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PJ.02-W2-14.3 SPR-INTEROP/OSED - Part IV - Human Performance Assessment Report for V3

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PJ.02-W2 AART

AIRPORT, AIRSIDE AND RUNWAY THROUGHPUT

This Human Performance Assessment Report is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874477 under European Union's Horizon 2020 research and innovation programme.

Abstract

The scope of the HP Assessment Report (HPAR) is to ensure all relevant HP aspects have been identified and considered for the operational and technical development of solution PJ.02-W2-14.3 – "Increased Second Glide Slope (ISGS)", in accordance with the HP Assessment Process [1].

PJ.02-W2-14.3 aims to improve airport performances on the Environmental Sustainability and Capacity Key Performance Areas by introducing the ISGS concept, AO-0320. The concept was already investigated within SESAR1 Programme and SESAR 2020 PJ.02-02 in Wave 1, but as an outcome of this previous R&D Programme, it did not achieve full V3 maturity. PJ.02-W2-14.3 aims to complete the validation activities on ISGS concept, so that they can be moved to the next phase of the validation cycle.

The addressed OI for the validation activities was:

- AO-0320 – Enhanced approach operations using an increased second glide slope (ISGS).

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1 Executive Summary

PJ.02-W2-14.3 aims to improve airport performance on the Environmental Sustainability and Capacity Key Performance Areas by introducing the ISGS concept, AO-0312. The concept was already investigated within SESAR1 Programme and SESAR 2020 PJ.02-02 in Wave 1, but as an outcome of this previous R&D Programme, it did not achieve full V3 maturity. PJ.02-W2-14.3 aims to complete the validation activities on ISGS concept, so that they can be moved to the next phase of the validation cycle.

The HP Assessment Report (HPAR) ensures that relevant Human Performance (HP) aspects have been identified and considered for the operational and technical development of PJ.02 Airport & Airside and Runway Throughput (AART) concepts, based on the HP Assessment Process [1] methodology. The HPAR is built on the structure of the HP Arguments which are “HP claims that need to be proven”, according to the HP Reference Material. In a first step – the scoping and change assessment- the arguments that are relevant for the concept were identified. A full description of ISGS can be found in the final PJ.02-W2-14.3 OSED/SPR-INTEROP Part I (D4.3.002) [2].

Up to date several validation activities were conducted to assess the ISGS Enhanced Arrival Procedure, with the use of the Optimal Runway Delivery (ORD) tool using the Paris CDG airport, with an approach environment for:

- AO – 0320 - Enhanced approach operations using an increased second glide slope (ISGS).

These Validation exercises were conducted to cover gaps identified following PJ.02-02 validation activities, which were about:

1. The management of non-nominal situations from ATC side (go-around/missed approaches, interception of wrong glide, loss of LORD tool in heavy traffic situations). One simulation covered these points;

2. Ground aids (runway marking, runway lighting and the PAPI) for the pilots. Runway marking and PAPI were covered by one simulation and the lighting by two.

The objectives of the validation exercises were to assess the following under non-nominal conditions:

- The usability and acceptability of ISGS;
- The usability and acceptability of the sequencing and separation tool (ORD);
- The impact of the enhanced arrival procedure on communication exchanges/ phraseology;
- The usability of the HMI;
- The acceptability of the number of a/c flying the ISGS.

The conclusions of the ATC real-time simulation is that the proposed ways to manage the non-nominal situations are acceptable and manageable by the controllers.

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The following arguments were identified as being relevant for the concept:

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 and team communication support the human actors in performing

Arg. 4: Human Performance related transition factors are considered.

The HPAR presents the outcome of the human performance activities conducted in order to adequately inform the development and validation of SESAR Solution PJ.02-W2-14.3 to full V3 maturity.

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.

A total of 27 potential HP issues/ benefits have been identified, on the basis of which three HP activities were proposed:

1. User workshops (with relevant experts – ATCOs, SUPs);
2. Real time simulations and debriefs;
3. Flight deck simulations.

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).

These activities were defined in order to cover the HP objectives that have been included in the Validation Plan. The outputs of these activities have been integrated in the list of requirements and recommendations that are described in Chapter 4, and related to:

- Future validation exercises covering the ISGS procedure;
- The operational concept and related procedures;
- The technical system and the design of the HMI;
- The training of the end users.

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2 Introduction

2.1 Purpose of the document

The purpose of the HPAR is to describe the final status of the HP issues and HP objectives identified on according to the Human Performance (HP) assessment process [1] and to define corresponding mitigations in the form of recommendations and requirements.

The SESAR Solution Development Life Cycle aims to structure and perform the work at project level and progressively increase SESAR Solution maturity, with the final objective of delivering a SESAR Solution data-pack for industrialisation and deployment. The Part IV of the OSED is a supporting document to the Part I, which is a key part of this SESAR Solution data-pack.

2.2 Intended readership

The intended audience for this document are primarily all the partners involved in SESAR 2020 PJ.02-W2-14.3.

Stakeholders are to be found among:

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

2.3 Structure of the document

The PJ.02-W2-14.3 OSED consists of five parts:

- Part I, providing the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP), that have been developed and validated during the validation activities to a V2 maturity level. They are presented in the context of the Operational Service and Environment Definition (OSED) which describes the environment, assumptions and other issues that are applicable to the SPR and INTEROP requirements;
- Part II: The Safety Assessment Report which describes the results of the safety assessment work that justify the associated SPR and INTEROP requirements in the Part I;
- Part III: The Environmental Assessment Report which describes the results of the environmental assessment work that justify the associated SPR and INTEROP requirements in the Part I;
- Part IV (this part): The Human Performance Assessment Report describes the results of the Human Performance Assessment Report which describes the results of the Human Performance assessment work that justify the associated SPR and INTEROP requirements in the Part I;
- Part V: The Performance Assessment Report that consolidates the performance results obtained across the different validation activities at the solutions level.

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184 Part IV of the SESAR Solution PJ.02-W2-14.3 OSED consists of four main sections:

185 • Section 1: Executive Summary of the brief description of the solution and the associated HP
186 implications;
187 • Section 2: Introduction covering the purpose of the document, the intended readership, the
188 glossary of terms and the list of acronyms;
189 • Section 3: The objectives and approach of the SESAR Human Performance Assessment process,
190 providing an understanding of the methodology and each of the steps involved;
191 • Section 4: The description of the Human Performance Assessment, the scenarios, assumptions,
192 understanding of the ATM concept and its implication on HP.

