be locally defined.
1.2.2-2	The procedures related to an abnormal mode of operations might have a negative impact on ATCO performance and acceptability of procedures,	Closed	OBJ-02.03-V2-VALP-HP1.2.2-002	• EXE-PJ02-03-V3-RTS02 • Workshops	See 1.2.2-1 The ATCOs consider the applicability of the 2.0 NM MRS abnormal procedures to be handled in the same way		

	with the application of 2.0NM MRS.				as currently applied for 2.5NM MRS.		
Arg. 1.2.3: Operating methods cover degraded modes of the ATM system.							
1.2.3-1	Operating methods do not cover degraded mode procedures	Closed	OBJ-02.03-V2-VALP-HP1.2.3-001	• EXE-PJ02-03-V3-RTS02	Two degraded mode scenarios were simulated during the RTS (loss of ORD tool and data corruption-related to a/c type and wake turbulence category). Overall under both scenarios, the operations were safely managed by the APP and TWR ATCOs, with no need for additional functionalities or procedures. Although not simulated ATCOs were asked about an unplanned blocked RWY involving successive go-arounds.		

					They stated that this could be managed as per current operations: • Instruct successive go-arounds (depending on what is accepted at each airport, alternating between left, straight and right to achieve horizontal separation); • Instruct level off at different intermediary altitudes (for vertical separation); • Transfer to Departures. Controllers do not think that reducing MRS to 2NM will have a major impact on separation		

					infringements during a blocked runway scenario. However, in order to demonstrate this remains safe with MRS 2NM, such a scenario will have to be simulated and assessed prior to local implementation. Another degraded mode scenario discussed during a safety debriefing was about the corruption of the ORD tool indicators. Normally, the corruption might or might not be detected depending on the amplitude of the error. However, ATCOs agree that the detection would be very difficult in TB-PWS mode.		

1.2.3-2	The procedures related to a degraded mode of operations might have a negative impact on ATCO performance and acceptability of procedures, with the application of 2.0NM MRS.	Closed	OBJ-02.03-V2-VALP-HP1.2.3-002	Covered by 1.2.3-1	Two degraded mode scenarios were simulated during the RTS (loss of ORD tool and data corruption-related to a/c type and wake turbulence category). Overall under both scenarios, the operations were safely managed by the APP and TWR ATCOs, with no need for additional functionalities or procedures. See 1.2.3-1		

1.2.3-3	In case the runway is suddenly to be closed and successive go-arounds are required		OBJ-02.03-V2-VALP-HP1.2.3-003	• EXE-PJ02-03-V3-RTS02 • Workshops			**REQ_HP_MRS_03:** The reduction to 2 NM MRS shall be applied only when the Separation/Spacing Minima constraints and the provision of appropriate ROT Spacing are actively managed through the supporting of specific ATC procedures allowing predefined conditions influencing ROT to be satisfied. (e.g. braking action reported as good, no runway contaminants such as slush, snow or ice, etc.)
Arg. 1.2.4: The content of operating methods is clear and consistent (in V1: non-contradictory).							
1.2.4-1	Procedures are not clear and consistent (i.e. normal, abnormal and degraded mode of operations)	Closed	OBJ-02.03-V2-VALP-	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	The results of the validations confirm that the procedures were considered to be clear and consistent for all simulated positions, in		

			HP1.2.4-001		both scenarios (TBS with ORD and DBS with no tool).		
1.2.4-2	The traffic during the transition to 2.0 NM MRS might not be appropriately accommodated	Closed	OBJ-02.03-V2-VALP-HP1.2.4-002	• EXE-PJ02-03-V3-RTS02 • Workshops	The traffic during transition was appropriately accommodated during the simulation. Nonetheless, ATCOs consider that the transition should not be taking place in peak hours. Mode transitions that take place during the peak period should be considered as a non-nominal event. Please check PJ02-01 requirements related to a conditional mode of application.		

1.2.4-3	The transition to a 2.0NM MRS could create several WT encounters	Closed	OBJ-02.03-V2-VALP-HP1.2.4-003	• EXE-PJ02-03-V3-RTS02 • Workshops	It was concluded that if pilots report several WT encounter under WDS then ATCOs should recommend reverting to default separation procedures. In current operations for a RWY configuration change – the ATCO would wait for 3 pilots to report a tailwind on the final before changing the runway configuration, after the supervisor checks the weather conditions. Please check PJ02-01 requirements related to a conditional mode of application.		
Arg. 1.2.5: Operating methods (procedures) can be followed in an accurate, efficient and timely manner.							

1.2.5-1	The transition from 2.5NM MRS to 2.0NM MRS and vice versa impacts efficiency and negatively impacts human performance (increases potential for human error, reduces task efficiency or accuracy)	Closed	OBJ-02.03-V2-VALP-HP1.2.5-001	• EXE-PJ02-03-V3-RTS02 • Workshops	See issue ID: • 1.1.2-3 • 1.1.2-4 • 1.2.4-2 Please check PJ02-01 requirements related to a conditional mode of application.		
1.2.5-2	The transition from 2.5NM MRS to 2.0NM MRS and vice versa cannot be performed accurately and efficiently	Closed	OBJ-02.03-V2-VALP-HP1.2.5-002	• EXE-PJ02-03-V3-RTS02 • Workshops	See issue ID: • 1.1.2-3 • 1.1.2-4 • 1.2.4-2 Please check PJ02-01 requirements related to a conditional mode of application.		
1.2.5-3	New procedures & practices associated with the 2.0NM MRS and the associated	Closed	OBJ-02.03-V2-	• EXE-PJ02-03-V3-RTS02 • Workshops	The procedures applied in RTS2 and the IRD tool have been confirmed		

	ATCO tools are not usable/ suitable (e.g. they cannot be followed and executed in an accurate, efficient and timely manner)		VALP-HP1.2.5-003		through validation exercises to be usable and suitable. All procedures have been executed in a timely and efficient manner, without any concerns expressed by the ATCOs. Both the procedures and the ORD tool were rated by the ATCOs as acceptable and usable. Please check PJ02-01 requirements related to the use of the ORD tool.		
1.2.5-4	Changes in the procedures resulting from 2.0NM MRS are neither clearly defined nor acceptable for the TWR and APP Supervisors. Procedures cannot be followed in an accurate, efficient and timely manner (e.g. updating the	Closed	OBJ-02.03-V2-VALP-HP1.2.5-004	• Workshops	One of the TWR ATCOs participating in the Workshop is also an active TWR Supervisor. No changes compared to the current operating procedures have been envisaged for the Supervisor position.		