193 2.4 Acronyms and Terminology

Term	Definition
AFA	Audio Flare Assistant
AFS CP	Automatic Flight System Control Panel
ANSP	Air Navigation Service Provider(s)
AP/FD	Autopilot/Flight Director
APM	Approach Path Monitoring
APP	Approach
ASS	Assumption
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Services
CAT	Category
CDG	Charles De Gaulle airport
CSPR ST	Closely Spaced Parallel Runways - Staggered Threshold
CWP	Controller Working Position
DCB	Demand Capacity Balancing
DEP	Departure
DOD	Detailed Operational Description
EAP	Enhanced Arrival Procedures
EXE	Exercise
FCOM	Flight Crew Operating Manual
FTD	Final Target Distance
GBAS	Ground Based Augmentation System
GLS	GBAS Landing System
HMI	Human Machine Interface
HPAP	Human Performance Assessment Plan
HPAR	Human Performance Assessment Report
IFR	Instrument Flight Rules
IGS	Increased Glide Slope
ILS	Instrument Landing System
INI	Initial Approach Controller
INTEROP	Interoperability
ISA	Instantaneous Self-Assessment
ISGS	Increased Second Glide Slope
ITD	Initial Target Distance

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ITM	CDG Approach sector
KPA	Key Performance Area
LORD	Landing with Optimised Runway Delivery
MRS	Minimum Radar Separation
NOTAM	Notice to Airmen
NSA	National Supervisory Authority
OBJ	Objective
OI	Operational Improvement
OPS	Operations
ORD	Optimised Runway Delivery
OSED	Operational Service and Environment Definition
PAPI	Precision Approach Path Indicator
REQ	Requirement
RNAV	Area Navigation
ROT	Runway Occupancy Time
RTCS	Recruitment, Training, Competence, and Staffing
RTS	Real-Time Simulation
SASHA	Situational Awareness for SHAPE
SATI	SHAPE Automation Trust Index
SBAS	Satellite-Based Augmentation System
SESAR	Single European Sky ATM Research
SOP	Standard Operating Procedures
SPR	Safety and Performance Requirements
SRAP	Secondary Runway Aiming Point
STAR	Standard Arrival Route
STQ	SHAPE Teamwork Questionnaire
TLX	Task Load Index
TMA	Terminal Manoeuvring Area
TOD	Top Of Descent
TRN	Training
TWR	Tower
VALP	Validation Plan
VALR	Validation Report
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules

194 **Table 1: Acronyms table**

195

Term	Description
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 workplace) 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

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	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 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 Argument	An HP argument is an HP claim that needs to be proven through the HP Assessment Process.
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 SESAR Solutions into larger clusters (e.g. 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.

196 **Table 2: Terminology table**

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3 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process described in detail in Human Performance Guidance document [1] is to ensure that HP aspects related to SESAR Solution 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, which will be defined in the HP Assessment Report (HPAR).

The HP assessment process is a four-step process. [1] provides an overview of these four steps with the tasks to be carried out and the two main outputs (i.e. HPAP and HPAR). Please note that a HP log is not to be developed in support of this solution, given the low complexity of the assessment required. As such, please disregard references to 'HP Log' in the figure below:

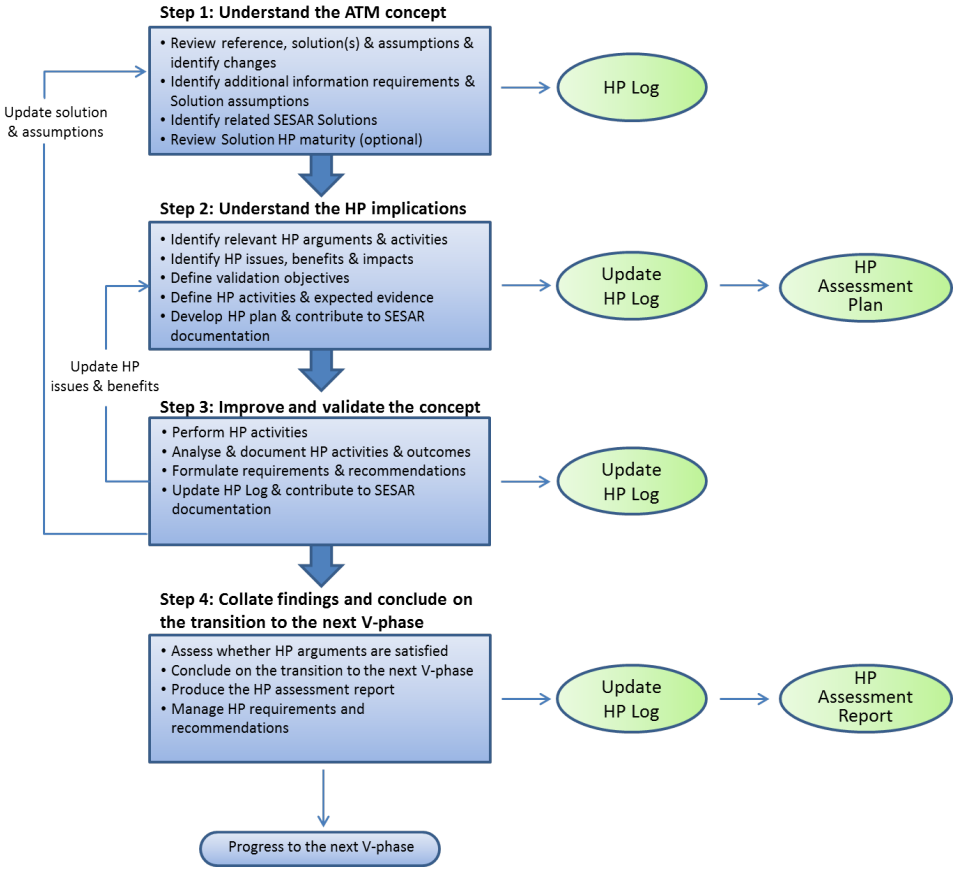

Figure 1: Steps of the HP assessment process

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214 # 4 Human Performance Assessment

215 ## 4.1 Step 1 Understand the ATM concept

216 ### 4.1.1 Description of reference scenario

217 The **reference scenario** is represented by the current final approach operations conducted with a
218 nominal (3°) and a continuous glide path angle, with a non-displaced threshold, based on the various
219 available technologies: Instrument Landing System (ILS), GBAS CAT I, Area Navigation (RNAV) or
220 Satellite-Based Augmentation System (SBAS).

221 ### 4.1.2 Description of solution scenario

AO-0320	Enhanced approach operations using an increased second glide slope (ISGS)	Full
Enhanced approach operations using an Increased Second Glide Slope (ISGS) will allow inbound aircraft to reduce noise footprint (environmental benefit). ISGS procedures are published approaches which feature a glide slope between the "standard" published one (commonly 3 degrees) and 4.49 degrees (limit above which steep approach concept applies), in order to provide a significant reduction in ground noise level (order of magnitude: -3 dBA in approach between 15 NM and 4 NM from runway threshold).		

222 ### 4.1.3 Consolidated list of assumptions

Identifier	Title	Description	Justification	Impact on Assessment
R01-ASS-01	Aircraft equipage capabilities	92% of the aircraft in the traffic sample are able to fly ISGS enabled by a specified system: RNAV or GBAS. 56% are planned for an RNAV or GBAS approach.	To be in line with the forecast for 2030	HIGH
R01-ASS-02	Separation standards and responsibilities	The minimum radar separation and runway related spacing constraints have to be respected if the ORD tool is not available.	For realistic simulation environment	HIGH
R01-ASS-03	No wind conditions	There will be no wind conditions simulated	This will not influence the results as the ORD tool considers the wind in the separation that it provides and the controllers will follow the chevrons provided by the ORD tool.	N/A

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Identifier	Title	Description	Justification	Impact on Assessment
R01-ASS-04	Traffic Sample	Observed traffic figures have been augmented to represent traffic in 2030.	This is required to understand the feasibility of the concepts during the expected implementation time.	HIGH
R01-ASS-05	Runway Occupancy Times (ROT)	The same runway occupancy times are used for both runway thresholds.	This will not influence the results as the ORD tool considers the ROT in the separation that it provides and the controllers will follow the chevrons provided by the ORD tool.	N/A
R01-ASS-06	Go-Arounds and Missed Approaches	Aircraft performing a go-around or a missed approach are not re-introduced into the sequence, but are "killed".	The purpose of the simulation is to assess how the missed approach or go-around is managed at the moment that they occur. Once managed, the controller returned to nominal situation.	LOW
R01-ASS-07	No crossing Traffic	The simulation only includes North arrivals. No departures or traffic from other surrounding airports.	The simulation environment is supposed to be generic for all airports. This is also required to understand the feasibility of the concepts during the expected implementation time.	LOW
R01-ASS-08	Aircraft General Characteristics	All aircraft have the same nominal characteristics.	For a realistic simulation environment	HIGH
R01-ASS-09	Airspace Organisation	European airspace will be based on current ICAO ATS classifications, regulations and applicable rules, including VFR and IFR.	For a realistic simulation environment	HIGH
R01-ASS-10	Actor Compliance	General Compliance by all actors with existing standards and guidelines.	For a realistic simulation environment	HIGH

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Identifier	Title	Description	Justification	Impact on Assessment
R01-ASS-11	Standards	Airport standards and responsibilities are unchanged.	For a realistic simulation environment	HIGH
R01-ASS-12	Training	All staff have appropriate training and competencies. Even though the traffic level at Paris CDG has decreased significantly due to the COVID-19 pandemic, it is assumed that controllers are still able to manage the level of traffic.	For a realistic simulation environment	HIGH

Table 3: Assumptions overview

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

All solutions of PJ.02-W2-14 using the same ATCO tool have to be considered relevant and interrelated.

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 [1] 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 [1].

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	For both air & ground there are no role changes foreseen in the project. What could occur is a different task sharing between existing roles, with the same responsibilities.
1.2 OPERATING	Operators and pilots intending to conduct any approach operations should fill the appropriate flight plan suffixes and the on board navigation data must be current

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METHODS	and include the appropriate procedures, including the new ISGS (that must be selectable from a valid navigation database (NavDB) and not prohibited by a company instruction or Notice to Airmen (NOTAM)). Aircraft capability to fly glide slope increase shall be indicated in flight plan so that the capability can be considered in the Demand Capacity Balancing (DCB) process. The crew has to respect the Standard Operational Procedure defined for the corresponding ISGS flown if any (described in the Flight Crew Operating Manual FCOM). That concerns particularly the aircraft configurations deployment in order to be stabilized in speed and thrust level no later than 1000ft. The crew must also comply with the ATC speed constraints if any. ATCO manages the landing sequence of the a/c flying a mix of different standard approach procedures and ISGS. ATC tools are enhanced to support ATCOs. TMA/APP ATCO through ATIS informs a/c about the EAP in use; instructs a/c to fly STAR or they receive clearances by ATC to follow radar vectoring instructions . In ISGS the descent profile should contain at least one fix, where pilots compare the actual crossing altitude with the required crossing altitude . Lateral or vertical profile changes may impact aircraft deceleration capability and on-board energy management . That may require that pilots adapt the current operating procedure in order to ensure safe approach and landing operations. In addition, pilots will have to consider the impact of the conditions of the day (wind, temperature) to adapt the procedure.
1.3 TASKS	Before capturing the final approach segment, the flight crew must verify the correctness of the arrival data from the Navigation Database, crosschecking them with the approach chart. Moreover, the crew must verify that there is not any failure (e.g. faulty slats/flaps…) affecting the aircraft performance and especially impairing the aircraft deceleration capability. On most modern avionics, following ATC clearance to fly final approach, the crew arms the approach guidance modes on the Automatic Flight System Control Panel (AFS CP) and then the aircraft captures and flies the final approach path down to the runway. In addition to the standard info, the ATCO provides the a/c with the leading a/c precision approach segment; At TOD ATCO requests to fly ISGS. If refused by a/c – the standard ILS precision segment is instructed; Monitoring of the weather conditions and the GBAS (or other EAP enablers) equipment status are necessary. In ISGS increased monitoring of the a/c deceleration is needed; Increasing the slope may challenge pilots' habit regarding approach procedure: new perception of the runway, new tasks to accomplish, which may be more mentally demanding than for conventional approaches leading therefore to potential additional workload. Additional actions/checks linked to these operations: An inadequate integration of tasks could raise issues regarding task accomplishments, situational awareness, workload management, etc. leading to potential difficulties to manage the approach.