	procedures with corresponding MRS, communicating updates to ATCOs)				Nonetheless, a local assessment is required before implementation.		
1.2.5-5	Changes in the procedures / practices resulting from 2.0NM MRS are not acceptable with pilots and / or airline operators. I.e. procedures cannot be followed in an accurate efficient and timely manner	Closed	OBJ-02.03-V2-VALP-HP1.2.5-005	Workshops	The pilots participating in the workshop has mentioned that with reduced separations (especially if combined with TBS) it becomes "impossible for the flight crew to be different with the separation minima applicable on airports around the world". As a result, flight crew shall comply with ATC instructions, which requires high trust in the ATCOs, which would be reinforced by information campaigns which would bring the flight crew the required updates. Additionally the separation minima		**REQ_HP_MRS_04:** The Flight Crew shall be made aware of the locally applied separation mode and minima via appropriate means (e.g. from ATIS, AIP, NOTAM, information campaigns).

					values shall be available in the corresponding documentation (e.g. ATIS, NOTAM etc.)		
Arg. 1.3.1: The potential for human error is reduced to a tolerable level							
1.3.1-1	The increase of traffic through the separation reduction might lead to the fact that there is less time to correct errors	Closed	OBJ-02.03-V2-VALP-HP1.3.1-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	In EXE-PJ02-03-V3-RTS02, one of the ATCOs mentioned that the timing of instructions becomes more important with 2.0 NM MRS as compared to 2.5NM MRS, feeling therefore an “increased pressure” as compared to today`s operations. Nonetheless, with appropriate flight crew responses, the ATCOs consider the 2.0NM MRS appropriate corrections can be applied in a safely manner. Additionally, the HP indicators (workload, situational		

					awareness, potential increase in human error) have not been identified as negatively impact in none of the 2 scenarios.		
1.3.1-2	The wake categories do not allow for MRS but MRS is applied	Closed	OBJ-02.03-V2-VALP-HP1.3.1-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	The questionnaire results and the debrief notes have confirmed that with the use of the ORD tool the ATCOs are in general less aware of the a/c type and the WV category. Nonetheless, this is not regarded as a potential for human error, As long as the ORD tool works accurately, the ATCOs see the ORD tool as adding significant value to their work, admitting the fact that they do not question the ORD features. In the prototyping session when the 2.0NM MRS was applied		

					without the tool, one of the concerns of the ATCOs was that "too many different procedures that can be applied under different criteria/ conditions may lead to confusion and errors". The ORD tool is seen as a mitigation to this issue.		
1.3.1-3	ATCOs may miss-identify which aircraft has been chosen as the first a/c in the sequence where the 2.0NM MRS applies	Closed	OBJ-02.03-V2-VALP-HP1.3.1-003	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	The functionalities of the ORD tool are considered to enhance awareness with regard to potential errors. Please check PJ02-01 requirements related to the use of the ORD tool.		

Arg. 1.3.2: The potential for human error is reduced to a tolerable level							
1.3.2-1	The pilot is unaware that MRS is in place	Closed	OBJ-02.03-V2-VALP-HP1.3.2-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Covered by 1.2.5-5		
1.3.2-2	The approach controller can hand over visual control to the pilots while the tower controller is not able to do that (at some airports?). The runway might not be vacated in time.	Closed	OBJ-02.03-V2-VALP-HP1.3.2-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Covered by REQ-02.03-OSED.0020.		**REQ_HP_MRS_09**: For the case without the Separation Delivery Tool, when using the ICAO WTC scheme, the a 2NM MRS Spacing Minimum mode shall be activated only when the runway surface and glide-slope wind is equal or greater than the 2NM MRS threshold (in addition to the satisfaction of the predefined conditions influencing ROT).
1.3.2-3	In case of more speed instructions (e.g. more a/c	Closed	OBJ-02.03-	• EXE-PJ02-03-V3-RTS02	As discussed with the Heathrow ATCOs, a	**REC_HP_MRS_02:** To reduce R/T occupancy	

	per unit) the RT load might increase for the approach controller		V2-VALP-HP1.3.2-003	• Prototyping session • Workshops	significant R/T occupancy increase was noticed when transferring from 3.0NM MRS to 2.5NM MRS, but no change in shift lengths was required or any other adjustments.	issues, local implementation should consider mitigations such as silent transfer of communication fin final APP sector, data link communication or optimising phraseology (e.g. calling with call sign only).	
1.3.2-4	In case of more speed instructions the RT load might increase for the pilot	Closed	OBJ-02.03-V2-VALP-HP1.3.2-004	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See Issue ID: • 1.3.2-3		
1.3.2-5	The ATCO might not be able to reduce the separation from 3nm to less than 2.5 nm in time; this might be mitigated by extending the MRS	Open	OBJ-02.03-V2-VALP-HP1.3.2-005	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Following the EXE-PJ02-03-V3-RTS02, ATCOs consider that "there must be a different separation minima allowed on the base leg, as one would only be comfortable with working so tight, if the currently accepted	**REC_HP_MRS_03:** The separation reduction on final approach to 2.0NM MRS should be accompanied with a reduced separation reduction of the MRS separation on the baseleg to 2/.5NM MRS.	**REQ_HP_MRS_05:** In case a separation reduction of the MRS on the baseleg to 2.5NM MRS is considered, it shall be approved by local regulators.

					separation minima of 3NM (on the baseleg) can be infringed".	**REC_HP_MRS_04:** The final Approach ATCOs should consider using vertical separations when appropriate to avoid separations infringements on the baseleg.	
1.3.2-6	Supervisors are unable to • carry out their tasks for the activation of 2.0NM MRS or reversion to 2.5NM MRS in a timely manner; • consult with ATCOs to identify any tactical restraints for 2.0NM MRS activation in a timely manner; • activate 2.0NM MRS in co-ordination across TWR and APP Supervisor positions in a timely manner;	Closed	OBJ-02.03-V2-VALP-HP1.3.2-006	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Covered by the requirement on locally defined procedures for all actors involved.		

	• inform APP & TWR ATCOs that 2.0NM MRS is activated in a timely manner; • consult with ATCOs to identify any tactical restraints for 2.5NM MRS reversion in a timely manner; • de-activate 2.0NM MRS in co-ordination across TWR and APP Supervisor positions in a timely manner; • inform APP & TWR ATCOs when 2.5NM MRS reversion will take place & indicate 1st a/c in the arrival sequence in a timely manner; • inform APP & TWR ATCOs that 2.0NM MRS						

	is de-activated in a timely manner;						
Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable.							
1.3.3-1	The decrease of separation might mean for the final approach controller that he has to handle more aircraft at the same time than today that could lead to an increase of workload and its consequences. (e.g. more speed instructions)	Closed	OBJ-02.03-V2-VALP-HP1.3.3-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	The workload of the APP and TWR ATCOs was not negatively impacted under any of the two scenarios. Nonetheless it should be assessed prior to local implementation as the increase in workload could be influenced by other local factors.	**REC_HP_MRS_06:** Local assessment should evaluate the need of reducing shift times as a result of a potential increase in workload following due to the implementation of 2.0NM MRS (e.g. increased R/T etc.)	
1.3.3-2	The decrease of separation might mean for the tower controller that he has to handle more aircraft at the same time than today, that could lead to an increase of workload and its consequences.	Closed	OBJ-02.03-V2-VALP-HP1.3.3-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	• Prototyping session (ICAO DBS- no tool) No difference was found for Tower position in terms of the subjective workload experienced in the reference scenarios and solution scenarios,		

					as measured by the NASA-TLX workload rating scale. Although it should be noted that as with the approach controller more aircraft were handled per hour in the solution scenarios compared to the reference scenarios. As with the approach controllers this suggests that there was no negative impact on controller workload even though slightly more aircraft were handled per hourly rate. No negative impact on the workload measurements was found for the TWR position in EXE-PJ02-03-V3-RTS02		