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	Potential impact on existing role and responsibilities sharing within the crew.
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	The approach can be flown with various levels of automation: with Autopilot/flight director (AP/FD), with FD only and without AP/FD (using only the raw data). The target distance indicators will be displayed in order to help the ATCOs determine and achieve the required a/c spacing /separation. The ORD support tool will provide the minimum distance to be maintained down to threshold (the final target distance indicator). In addition, the HMI will also present the compression effect to help ATCOs deliver the required minimum separation at threshold (the initial target distance indication). This means that the system, and not the ATCO, is now calculating the required spacing between different a/c pairs. Furthermore, an ATCO support tool monitoring the glide interception is foreseen. With the ISGS the aircraft flies a different glide slope and the ATCO needs support.
2.2 PERFORMANCE OF TECHNICAL SYSTEM	A/c trajectory, performance and status are shared between a/c and ground via the conformance monitoring tool; glide path monitor. On-board system may need to be improved in order to ensure safe approach and landing operations in automatic and manual mode. On the visual segment below the minima, additional flight deck aids may be provided to the pilot to achieve correctly the manual flare manoeuvre. However, tailwind conditions may have a negative impact on aircraft deceleration capabilities (impact is under study). Therefore, before performing an ISGS approach, flight crew would also need to check from ATIS reports or in coordination with ATC if the weather condition on the arrival airport allows performing a safe ISGS approach. Pilots need access to accurate information to be able to analyse it differently than today to ensure ISGS flyability. Generally, low visibility is a concern for GBAS ISGS.
2.3 HUMAN – MACHINE INTERFACE	The ATCO has the indication that the aircraft flies an ISGS on the human machine interface.
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No change
3.2 ALLOCATION OF TASKS	No change
3.3 COMMUNICATION	Aircraft that are approaching an aerodrome are informed about the ISGS in use, in addition to the standard final approach instrument procedure, through the automatic terminal information service (ATIS and NOTAM).

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	The introduction of the ISGS functions could imply (e.g. in case of rejection, more information etc.) additional communications between flight crew and controllers.
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	No changes foreseen but assessed
4.2 COMPETENCE REQUIREMENTS	An understanding of aircraft behaviour when following ISGS is needed and take this into account when setting up sequence and spacing. The controllers also need to understand the technology, the enablers for ISGS(GBAS; RNAV/ SBAS) is built on and how that differs from for example ILS system.
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	No changes
4.4. RECRUITMENT AND SELECTION	No changes
4.5. TRAINING NEEDS	The ATCO training shall include training of the ORD tool and the related changes in operating methods, procedures and the technology that enables ISGS. Training is needed on the aircraft behaviour when following ISGS and take this into account when setting up sequence and spacing.

241 **Table 4: Description of the change**

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4.2 Step 2 Understand the HP implications

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

Given that the development of the current HPAP was done at an early stage when the OSED was not yet finalised, some of the HP issues might be updated or new ones might be integrated in the next iteration of the VALP.

Arg.	Issue ID	HP issue / Benefit	HP/Valid. Obj. ID	HP validation objective	Recommended activity/ies
Arg.1.2	HPI Arg 1.2.1_ISGS02	ISGS procedures are not accepted by pilots	ISGS-HP-OBJ 02	Assess acceptability of ISGS procedures by pilots	Flight sim
	HPI Arg 1.2.2_ISGS01	The procedures for abnormal situations are not acceptable.	ISGS-HP-OBJ 03	Define and assess procedures for consecutive go-arounds	Workshop RTS
			ISGS-HP-OBJ 04	Define and assess procedures for sequence break out.	Workshop RTS
	HPI Arg 1.2.2_ISGS02	The transition procedures from normal to abnormal conditions are not acceptable.	ISGS-HP-OBJ 05	Clear procedures for the transition from for non-nominal modes of operations shall be defined (e.g. until which phase of flight can the transition mode take place?) and assessed	Workshop RTS
	HPI Arg 1.2.3_ISGS01	Transition procedures for degraded modes are not acceptable	ISGS-HP-OBJ 06	Assess procedures in case of tool loss (revert to conventional procedures)	Workshop RTS

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	HPI Arg 1.2.3_ISGS02	Following a failure of the sequencing and separation tool, the ATCO fails to accurately and efficiently perform the tasks	ISGS-HP-OBJ 07	Asses ATCOs ability to revert to conventional procedures as a result of a tool failure	Workshop RTS
	HPI Arg 1.2.3_ISGS03	Following a failure of the enabler for EAP (GBAS, RNAV/SBAS) the ATCO or pilot fails to accurately and efficiently perform the tasks	ISGS-HP-OBJ 08	Assess the ability of the ATCOs and pilots to accurately and efficiently perform the task in case of a degraded mode of the EAP enabler.	RTS Flight sim
Arg.1.3	HPI Arg 1.3.1_ISGS01	The ATCO does not detect that the aircraft intercepts the wrong glide slope	ISGS-HP-OBJ 09	ATCO tool in place to mitigate this issue; Assess the usability of the tool.	Workshop RTS
	HPI Arg 1.3.1_ISGS02	The ATCO does not detect in due time that one of the a/c in the sequence is performing a go-around.	ISGS-HP-OBJ 10	ATCO tool (alert) to mitigate this issues. Assess the timeliness of the detection from the ATCOs (for both cases in which the go-around is identified by the ATCOs first and the cases in which the go-around is only acknowledged upon FC information).	Workshop RTS
	HPI Arg 1.3.1_ISGS03	Flight crew is not supported by appropriate landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach	ISGS-HP-OBJ 11	Assess the acceptability of the landing visual aid references in flight simulator	Flight sim
	HPI Arg 1.3.1_ISGS04	APP PC does not realize that provided weather information (important for the conduct of ISGS) in the ATIS is erroneous (SV input). Consequently, the ATCO clears for a procedure that is not feasible.	ISGS-HP-OBJ 12	Identify and assess mitigations for erroneous ATIS info	Workshop

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	HPI Arg 1.3.2_ISGS01	When the a/c on the lower glide is going on missed approach / instructed to Go-around, the ATCO (APP or TWR) does not succeed to compare the actual separation to the RECAT standard separation.	ISGS-HP-OBJ 13	Assess the feasibility of procedure (ATCO to crosscheck information in high workload conditions).	RTS
	HPI Arg 1.3.3_ISGS01	Transition instructions given on the base leg, increase flight crew workload.	ISGS-HP-OBJ 14	Assess transition procedures from the flight crew perspective	Flight sim
	HPI Arg 1.3.3_ISGS02	In case of multiple go-arounds the ATCOs workload increases to unacceptable levels (once detected the 1st go-around, check if follower is on the higher slope or not, check against standard minima & coordinate TWR/APP).	ISGS-HP-OBJ 15	Assess ATCO workload in non-nominal situations	RTS
	HPI Arg 1.3.5_ISGS01	Due to the more complex procedures and a higher traffic sample, the ATCOs might have a reduced level of SA and in case of degraded or abnormal mode of operation they would not be aware of all the details of the traffic.	ISGS-HP-OBJ 16	Assess the situational awareness of ATCOs in degraded conditions and abnormal situations.	RTS
Arg.2.1	HPI Arg 2.1.1_ISGS01	The ATCO becomes over-reliant on the ORD tool and fails to revert easily to working without the tool (degraded mode).	ISGS-HP-OBJ 17	Assess how the changed in the allocation of task between the human and the machine impact human performance.	Workshop RTS
Arg.2.3	HPI Arg 2.3.3_ISGS01	The auditory is the first canal that is inhibited with high workload. Any surprise effect, unexpected information, additional data to compute, distrust toward indicators or stress may increase workload. One issue is the perseveration (attentional tunnelling). During the flare, many parameters that may lead to perseveration are present	ISGS-HP-OBJ 18	*(Optional issue- not mandatory to achieve V3):* Test the flare assistance sounds in real conditions to make sure that they are easily noticed.	Test flights

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		(stress, workload, temporal pressure, attentional focus on current task…). Pilots may be able to hear, understand and apply the assistance proposition during the flare manoeuvre. When focusing on flare assistant sound, pilots may be able to hear, understand other sounds than Audio Flare Assistant (AFA) such as ATC clearance or flight deck warning during the flare manoeuvre.			
	HPI Arg 2.3.3_ISGS02	Inadequate external visual aids may lead to difficulties to handle the function and to understand what actions pilots have to do to perform an ISGS approach.	ISGS-HP-OBJ 19	Assess visual references	Flight sim
	HPI Arg 2.3.3_ISGS03	Energy Management Assistant function use is expected to help the pilots when the aircraft is on the Glide Slope providing them relevant information to support the management of the energy and to facilitate the choice of strategy to adopt. This in turn will bring a benefit in terms of human performance	ISGS-HP-OBJ 20	*(Optional issue not mandatory to achieve V3):* Assess the energy management assistant function (Does it provide the pilot with sufficient information to make a decision in any circumstances)	Flight sim
	HPI Arg 2.3.3_ISGS04	Energy Management Assistant function use is expected to provide pilots an energy awareness in case of high workload during the approach phase giving relevant information that can help them to choose the appropriate strategy to adopt. This in turn will bring a benefit in terms of human performance (other allocation of cognitive resources).	ISGS-HP-OBJ 21	*(Optional issue not mandatory to achieve V3):* Assess the energy management assistant function (Does it provide the pilot with sufficient information to make a decision in any circumstances)	Flight sim

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	HPI Arg 2.3.4_ISGS01	The glide alert improves the monitoring and the implementation of ISGS.	ISGS-HP-OBJ 22	Assess usability of the glide alert	Workshop RTS
	HPI Arg 2.3.6_ISGS01	The usability of the glide alert is poor, not intuitive nor easy to use/ interpret and reduces situation awareness	ISGS-HP-OBJ 23	Assess usability of the HMI (alert and ORD tool)	Workshop RTS
Arg. 3.3	HPI Arg 3.3.1_ISGS01	Multiple go-arounds management requires additional coordination between APP and TWR (especially in the case in which the lead a/c is in contact with the TWR and the follower in contact with APP (ITM).	ISGS-HP-OBJ 24	Assess communication load and its impact on the workload of the ATCOs.	RTS
	HPI Arg 3.3.1_ISGS02	The potential case of multiple go-arounds require additional coordination between the ATCOs and FC, which might have a negative impact on workload.	ISGS-HP-OBJ 25	Assess communication load and its impact on the workload of the ATCOs and FC.	RTS
	HPI Arg 3.3.2_ISGS01	Phraseology needs to be revised for abnormal conditions.	ISGS-HP-OBJ 26	Assess phraseology needs for abnormal conditions	Workshop RTS
Arg. 4.1	HPI Arg 4.1.1_ISGS01	The new abnormal procedures could have an impact on acceptability for both ATCOs and pilots.	ISGS-HP-OBJ 22	Assess acceptability of abnormal procedures	Workshop RTS
Arg. 4.5	HPI Arg 4.5.1_ISGS01	ATCOs and pilots are not sufficiently familiar with the novel ISGS operations and associated changes (e.g. runway marking and lighting, glide alerts, abnormal conditions).	ISGS-HP-OBJ 22	Assess training needs	Workshop RTS

Table 5: HP Arguments, related HP issues and benefits, and proposed HP activity

4.3 Step 3 Improve and validate the concept

4.3.1 Description of HP activities conducted

Activity 1.	Workshop
Description	The workshop was planned to cover the non-nominal situations that were not covered sufficiently in Wave 1 (e.g. coping with sudden loss of the ATC ORD separation tool, consecutive go-arounds and wrong glide alert interception).
Arguments & related issues addressed	HPI Arg 1.2.2_ISGS01 HPI Arg 1.2.2_ISGS02 HPI Arg 1.2.3_ISGS01 HPI Arg 1.2.3_ISGS02 HPI Arg 1.3.1_ISGS01 HPI Arg 1.3.1_ISGS02 HPI Arg 1.3.1_ISGS04 HPI Arg 2.1.1_ISGS01 HPI Arg 2.3.4_ISGS01 HPI Arg 2.3.6_ISGS01 HPI Arg 3.3.2_ISGS01 HPI Arg 4.1.1_ISGS01 HPI Arg 4.5.1_ISGS01
HP objectives	• Define and assess procedures for consecutive go-arounds; • Clear procedures for the transition from for non-nominal modes of operations to be discussed; • Discuss procedures in case of tool loss (revert to conventional procedures); • Discuss the usability of the ATCO tool. (ATCO tool to indicate wrong glide slope interception in place to mitigate this issue).
Tools / Methods selected out of the HP repository	User workshop
Summary of the HP activity	This activity was not conducted as planned in Wave 2 due to time and effort resource limitations.