1.3.3-3	Changes in operating methods might increase APP and TWR Supervisors workload.	Closed	OBJ-02.03-V2-VALP-HP1.3.3-003	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See Issue ID: 1.3.3-1		
1.3.3-4	Changes to flight deck procedures under 2.0NM MRS increase pilot workload.	Closed	OBJ-02.03-V2-VALP-HP1.3.3-004	• Workshops	No concerns with regard to an increase in workload were mentioned by the pilots participating in the workshop.		
1.3.3-5	Equitable distribution of workload between APP (INT, FIN) and RWY controllers.	Closed	OBJ-02.03-V2-VALP-HP1.3.3-006	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Based on expert judgement and exercise performance, no concerns are reported with regard to the equitable distribution of workload.		

1.3.3-7	ATCO WL is increased due to: • issuing more speed instructions using the TDIs; • checking speed conformance more often through the HMI.	Closed	OBJ-02.03-V2-VALP-HP1.3.3-007	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
1.3.3-8	With a steady flow of 2nm separation and therefore with the increase of traffic the tower controller is very busy and will not be able take calls from VFR traffic, there might be the need to add a separate position (see staffing)	Closed	OBJ-02.03-V2-VALP-HP1.3.3-008	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See: REQ_HP_MRS_01:		
1.3.3-9	In case of ROT being the constraining factor the tower controller will have an increase of workload as he has to monitor the aircraft pair closer.	Closed	OBJ-02.03-V2-VALP-HP1.3.3-009	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to a conditional mode of application.		
Arg. 1.3.4: The level of trust in the new concept/ the new procedures is appropriate							

1.3.4-1	ATCOs do not trust the new operating methods and the corresponding tools, as they consider the buffer is insufficient. This may lead to them adding extra buffer or not using the TDIs as indicated	Closed	OBJ-02.03-V2-VALP-HP1.3.4-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
1.3.4-2	Pilots do not conform to ATC clearances as they may be reluctant to reduce the separations while the WVE risk could be interpreted as higher due to the headwind, e.g. pilots may reduce speed to ensure they have what they consider to be a safe spacing between themselves and the a/c ahead.	Closed	OBJ-02.03-V2-VALP-HP1.3.4-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	REQ_HP_MRS_04:		
Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness							
1.3.5-1	Pilots might adjust speed by themselves without telling the ATCO ; Controller might lose SA	Open	OBJ-02.03-V2-VALP-	• EXE-PJ02-03-V3-RTS02 • Prototyping session	REQ_HP_MRS_04:		

			HP1.3.5-001	• Workshops			
1.3.5-2	ATCO will focus more on the closely separated aircraft pair ; he might lose overall SA	Closed	OBJ-02.03-V2-VALP-HP1.3.5-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	The perceived situation awareness was satisfactory under both tested scenarios.		
1.3.5-3	ATCO SA may reduce due to not having to consider wake vortex types or a/c type or performance or checking a/c landing stabilisation speed characteristics.	Closed	OBJ-02.03-V2-VALP-HP1.3.5-003	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	The perceived situation awareness was satisfactory under both tested scenarios.		
1.3.5-4	ATCOs SA may reduce and they may forget their other controlling tasks if they focus their attention too much on the TDIs, especially while working under the pressure of 2.0NM MRS that leaves a very small buffer for errors.	Closed	OBJ-02.03-V2-VALP-HP1.3.5-004	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		

Arg. 2.1.1: The task allocation between the human and the machine is consistent with automation principles

2.1.1-1	The task allocation between the human and the machine (e.g. Sequencing tool, TDIs) is not consistent with automation principles.	Closed	OBJ-02.03-V2-VALP-HP2.1.1-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
Arg. 2.1.2: Changes to the task allocation between human and machine support human performance							
2.1.2-1	Benefit: The ORD tool can reduce the possible workload increase	Closed	OBJ-02.03-V2-VALP-HP2.1.2-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
2.1.2-2	Human performance is negatively impacted by the changes in task allocation between the ATCOs and the system, e.g. ATCOs unable to deliver a/c as efficiently or accurately, workload is increased, or situation awareness is negatively impacted or longer term, ATCOs unable to cope under	Closed	OBJ-02.03-V2-VALP-HP2.1.2-002	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		

	abnormal and /or degraded modes						
Arg. 2.1.3: Transition from automatic to manual modes and vice versa, human intended or failure induced, can be performed by the human actors in a timely, efficient and accurate manner							
2.1.3-1	Transition between 2.5nm MRS and 2.0 nm MRS results in ATCO confusion. ATCOs are not sure whether they are operating under 2 or 2.5nm MRS.	Closed	OBJ-PJ2.01-V3-VALP-HP1.2	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops			**REQ_HP_MRS_10:** Local procedures/rules shall be defined in order to ensure safe transition of the aircraft from 3NM to 2NM MRS, such as to avoid loss of separation minima during on base leg
Arg. 2.1.4: The level of workload (induced by the allocation of tasks between the human and the machine) is acceptable.							
2.1.4-1	Benefit: TDIs help reduce ATCO workload.	Closed	OBJ-02.03-V2-VALP-HP2.1.4-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
Arg. 2.1.6: The level of trust in automated functions is appropriate							

2.1.6-1	The ATCO does not trust the support tool meant to support the application of 2.0nm MRS.	Closed	OBJ-02.03-V2-VALP-HP2.1.6-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
Arg. 2.2.1 The accuracy of information provided by the system is adequate for carrying out the task							
2.2.1-1	Benefit: The tool takes into account the different wake vortex categories, decreasing the workload of the ATCOs.	Closed	OBJ-02.03-V2-VALP-HP2.2.1-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
2.2.1-2	The STCA is not taking into account the MRS.	Closed	OBJ-02.03-V2-VALP-HP2.2.1-002	• Workshops	All support tools/ safety nets shall be harmonised.		**REQ_HP_MRS_06:** If available for the Final Approach Controllers, the Short Term Conflict Alert shall be adjusted to accommodate the 2NM MRS concept
2.2.1-3	The STCA is based on time and not on distance therefore an alert might not	Closed	OBJ-02.03-V2-	• Workshops	See 2.2.1-2		

	go off despite the fact it is required.		VALP-HP2.2.1-003				
2.2.1-4	The tool does not adequately compute distances when transitions are made to a reduced (2.0NM MRS) minima and vice versa	Closed	OBJ-02.03-V2-VALP-HP2.2.1-004	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
Arg. 2.2.2: The timeliness of information provided by the system is adequate for carrying out the task							
2.2.2-1	The timeliness of information provided by the system is adequate for carrying out the task	Closed	OBJ-02.03-V2-VALP-HP2.2.2-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		**REQ_HP_MRS_11:** When the 2NM MRS concept is applied in TB-modes, DB PWS-A and/or WDS-A, the Intermediate Approach, Final Approach and Tower Controllers shall be provided with a