Table 6: Description of Activity 1 – Workshop

ACTIVITY 2.	Real Time Simulation
Description	A Real Time Simulation (RTS) is used to validate complex airspace organisations, new tools or concepts in a realistic simulated Air Traffic Management environment. The simulator replays real traffic data and the ATCO worked as they would in real life. The RTS covered only non-nominal situations and the evaluation of ATCO acceptability of the new glide alert.
Arguments & related issues addressed	HPI Arg 1.2.2_ISGS01 HPI Arg 1.2.2_ISGS02 HPI Arg 1.2.3_ISGS01 HPI Arg 1.2.3_ISGS02 HPI Arg 1.2.3_ISGS03 HPI Arg 1.3.1_ISGS01 HPI Arg 1.3.1_ISGS02

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	HPI Arg 1.3.2_ISGS01 HPI Arg 1.3.3_ISGS02 HPI Arg 1.3.5_ISGS01 HPI Arg 2.1.1_ISGS01 HPI Arg 2.3.4_ISGS01 HPI Arg 2.3.6_ISGS01 HPI Arg 3.3.1_ISGS01 HPI Arg 3.3.1_ISGS02 HPI Arg 3.3.2_ISGS01 HPI Arg 4.1.1_ISGS01 HPI Arg 4.5.1_ISGS01
HP objectives	• Assess acceptability of ISGS in parallel runway conditions by ATCOs; • Define and assess procedures for consecutive go-arounds; • Define and assess procedures for sequence break out; • Clear procedures for the transition from for non-nominal modes of operations shall be defined (e.g. until which phase of flight can the transition mode take place?) and assessed; • Assess procedures in case of tool loss (revert to conventional procedures); • Assess the usability of the ATCO tool. (ATCO tool to indicate wrong glide slope interception in place to mitigate this issue); • Assess acceptability of ISGS by the ATCO; • Assess the ISGS procedure from a realistic tower position; • Assess the situational awareness of ATCOs in degraded conditions and abnormal situations.
Tools/Methods selected out of the HP repository	SATI Bedford scale China Lakes SASHA NASA TLX Etc.
Summary of the HP activity	EXE-14.3-V3-VALP-R01 – Non nominal situations The aim of this exercise is to assess: • the impact on controllers of go around/missed approach; • the impact on controllers of the loss of the separation assistance tool; • the use of the glide alert function.

Table 7: Description of Activity 2 – RTS

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ACTIVITY 3.	Flight simulations
Description	The flight simulations were used to validate concept elements that relate to the airside. Specifically the runway lighting system, runway marking and the visual aid system were assessed under different visibility and weather conditions.
Arguments & related issues addressed	HPI Arg 1.2.1_ISGS02 HPI Arg 1.2.3_ISGS03 HPI Arg 1.3.1_ISGS03 HPI Arg 1.3.3_ISGS01 HPI Arg 2.3.3_ISGS02 HPI Arg 2.3.3_ISGS03 HPI Arg 2.3.3_ISGS04
HP objectives	• Assess acceptability of ISGS procedures by pilots; • Assess the air crew procedures for abnormal situations; • Assess landing visual aid references in flight simulator in the switching scenario, (at the time of the landing clearance the "correct" runway has to be illuminated and switching should be finished latest at around 1000ft. This is the "gate" at which also in the flight deck everything must be stable (aircraft fully configured, at the correct approach speed and approach path and with stable thrust settings)) Need for an adapted external visual aid: It is recommended to provide to the crew an adapted external visual aid (VASI/PAPI) for ISGS approach operations in order to avoid pilot's confusion; • Assess the acceptability of the landing visual aid references in flight simulator; • Assess transition procedures from the flight crew perspective; • Assess the energy management assistant function.
Tools/Methods selected out of the HP repository	No specific tool, open question questionnaires were used
Summary of the HP activity	**EXE-14.3-V3-VALP-R16 - Runway marking and lighting** The aim of the Real Time Simulation (RTS) is to assess the proposed solutions for the PAPI for the second active slope linked to ISGS. The aim of the RTS is to assess operational acceptability of ISGS from pilots' point of view, and in particular the installation and use of a second PAPI for the second active slope. A series of cockpit simulations using a high-level professional Level D/Type 7 flight crew training simulator will be conducted. The purpose is to collect pilots' feedback on the additional glide slope operation (acceptability, workload, operational procedures), and in particular on the solutions proposed for the PAPI linked to the second slope. Different visibility conditions will be simulated and the aircraft following the enhanced procedure will be mixed with aircraft following ILS to normal threshold.

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

4.4.1 Summary of HP activities results & recommendations / requirements

This part provides a summary of the HP argument and related issues / benefits along with the HP activities conducted. It reports on the outcomes of HP issues that were included into the HP assessment plan. For each argument and issue / benefit the results/evidence obtained from the activities conducted are briefly described along with the recommendations and / or requirements generated.

The status of each HP issue is also given. The status of an issue / benefit can either be 'closed', 'open', 'cancelled'.

- An issue is considered 'closed' when the issue had been sufficiently answered or no additional activities relating to that issue are foreseen as necessary;
- An issue is considered as being 'open' when the issue has been either: partially addressed and more studies are needed or; the issue had been addressed by certain activities but as a result other related issues had arisen or; when no activity has been performed to date to address a specific issue;
- An issue is considered as being 'cancelled' when the activities conducted have shown the issue to be not relevant to the given concept under investigation.

The HP recommendations and requirements fall into one of several categories:

- System design;
- OPS (operating methods / procedures);
- New objective;
- Training;
- Other.

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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 (procedures) cover operations in normal operating conditions.							
HPI Arg 1.2.1_ISGS 02	ISGS procedures are not accepted by pilots	Closed	ISGS-HP-OBJ02	Flight sim	More than 95% of the pilots indicated that they executed all tasks in line with the SOPs and that they can imagine using the concept of ISGS in an every-day operation.	EAP_HPREC_OPS02 EAP_HPREC_OPS09	EAP_HPREQ_OPS01 ISGS_HPREQ_006 ISGS_HPREQ_009
Arg. 1.2.2: Operating methods (procedures) cover operations in abnormal operating conditions.							
HPI Arg 1.2.2_ISGS01	The procedures for abnormal situations are not acceptable.	Closed	ISGS-HP-OBJ03 ISGS-HP-OBJ04	RTS	Results from the simulation show that the ISGS arrival procedures are feasible during non-nominal situations according to subjective feedback. The simulation led to the development of particular requirements for each non-nominal situation during ISGS arrival procedures.	EAP_HPREC_OPS02 ISGS_HPREC_006 ISGS_HPREC_007	EAP_HPREQ_OPS01