							Separation Delivery Tool displaying Target Distance Indicators (TDI) to enable consistent and accurate application of separation rules on final approach and landing **REQ_HP_MRS_12:** When the 2NM MRS concept is applied in DB-modes not including DB PWS-A, the Intermediate Approach, Final Approach and Tower Controllers should be provided with a Separation Delivery Tool displaying Target Distance Indicators (TDI) to enable consistent and accurate application of separation rules on final approach and landing
2.2.2-2	The TDIs are presented too early or too late, removed too early or too late.	Closed	OBJ-02.03-V2-	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		

			VALP-HP2.2.2-002				
Arg. 2.3.1: The type of information provided satisfies the information requirements of the human							
2.3.1-1	In case of a change from a reduced MRS to conventional MRS values, the STCA does not switch	Closed	OBJ-02.03-V2-VALP-HP2.3.1-001	Workshop	See 2.2.1-2		
2.3.1-3	The ORD tool shows still the 2.0NM MRS parameters after a switch to 2.5nm or more separation	Open	OBJ-02.03-V2-VALP-HP2.3.1-003	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
2.3.1-3	Pilots require additional information related to a reduced MRS of 2.0NM in order to continue to monitor & conform to safe separation approach.	Closed	OBJ-02.03-V2-VALP-HP2.3.1-004	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See 1.2.5-5		

2.3.1-5	The information that is provided on the HMI is sufficient for controllers to inform pilots of their position with respect to the a/c ahead on final approach.	Closed	OBJ-02.03-V2-VALP-HP2.3.1-005	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
Arg. 2.3.2: The type of information provided satisfies the information requirements of the human							
2.3.2-1	The ability to input target distance changes to the TDIs (e.g. in case of a departure insertion, runway inspection) is not intuitive and easy to perform.	Closed	OBJ-02.03-V2-VALP-HP2.3.2-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
2.3.2-2	Input devices for acknowledging the activation of a 2.0NM MRS (and reversion 2.5NM MRS) on the CWP HMI need to correspond to HF principles.	Closed	OBJ-02.03-V2-VALP-HP2.3.2-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		
Arg. 2.3.3: The type of information provided satisfies the information requirements of the human							
2.3.3-1	Visual displays do not support ATCOs to know	Closed	OBJ-02.03-V2-	• EXE-PJ02-03-V3-RTS02	See Issue ID:		

	which mode of operation and MRS values they are in.		VALP-HP2.3.3-001	• Prototyping session • Workshops	2.2.2-1		
2.3.3-2	The visual displays do not adhere to HF principles for: • checking winds are above/below threshold; • indicating to ATCOs (and Supervisors) when the conditions are met/no longer met for a reduced MRS value; • acknowledging activation of MRS reversion to 2.5NM MRS on the CWP HMI.	Closed	OBJ-02.03-V2-VALP-HP2.3.3-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See Issue ID: 2.2.1-1 2.2.2-1		
2.3.3-3	The TDIs do not support ATCOs to know which type of spacing the a/c pairs are under: MRS, WT, ROT, departure spacing or other spacing.	Closed	OBJ-02.03-V2-VALP-HP2.3.3-003	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool		

Arg. 2.3.4: Alarms and alerts have been developed according to HF principles

2.3.4-1	See 2.2.1 and 2.3.1 Alarms and alerts are not consistent with HF principles	Closed	OBJ-02.03-V2-VALP-HP2.3.4-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool <u>Note regarding MRS 2NM without tool:</u> ORTOP3 ATCO feed-back is that no need for imminent separation infringement alert, but it could be a "nice to have feature". It is nonetheless recommended to implement the application of 2 NM MRS with the support of the ORD tool, due to the complex support it offers to the ATCOs based on alerts and indication of the TDIs. Currently in Heathrow there is no alert with	**REC_HP_MRS_05:** An imminent separation infringement alert could be available for the ATCOs.	REQ_HP_MRS_13: In case of wind monitoring alert, the Approach and Tower Controllers shall revert to the corresponding Spacing Minimum mode (e.g. 2.5NM or 3NM Spacing Minimum), with or without the FTD and ITD indicators and when needed take corrective actions during the transition phase like instructing go-arounds. **REQ_HP_MRS_14:** For all DB modes with ORD (i.e. displaying ITDs) and TB modes, the Approach and Tower Controllers and Supervisors shall be alerted by the glideslope wind monitoring function about a significant difference between actual glideslope

					respect the 2.5NM MRS infringement but a separation monitoring function that is displayed on the screen of the "management" for safety analyses. Potentially, a similar tool could be implemented as a support tool for ATCOs in case an infringement of 2NM MRS could take place, given that the safety impact could be higher with the reduced MRS as compared to today`s operations		headwind profile and the glideslope headwind profile used for the TDI computation, i.e. when the predicted time-to-fly (based on the headwind profile prediction used for Target Distance Indicator computation) compared to the actual time-to-fly (based on the actual headwind measurement) exceeds a threshold to be determined locally.
2.3.4-2	ATCOs and Supervisors may not notice when wind forecasting is not functioning, therefore an alert may be required.	Closed	OBJ-02.03-V2-VALP-HP2.3.4-002	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to a conditional mode of application.		

Arg. 2.3.6: The usability of the user interface (input devices, visual displays/ output devices, alarms & alerts) is acceptable.							
2.3.6-1	The support tool and all the linked components (ITD, FTD etc.) are not acceptable for the ATCOs	Closed	OBJ-02.03-V2-VALP-HP2.3.6-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
2.3.6-2	Target distance indicators increase pressure on ATCOs to over perform.	Closed	OBJ-02.03-V2-VALP-HP2.3.6-002	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
2.3.6-3	Target distance indicators on supervisor positions are used to judge individual performance and put pressure on ATCOs	Closed	OBJ-02.03-V2-VALP-HP2.3.6-003	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
Arg. 2.3.7: The user interface design reduces human error as far as possible							
2.3.7-1	MRS is applied when it should not be applied ; the user interface with the	Closed	OBJ-02.03-V2-	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to		

	support tool should ensure ATCOs avoid that		VALP-HP2.3.5-001		a conditional mode of application. .		
2.3.7-2	Controllers may misidentify /mistake indicators and other information on the radar screen due to their visual channels already heavily loaded.	Closed	OBJ-02.03-V2-VALP-HP2.3.5-002	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
2.3.7-3	Benefit: FTD/ITD indicators help to reduce the number of separation infringements.	Open	OBJ-02.03-V2-VALP-HP2.3.5-003	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
Arg. 2.3.8: The user interface design supports a sufficient level of team situation awareness							
2.3.8-1	The ATCO is not aware which aircraft pair is flying 2.0NM MRS ; the tool should mitigate this issue	Closed	OBJ-02.03-V2-VALP-	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		