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HPI Arg 1.2.2_ISGSP02	The transition procedures from normal to abnormal conditions are not acceptable.	Closed	ISGS-HP-OBJ 05	RTS	The participants expressed that the defined procedure was feasible, acceptable and can be resolved safely with a tolerable workload and sufficient situational awareness.	EAP_HPREC_OPS02 EAP_HPREC_OPS03 ISGS_HPREC_006 ISGS_HPREC_007	EAP_HPREQ_OPS01
Arg. 1.2.3: Operating methods(procedures) cover degraded modes of the ATM system.							
HPI Arg 1.2.3_ISGS01	Transition procedures for degraded modes are not acceptable	Closed	ISGS-HP-OBJ 06	RTS	The participants expressed that the defined procedure was feasible, acceptable and can be resolved safely with a tolerable workload and sufficient situational awareness. The rules of the separation delivery tool failure procedure were found to be easy enough to remember and apply during ISGS arrival procedures.	EAP_HPREC_OPS02 EAP_HPREC_OPS03 ISGS_HPREC_003 ISGS_HPREC_004 ISGS_HPREC_005 ISGS_HPREC_023	EAP_HPREQ_OPS01 ISGS_HPREQ_001 ISGS_HPREQ_002 ISGS_HPREQ_011
HPI Arg 1.2.3_ISGS02	Following a failure of the sequencing and separation tool, the ATCO fails to accurately	Closed	ISGS-HP-OBJ 07	RTS	Overall, the participants expressed that the defined procedure was feasible,	ISGS_HPREC_003 ISGS_HPREC_004	ISGS_HPREQ_001 ISGS_HPREQ_003 ISGS_HPREQ_011

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	and efficiently perform the tasks				acceptable and can be resolved safely. The participants were comfortable with the procedure and feel that no further modifications at this stage are required. However, some requirements and recommendations were suggested.		
HPI Arg 1.2.3_ISGS03	Following a failure of the enabler for EAP (GBAS, RNAV/SBAS) the ATCO or pilot fails to accurately and efficiently perform the tasks	Open	ISGS-HP-OBJ 08	RTS Flight sim	No failure of these enablers were simulated during the Wave 2 activities.	ISGS_HPREC_017	
Arg. 1.3.1: The potential for human error is reduced to a tolerable level							
HPI Arg 1.3.1_ISGS01	The ATCO does not detect that the aircraft intercepts the wrong glide slope	Closed	ISGS-HP-OBJ 09	RTS	Results from the simulation show that the alert when an aircraft intercepts the wrong glideslope is acceptable according to the participants' subjective feedback. This is if the requirement for the	ISGS_HPREC_008 ISGS_HPREC_009 ISGS_HPREC_010 ISGS_HPREC_011 ISGS_HPREC_013 ISGS_HPREC_014	ISGS_HPREQ_004 ISGS_HPREQ_005 ISGS_HPREQ_009 ISGS_HPREQ_010

					alert is met as the conclusion of the simulation that the alert must be reliable and there must not be any false alerts, is met.	ISGS_HPREC_015	
HPI Arg 1.3.1_ISGS02	The ATCO does not detect in due time that one of the a/c in the sequence is performing a go-around.	Closed	ISGS-HP-OBJ 10	RTS	As a result of the simulation, it was recommended that coordinator/assistant be available to aid the Approach for checking the separations between aircraft and suggesting which aircraft should be sent around. During high density traffic, this would be a requirement. There should also be communication between the sectors about which aircraft have been sent around and a communication to the TWR Runway Control informing them of the final aircraft in the sequence that will be flying on the upper glideslope and	ISGS_HPREC_016	

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					performing an ISGS arrival procedure.		
HPI Arg 1.3.1_ISGS03	Flight crew is not supported by appropriate landing visual aid references for their flown approach procedure (e.g. specific PAPIs) , down to CAT I minima resulting in a unstable approach	Closed	ISGS-HP-OBJ 11	Flight Sim	At least 80% of all pilots could accept the additional PAPI as an additional guidance to execute the ISGS approach. As well the comparison between day and night provides the same results. Nevertheless, there is no influence with respect of day or night operations identifiable.	RTS14_2019_(IGS)_Design_Recommendation_04 EAP_HPREC_OPS09	EAP_HPREQ_OPS01
HPI Arg 1.3.1_ISGS04	APP PC does not realize that provided weather information (important for the conduct of ISGS) in the ATIS is erroneous (SV input). Consequently, the ATCO clears for a procedure that is not feasible.	Open	ISGS-HP-OBJ 12	N/A	The workshop activity was not conducted in Wave 2 and no erroneous ATIS weather information was simulated during the Wave 2 activities.	ISGS_HPREC_018	
Arg. 1.3.2: Tasks can be achieved in a timely manner.							
HPI Arg 1.3.2_ISGS01	When the a/c on the lower glide is going on missed approach / instructed to Go-around, the ATCO (APP or TWR)	Open	ISGS-HP-OBJ 13	RTS	No evidence on this issue was reported on from the RTS.	ISGS_HPREC_019	ISGS_HPREQ_002 ISGS_HPREQ_003 ISGS_HPREQ_008

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	does not succeed to compare the actual separation to the RECAT standard separation.						
Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable.							
HPI Arg 1.3.3_ISGS01	Transition instructions given on the base leg, increase flight crew workload.	Open	ISGS-HP-OBJ 14	Flight sim	No evidence on this issue was reported on from the Flight sim.	ISGS_HPREC_020	
HPI Arg 1.3.3_ISGS02	In case of multiple go-arounds the ATCOs workload increases to unacceptable levels (once detected the 1st go-around, check if follower is on the higher slope or not, check against standard minima & coordinate TWR/APP).	Closed	ISGS-HP-OBJ 15	RTS	Results from the simulation show that controller workload is tolerable for ISGS arrival procedures during non-nominal situations according to subjective feedback and sector performance metrics.	ISGS_HPREC_019 ISGS_HPREC_023	ISGS_HPREQ_002 ISGS_HPREQ_003 ISGS_HPREQ_008
Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness.							
HPI Arg 1.3.5_ISGS01	Due to the more complex procedures and a higher traffic sample, the ATCOs might have a reduced level of SA and in case of degraded or abnormal mode of operation they would	Closed	ISGS-HP-OBJ 16	RTS	Results from the simulation show that controller situational awareness is acceptable for ISGS arrival procedures during non-nominal situations according to subjective feedback.	ISGS_HPREC_012	ISGS_HPREQ_003