			HP2.3.8-001				
2.3.8-2	The tower controller does not see on the HMI which aircraft the approach controllers plans to have on MRS and vice versa (?)	Closed	OBJ-02.03-V2-VALP-HP2.3.8-002	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to a conditional mode of application. .		
2.3.8-3	Over reliance on the FTD indication for the indication of required separation results in ATCOs not perceiving losses of separation and/or not acting to restore separation in a timely manner, outside the axis area	Closed	OBJ-02.03-V2-VALP-HP2.3.8-003	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
Arg. 2.3.9 The user interface design supports a sufficient level of team situational awareness							
2.3.9-1	The user interface design supports a sufficient level of situational awareness for the tasks involving a	Closed	OBJ-02.03-V2-VALP-	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		**REQ_HP_MRS_15:** If the introduction of 2NM MRS with ORD requires to change the current

	coordination between the ATCOs and the Supervisors		HP2.3.9-001				surveillance system (e.g. for a higher update rate) in local implementation, there shall be a synchronisation of the update rate between the APP and TWR ATCOs radar screens in order to allow smooth radar visualisation upon aircraft transfer from APP to TWR
Arg. 3.2.1 Changes to the task allocation between human actors does not lead to adverse effects on human tasks							
3.2.1-1	The distribution of tasks is not acceptable for the APP and TWR ATCOs during peak hours when a reduced MRS of 2.0NM applies	Closed	OBJ-02.03-V2-VALP-HP3.2.1-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See 1.3.3-5		
Arg. 3.2.2 The proposed task allocation between human actors is supported by technical systems/ the HMI.							
3.2.2-1	Benefit: The HMI supports the needs of redistributing tasks between ATCOs, in case needed, allowing them to have an increased awareness	Closed	OBJ-02.03-V2-VALP-	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		

	of what is happening in the other sector, due to the TDIs.		HP3.2.2-001				
Arg. 3.2.3 The proposed task allocation between human actors is supported by technical systems/ the HMI.							
3.2.3-1	Removal of ITD and FTD indications may lead to human errors.	Closed	OBJ-02.03-V2-VALP-HP3.2.3-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
Arg. 3.2.4 Team tasks can be achieved in a timely and efficient manner.							
3.2.4-1	The transition from 2.0NM MRS to 2.5NM MRS (and vice versa) cannot be done in an efficient and timely manner, as the supervisor and the ATCO do not manage to apply the related procedures swiftly	Closed	OBJ-02.03-V2-VALP-HP3.2.4-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to a conditional mode of application.		
Arg. 3.3.1 Intra-team and inter-team communication supports the information requirements of team members							
3.3.1-1	The transition to a reduced MRS of 2.0 NM (and vice versa) is not clearly	Closed	OBJ-02.03-V2-	• EXE-PJ02-03-V3-RTS02	To be covered in local procedures.		

	communicated to supervisors and / or ATCOs in both APP and TWR.		VALP-HP3.3.1-001	• Prototyping session • Workshops			
Arg. 3.3.2 The phraseology supports communication in all operating conditions							
3.3.2-1	Current phraseology between ATCO and pilot does not support the use of a reduced MRS of 2.0NM.	Closed	OBJ-02.03-V2-VALP-HP3.3.1-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See 1.3.2-3		
Arg. 3.3.4 The communication load of team members is acceptable in normal and abnormal conditions and degraded mode of operations							
3.3.4-1	2.0NM MRS negatively impacts the amount of R/T usage between pilots & ATCOs during normal, abnormal or degraded modes of operation .e.g. The communication load may be significant if it is done for each a/c on frequency (confirm to follower a/c their	Closed	OBJ-02.03-V2-VALP-HP3.3.4-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	See 1.3.2-3		

	position with respect to the a/c ahead on final approach).						
Arg. 3.3.5 Team members can maintain a sufficient level of shared situation awareness							
3.3.5-1	Benefit: The communication between the ATCO and flight crew regarding their position relative to the a/c ahead will improve the shared situation awareness (e.g. ATCO to confirm to follower a/c their position with respect to the a/c ahead on final approach).	Closed	OBJ-02.03-V2-VALP-HP3.3.5-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Please check PJ02-01 requirements related to a conditional mode of application.		
Arg. 4.1.1 Changes in roles and responsibilities are acceptable to the affected human actors							
4.1.1-1	Due to the increase in throughput and the increase of the complexity of tasks and the increase in workload the ATCOs do not accept the proposed solution	Closed	OBJ-02.03-V2-VALP-HP4.1.1-001	• EXE-PJ02-03-V3-RTS02 • Prototyping session	ATCOs considered the two scenarios to be operationally feasible and no increase in workload was identified as compared to the reference scenario. However, there were concerns about the operational		

					acceptability of the procedures in real live operations in Vienna due to the fact the procedures were conditional on certain wind conditions (still to be defined). – please check the Prototyping session report **Error! Reference source not found.** for an in depth understanding of the 2.0NM MRS ICAO DBS exercise with no tool.		
4.1.1-2	Due to the reduction in separation and hence a smaller buffer for error, pilots might not accept the proposed solution	Closed	OBJ-02.03-V2-VALP-HP4.1.1-002	• Workshops	The pilots participating in the workshop did not identified novel safety concerns as compared to the 2.5NM MRS concept.		
Arg. 4.1.2 The impact of changes on the job satisfaction of affected human actors has been considered.							

4.1.2-1	The distance target tool could take away a lot of the cognitive demands placed on the ATCOs (particularly APP), especially if the compression factor is incorporated and presented to the ATCOs) in terms of calculating the required inter a/c spacing.	Closed	OBJ-02.03-V2-VALP-HP4.1.2-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		
Arg. 4.2.1 Knowledge, skill and experience requirements for human actors have been identified							
4.2.1-1	ATCOs might lose their skills when working with the ORD tool	Closed	OBJ-02.03-V2-VALP-HP4.2.1-001	• EXE-PJ02-03-V3-RTS02 • Workshops	Please check PJ02-01 requirements related to the use of the ORD tool.		**REQ_HP_MRS_07:** When operating under 2NM MRS without the Separation Delivery Tool, the APP ATCO shall receive additional training to emphasize the specific use of the IAS and GS indications for managing separation at interception **REQ_HP_MRS_08:** When the Separation Delivery Tool is used, the training

							curricula shall ensure the ATCOs are capable of maintaining the required separations on base leg (horizontal and vertical) despite getting in the habit of working with the TDIs on the axis
Arg. 4.3.1 The impact on staff levels is identified.							
4.3.1-1	With a steady flow of 2nm separation and therefore with the increase of traffic the tower controller is very busy and will not be able take calls from VFR traffic, there might be the need to add a separate position (see staffing)	Closed	OBJ-02.03-V2-VALP-HP4.3.1-001	Workshops	REC_HP_MRS_01:		
4.3.1-2	The tower controller might be very busy and it might ask for an additional position ; one for departure one for arrival separately	Closed	OBJ-02.03-V2-VALP-	Workshops	REC_HP_MRS_01:		

			HP4.3.1-002				

Table 7: Summary of the HP results and recommendations/ requirements for each identified issue & related argument

4.4.2 Maturity of the Solution

Maturity checklist for finalising the V3 assessment 2.0NM MRS with ORD tool			
ID	**Question**	**Answer** *Fill in 'yes' or 'no'.*	**Comments** *Please substantiate your answer.*
1	Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported?	Yes	*Based on the Change and Argument Identifications section, a total of 87 issues have been identified, covering all 4 HP Arguments.* *All 4 high-level HP Arguments have been covered.* *2nd level HP Arguments covered:* *- Argument 1.2. Operating Methods* *- Argument 1.3. Tasks* *- Argument 2.1 Allocation of tasks (between the human and the machine)* *- Argument 2.2 Performance of technical system* *- Argument 2.3. Human-machine interface* *- Argument 3.2. Allocation of tasks (between human actors)* *- Argument 3.3. Communication between team members* *- Argument 4.1. Acceptance and job satisfaction* *- Argument 4.2. Competence requirements* *- Argument 4.3. Changes in staffing requirements and staffing levels* *Based on the validation activities (task analysis, workshops and RTS) all aforementioned arguments have been properly addressed in relation to the expected evidence for a V3 maturity level.*
2	Are the benefits and issues in terms of human performance and operability related to the proposed solution sufficiently assessed (i.e. on the level required for V3)?	Yes	*All parts of the solution/concept have been considered, on the basis of the change and argument identification step- which represented the starting point of the HP activities. For a detailed description of the issues addressed in validation activities, please refer to Chapter 4.4 above.*

3	Have all the parts of the solution/concept been considered?	Yes	*The solution is considered to have reached a V3 maturity level. All parts of the solutions have been covered for Pj02.03 (2.0NM MRS with the ORD tool) and all corresponding issues have been closed.*
4	Have potential interactions with related projects/concepts been considered and addressed?	Yes	*The list of the related projects/solutions has been identified - as documented in the OSED and the HP Plan- Part IV of the VALP.*
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes	*The level of human performance needed to achieve the desired system performance has been assessed and confirmed as consistent with human capabilities. (see VALR **Error! Reference source not found.**).*
6	Are the assessments results in line with what is targeted for that concept? If not, has the impact on the overall strategic performance objectives/targets been analysed?	Yes	- *Arguments addressed and associated actual evidence in the form of recommendations and requirements (Appendix A and Appendix B and PJ02-01 conditional application of reduced separation and ORD tool requirements and recommendations).*
7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes	*The validation activities were built and conformed to experimental design principles, ensuring realistic conditions and allowing the participants to get sufficiently familiar with the new concept through training sessions before the real time simulation was conducted. For all the issues that were not fully covered during RTS due to simulation limitations, the workshop discussions have ensured an in depth coverage of the remaining open issues. The latter have been closed based on "expert judgement" of both operational experts and HP experts.*
8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	*The validation results confirm that the interactions between human and technology are operationally feasible and consistent with agreed HP requirements. For a detailed view on the identified issues and the results of the validations, please consult Chapter 4.4 above.*
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements register sections of this Word document. A crosscheck with Safety has been performed as well in order to ensure there is no overlap between the HP and SAF requirements and correspondingly with the OSED Part I requirements.*

10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
12	Have the major factors that can influence the transition feasibility (e.g. changes in competence requirements, recruitment and selection, training needs, staffing requirements, and relocation of the workforce) been addressed? Are there any ideas on how to overcome any issues?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
13	Have any impacts been identified that may require changes to regulation in the area of HP/ATM? This includes changes in roles & responsibilities, competence requirements, or the task allocation between human & machine.	Yes	*All related recommendations and requirements relevant to changes in roles & responsibilities, competence requirements, or the task allocation between human & machine, are to be found in the Recommendations and Requirements sections. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes	*All identified issues for Pj02.03 have been closed.*

Table 8: Maturity checklist for 2.0NM MRS with the ORD tool

Maturity checklist for finalising the V3 assessment 2.0NM MRS without the tool			
ID	**Question**	**Answer** *Fill in 'yes' or 'no'.*	**Comments** *Please substantiate your answer.*
1	Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported?	No	*Based on the Change and Argument Identifications section, a total of 87 issues have been identified, covering all 4 HP Arguments.* *All 4 high-level HP Arguments have been covered.* *2nd level HP Arguments covered:* *- Argument 1.2. Operating Methods* *- Argument 1.3. Tasks* *- Argument 2.1 Allocation of tasks (between the human and the machine)* *- Argument 2.2 Performance of technical system* *- Argument 2.3. Human-machine interface* *- Argument 3.2. Allocation of tasks (between human actors)* *- Argument 3.3. Communication between team members* *- Argument 4.1. Acceptance and job satisfaction* *- Argument 4.2. Competence requirements* *- Argument 4.3. Changes in staffing requirements and staffing levels* *The prototyping session conducted assessed the operational feasibility and acceptability of 2.0NM MRS between medium-medium aircraft pairs with DBS ICAO separations and no ATCO support tool. Only nominal operating conditions have been assessed in a realistic operational environment, therefore additional investigation on abnormal and degraded modes of operations should be performed. Although addressed in workshop activities, validation activities are further required to complete a maturity level of V3.*
2	Are the benefits and issues in terms of human performance and operability related to the proposed solution sufficiently assessed (i.e. on the level required for V3)?	Yes	*All parts of the solution/concept have been considered, on the basis of the change and argument identification step- which represented the starting point of the HP activities. For a detailed description of the issues addressed in validation activities, please refer to Chapter 4.4 above.*

3	Have all the parts of the solution/concept been considered?	No	*Further validation activities are required for:* - *The criterion value or wind under which the 2.0NM MRS procedures can be applied between M-M pairs with no controller support tool needs to be determined, if the concept id progressed* - *The concept needs to be tested under different wind conditions, in particular with a wind at or around the criteria level of activation, to ensure it is feasible and acceptable from an operational perspective.* - *FTS simulations should be used to determine the possible runway throughput gains that can be gained in different airports with different mixes.*
4	Have potential interactions with related projects/concepts been considered and addressed?	Yes	*The list of the related projects/solutions has been identified - as documented in the OSED and the HP Plan- Part IV of the VALP.*
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes	*The level of human performance needed to achieve the desired system performance has been assessed and confirmed as consistent with human capabilities. (see VALR **Error! Reference source not found.**).*
6	Are the assessments results in line with what is targeted for that concept? If not, has the impact on the overall strategic performance objectives/targets been analysed?	Yes	- *Arguments addressed and associated actual evidence in the form of recommendations and requirements (Appendix A and Appendix B and PJ02-01 conditional application of reduced separation and ORD tool requirements and recommendations).*
7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	No	*The prototyping session conducted assessed the operational feasibility and acceptability of 2.0NM MRS between medium-medium aircraft pairs with DBS ICAO separations and no ATCO support tool. Only nominal operating conditions have been assessed in a realistic operational environment, therefore additional investigation on abnormal and degraded modes of operations should be performed. Although addressed in workshop activities, validation activities are further required to complete a maturity level of V3.*
8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	*The validation results confirm that the interactions between human and technology are operationally feasible and consistent with agreed HP requirements. For a detailed view on the identified issues and the results of the validations, please consult Chapter 4.4 above.*

9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements register sections of this Word document. A crosscheck with Safety has been performed as well in order to ensure there is no overlap between the HP and SAF requirements and correspondingly with the OSED Part I requirements.*
10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
12	Have the major factors that can influence the transition feasibility (e.g. changes in competence requirements, recruitment and selection, training needs, staffing requirements, and relocation of the workforce) been addressed? Are there any ideas on how to overcome any issues?	Yes	*The outcome of the HP activities is to be found in the Recommendations and Requirements – available in Appendix A and Appendix B of this document. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
13	Have any impacts been identified that may require changes to regulation in the area of HP/ATM? This includes changes in roles & responsibilities, competence requirements, or the task allocation between human & machine.	Yes	*All related recommendations and requirements relevant to changes in roles & responsibilities, competence requirements, or the task allocation between human & machine, are to be found in the Recommendations and Requirements sections. Additionally, all requirements and recommendations applicable to the conditional application of reduced separations and to the use of the ORD tool can be found in the HPAR of PJ02-01* ***Error! Reference source not found.****.*
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes	*All identified issues for Pj02.03 have been closed but the requirements and recommendations indicate the remaining issues to be addressed in validation activities for local implementation.*

Table 9: Maturity checklist for 2.0NM MRS without the tool

5 References

Human Performance

[1] SESAR Solution PJ02-03: Validation Plan (VALP) Part I for V3, Edition 00.01.00, 28th February 2019

[2] 16.006.05 D27 SESAR Human Performance Assessment Process V1 to V3- including VLDs, ed 00.02.00, 10 Avril 2018

[3] SESAR Solution PJ02-01: OSED for V3 - Part II - Safety Assessment Report, Edition 00.00.04, November 2019

[4] SESAR Solution PJ02-01: OSED for V3 - Part IV - Human Performance Assessment Report, Edition 00.00.03, November 2019

[5] SESAR Solution PJ02-03: Validation Plan (VALP) Template for V3 - Part IV - Human Performance Assessment Plan, edition 02.00.01, June 2019

[6] SESAR Solution PJ02-03: Validation Report for V3, Edition 00.00.03, 20 June 2019

[7] SESAR Solution PJ02-03 SPR-INTEROP/OSED for V3 - Part I, Edition 00.00.05, 22 March 2019

[8] SESAR PJ02-03 Release Note, edition 00.00.03, June 2019

Appendix A – Additional HP activities conducted

See Reference list.

Appendix B – HP Recommendations Register

HP Recommendations Register						
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Recommendation status	Rationale in case of rejection
REC_HP_MRS_01:	**Operational**	A second ATCO on the final approach position should be available in distance-based operations when 2nm MRS is applied in peak times (in highly complex environment), in order to ensure availability for go-around instructions while allowing the main ATCO to coordinate a steady inbound flow.	For distance based separation, the Vienna ATCOs explained that with a steady inbound of 2 nm, there is a need of a ATCO taking care only of the arrivals- avoiding VFR calls. This would be required because with 2.0nm MRS applied in distance based- the reactions must be quicker in order to avoid a go-around. The AF pilots used the example of the RRSM (RWY Reduced Separation Minima) in the US, where for very complex environments a second ATCOs is dedicated for monitoring and instructing go-arounds (in case the 2400 m wrt to the Leader are not met by the time the Follower attempts landing). In this case, 2nd frequency with a different ATCO needs to be monitored by pilots on final approach, in case a go-around is required.	Workshops	Open	

REC_HP_MRS_02:	**Operational**	To reduce R/T occupancy issues, local implementation should consider mitigations such as silent transfer of communication in final APP sector, data link communication or optimising phraseology (e.g. calling with call sign only).	In order to reduce R/T occupancy times	• EXE-PJ02-03-V3-RTS02 • Prototyping session • Workshops	Open	
REC_HP_MRS_03:	**Operational**	The separation reduction on final approach to 2.0NM MRS should be accompanied with a reduced separation reduction of the MRS separation on the baseleg to 2/.5NM MRS.	Following the EXE-PJ02-03-V3-RTS02, ATCOs consider that "there must be a different separation minima allowed on the base leg, as one would only be comfortable with working so tight, if the currently accepted separation minima of 3NM (on the baseleg) can be infringed".	EXE-PJ02-03-V3-RTS02	Open	
REC_HP_MRS_04:	**Operational**	The final Approach ATCOs should consider using vertical separations when appropriate to avoid	Following the EXE-PJ02-03-V3-RTS02, ATCOs consider that "there must be a different separation minima allowed on the base leg, as one would only be comfortable with working so tight, if the currently	EXE-PJ02-03-V3-RTS02	Open	

		separations infringements on the baseleg.	accepted separation minima of 3NM (on the baseleg) can be infringed".			
REC_HP_MRS_05:	**Operational**	An imminent separation infringement alert could be available for the ATCOs.	<u>Note regarding MRS 2NM without tool:</u> ORTOP3 ATCO feed-back is that no need for imminent separation infringement alert, but it could be a "nice to have feature". It is nonetheless recommended to implement the application of 2 NM MRS with the support of the ORD tool, due to the complex support it offers to the ATCOs based on alerts and indication of the TDIs. Currently in Heathrow there is no alert with respect the 2.5NM MRS infringement but a separation monitoring function that is displayed on the screen of the "management" for safety analyses. Potentially, a similar tool could be implemented as a support tool for ATCOs in case an infringement of 2NM MRS could take place, given that the safety impact could be higher with the reduced MRS as compared to today`s operations	Workshop	Open	
REC_HP_MRS_06:	Operational	Local assessment should evaluate the need of reducing shift times as a result of a potential	The workload of the APP and TWR ATCOs was not negatively impacted under any of the two scenarios. Nonetheless it should be assessed prior to local implementation as	Workshop	Open	

		increase in workload following due to the implementation of 2.0NM MRS (e.g. increased R/T etc.)	the increase in workload could be influenced by other local factors.			

Table 10: HP recommendations

Appendix C – HP Requirements Register

HP Requirements Register						
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Requirement status	Rationale in case of rejection
REQ_HP_MRS_01:	Operational	A set of working methods/guidelines to cover the 2 NM MRS concept and the related normal operating procedures (and associated tools) should be locally defined.	To ensure all actors involved (ATCOs, SUPs etc.) are fully aware of the working methods associated to the 2.0 nm MRS concept.	Workshops RTS Prototyping session	Open	
REQ_HP_MRS_02:	Operational	A set of working methods/guidelines to cover the 2 NM MRS concept and the related abnormal/ degraded operating	To ensure all actors (ATCOs, SUPs etc.) involved are fully aware of the working methods associated to the 2.0 nm MRS concept. However, following the validation activities, the	• EXE-PJ02-03-V3-RTS02 • Workshops	Open	

		procedures should be locally defined	ATCOs believe there will be np significant change compared to the operating methods associated with 2.5NM MRS.			
REQ_HP_MRS_03:	Operational	The reduction to 2 NM MRS shall be applied only when the Separation/Spacing Minima constraints and the provision of appropriate ROT Spacing are actively managed through the supporting of specific ATC procedures allowing predefined conditions influencing ROT to be satisfied (e.g. braking action reported as good, no runway contaminants such	This is in order to ensure safe operations in terms of acceptable rate of Go-arounds due to ROT. It is advised that an ORD Tool should be used to support the satisfaction of this requirement.	• EXE-PJ02-03-V3-RTS02 • Workshops	Open	

		as slush, snow or ice, etc.)				
REQ_HP_MRS_04:	Operational	The Flight Crew shall be made aware of the locally applied separation mode and minima via appropriate means (e.g. from ATIS, AIP, NOTAM, information campaigns).	The pilots participating in the workshop have mentioned that with reduced separations (especially if combined with TBS) it becomes "impossible for the flight crew to be different with the separation minima applicable on airports around the world". As a result, flight crew shall comply with ATC instructions, which requires high trust in the ATCOs, which would be reinforced by information campaigns which would bring the flight crew the required updates. Additionally the separation minima values shall be available in the corresponding documentation (e.g. ATIS, NOTAM etc.)	• Workshops	Open	
REQ_HP_MRS_05:	Operational	In case a separation reduction of the	Following the EXE-PJ02-03-V3-RTS02, ATCOs consider	EXE-PJ02-03-V3-RTS02	Open	

		MRS on the baseleg to 2.5NM MRS is considered, it shall be approved by local regulators.	that "there must be a different separation minima allowed on the base leg, as one would only be comfortable with working so tight, if the currently accepted separation minima of 3NM (on the baseleg) can be infringed".			
REQ_HP_MRS_06:	Operational	If available for the Final Approach Controllers, the Short Term Conflict Alert shall be adjusted to accommodate the 2NM MRS concept	In some environments STCA will be active on the final approach segment, for example outside 4NM. It is important that STCA does not trigger false positives for the pairs correctly separated at or close to 2NM on the specific segment where STCA is active.	Workshop	Open	
REQ_HP_MRS_07:	Training	When operating under 2NM MRS without the Separation Delivery Tool, the APP ATCO shall receive additional training	This is in order to avoid losses of radar separation on the base leg.	Workshop	Open	

		to emphasize the specific use of the IAS and GS indicatios for managing separation at interception				
REQ_HP_MRS_08:	Training	When the Separation Delivery Tool is used, the training curricula shall ensure the ATCOs are capable of maintaining the required separations on base leg (horizontal and vertical) despite getting in the habit of working with the TDIs on the axis	This is in order to avoid losses of radar separation on the base leg.	Workshop	Open	
REQ_HP_MRS_09:	Operational	For the case without the Separation Delivery Tool, when using the ICAO WTC scheme, the a 2NM	To reduce the potential for human error as the ATCOs would be required to mentally calculate the ROT values otherwise.	RTS/ Workshop	Open	

		MRS Spacing Minimum mode shall be activated only when the runway surface and glide-slope wind is equal or greater than the 2NM MRS threshold (in addition to the satisfaction of the predefined conditions influencing ROT).				
REQ_HP_MRS_10:	Operational	Local procedures/rules shall be defined in order to ensure safe transition of the aircraft from 3NM to 2NM MRS, such as to avoid loss of separation minima during on base leg	To avoid separation minima on the baseleg.	RTS/Workshop	Open	
REQ_HP_MRS_11:	Operational	When the 2NM MRS concept is applied in TB-	The Separation Delivery Tool is mandatory when the 2NM MRS concept is applied in TB-	RTS	Open	

		modes, DB PWS-A and/or WDS-A, the Intermediate Approach, Final Approach and Tower Controllers shall be provided with a Separation Delivery Tool displaying Target Distance Indicators (TDI) to enable consistent and accurate application of separation rules on final approach and landing	modes, DB PWS-A and/or WDS-A.			
REQ_HP_MRS_12:	Operational	When the 2NM MRS concept is applied in DB-modes not including DB PWS-A, the Intermediate Approach, Final Approach and Tower Controllers should be provided	The Separation Delivery Tool is not mandatory when the 2NM MRS concept is applied in DB-modes (not including DB PWS-A).	RTS		

		with a Separation Delivery Tool displaying Target Distance Indicators (TDI) to enable consistent and accurate application of separation rules on final approach and landing				
REQ_HP_MRS_13:	Operational	In case of wind monitoring alert, the Approach and Tower Controllers shall revert to the corresponding Spacing Minimum mode (e.g. 2.5NM or 3NM Spacing Minimum), with or without the FTD and ITD indicators and when needed take corrective actions during the transition phase like	If the wind monitoring alert shows, this means that there is a significant difference between the actual wind profile and the wind profile used by the tool (with impact on the correctness of the ITDs in any mode of operation and on the FTDs in TB-modes) which means that the mode of operation has be changed.	RTS		

		instructing go-arounds.				
REQ_HP_MRS_14:	Operational	For all DB modes with ORD (i.e. displaying ITDs) and TB modes, the Approach and Tower Controllers and Supervisors shall be alerted by the glideslope wind monitoring function about a significant difference between actual glideslope headwind profile and the glideslope headwind profile used for the TDI computation, i.e. when the predicted time-to-fly (based on the headwind profile prediction used for Target Distance Indicator computation) compared to the	A significant difference between the actual wind profile and the wind profile used by the tool will have an impact of the correctness of the ITDs in any mode of operation and on the FTDs in TB-modes. This can lead to an under-separation.	RTS		

		actual time-to-fly (based on the actual headwind measurement) exceeds a threshold to be determined locally.				
REQ_HP_MRS_15:	Operational	If the introduction of 2NM MRS with ORD requires to change the current surveillance system (e.g. for a higher update rate) in local implementation, there shall be a synchronisation of the update rate between the APP and TWR ATCOs radar screens in order to allow smooth radar visualisation upon aircraft transfer from APP to TWR	This is in order to allow smooth visualisation when aircraft are transferred between APP and TWR	RTS		

Table 11: HP Requirements

Appendix D – HP Log

No HP Log is available for PJ02.03 as all relevant information is available in the current Word document.

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