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	not be aware of all the details of the traffic.						
Arg. 2.1.1: The task allocation between the human and the machine is consistent with automation principles.							
HPI Arg 2.1.1_ISGS01	The ATCO becomes over-reliant on the ORD tool and fails to revert easily to working without the tool (degraded mode).	Closed	ISGS-HP-OBJ 17	RTS	Results from the simulation show that the separation delivery tool is trusted according to the participants' subjective feedback. It is recommended that the Approach Controller is aided by an assistant in the event of the separation delivery tool failure, otherwise the workload is too high and situational awareness is low when the ATCO works alone.	ISGS_HPREC_003 ISGS_HPREC_004 ISGS_HPREC_023	ISGS_HPREQ_001 ISGS_HPREQ_002 ISGS_HPREQ_008 ISGS_HPREQ_011
Arg. 2.3.3: Visual displays and other types of output devices adhere to HF principles.							
HPI Arg 2.3.3_ISGS01	The auditory is the first canal that is inhibited with high workload. Any surprise effect, unexpected information, additional data to compute, distrust	Open	ISGS-HP-OBJ 18	EXE-02.02-V3-VALP-R11 EXE-02.02-V3-VALP-R14	Wave 1 Findings: The sounds lasted too long and may have a high impact on radio Altitude callouts.	RTS11_2019 (IGS)_ Design_recommendation_01	

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	toward indicators or stress may increase workload. One issue is the perseveration (attentional tunnelling). During the flare, many parameters that may lead to perseveration are present (stress, workload, temporal pressure, attentional focus on current task…). Pilots may be able to hear, understand and apply the assistance proposition during the flare manoeuvre. When focusing on flare assistant sound, pilots may be able to hear, understand other sounds than AFA such as ATC clearance or flight deck warning during the flare manoeuvre.				Even if the flare assistant sounds were easily perceived in the flight deck environment, all pilots underlined the fact that they need to do test sounds in real conditions during flight tests in order to measure their impact and confirm that the flare assistant sounds remain easy to perceive		
HPI Arg 2.3.3_ISGS02	Inadequate external visual aids may lead to difficulties to handle the function and to	Closed	ISGS-HP-	Flight sim	The results clearly show the effect of flying an ISGS approach without any visual	RTS14_2019_(IGS)_Design_Recommendation_04	

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	understand what actions pilots have to do to perform an ISGS approach.		OBJ 19		guidance of a PAPI, indicating a clear decrease of safety for pilots. The pilots stated during the session having no PAPI for the ISGS approach would not be acceptable. The missing guidance had a significant effect on managing the approach, especially during the short final phase.	ISGS_HPREC_006 ISGS_HPREC_012	
HPI Arg 2.3.3_ISGS03	Energy Management Assistant function use is expected to help the pilots when the aircraft is on the Glide Slope providing them relevant information to support the management of the energy and to facilitate the choice of strategy to adopt. This in turn will bring a benefit in terms of human performance	Open	ISGS-HP-OBJ 20	Flight sim	The energy management assistant function was not assessed in the Wave 2 flight sim.	RTS14_2019_(IGS)_Operational_Recommendation_03 RTS14_2019_(IGS)_Design_Recommendation_06 RTS14_2019_(IGS)_Design_recommendation_EM_01 RTS14_2019_(IGS)_Design_recommendation_EM_01.a RTS14_2019_(IGS)_Design_recommendation_EM_02	

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						RTS14_2019_(IGS)_Design_recommendation_EM_02b RTS14_2019_(IGS)_Design_recommendation_EM_03 ISGS_HPREC_022	
HPI Arg 2.3.3_ISGS04	Energy Management Assistant function use is expected to provide pilots an energy awareness in case of high workload during the approach phase giving relevant information that can help them to choose the appropriate strategy to adopt. This in turn will bring a benefit in terms of human performance (other allocation of cognitive resources).	Open	ISGS-HP-OBJ 21	Flight sim	The energy management assistant function was not assessed in the Wave 2 flight sim.	RTS14_2019_(IGS)_Operational_Recommendation_03 RTS14_2019_(IGS)_Design_Recommendation_06 RTS14_2019_(IGS)_Design_recommendation_EM_01 RTS14_2019_(IGS)_Design_recommendation_EM_01.a RTS14_2019_(IGS)_Design_recommendation_EM_02 RTS14_2019_(IGS)_Design_recommendation_EM_02b	

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						RTS14_2019_(IGS)_Design_recommendation_EM_03 ISGS_HPREC_022	
Arg. 2.3.4: Alarms and alerts have been developed according to HF principles.							
HPI Arg 2.3.4_ISGS01	The glide alert improves the monitoring and the implementation of ISGS.	Closed	ISGS-HP-OBJ 22	RTS	Overall, the participants agreed that the wrong glideslope alert is useful, necessary and suitable for ISGS approach procedures. The participants also agreed that the design of the glide alert was clear, immediately noticeable and contained all the required information.	ISGS_HPREC_005 ISGS_HPREC_009 ISGS_HPREC_010	ISGS_HPREQ_004 ISGS_HPREQ_009 ISGS_HPREQ_010
Arg. 2.3.6: The usability of the user interface (input devices, visual displays/output devices, alarm& alerts) is acceptable.							
HPI Arg 2.3.6_ISGS01	The usability of the glide alert is poor, not intuitive nor easy to use/ interpret and reduces situation awareness	Closed	ISGS-HP-OBJ 23	RTS	During the simulation, many "false" alerts appeared on the HMI, which increased the task load, workload and communication load of the participants. Hence, a participant disagreed with the	ISGS_HPREC_005 ISGS_HPREC_009 ISGS_HPREC_010	ISGS_HPREQ_004 ISGS_HPREQ_009 ISGS_HPREQ_010

					statements that the alert was reliable and worked accurately. This will not be acceptable during real operations as it increases the workload and communication load of the ATCO. A requirement is needed stating that the wrong glideslope alert must be reliable and there must not be any false alerts.		

Arg. 3.3.1: Intra-team and inter-team communication supports the information requirements of team members.

HPI Arg 3.3.1_ISGS01	Multiple go-arounds management requires additional coordination between APP and TWR (especially in the case in which the lead a/c is in contact with the TWR and the follower in contact with APP (ITM).	Closed	ISGS-HP-OBJ 24	RTS	During the separation delivery tool failure, the workload for the Approach sector is too high. It is recommended that the Approach ATCO is aided by an assistant to help them with the procedures such as checking the separation between pairs and identifying which aircraft must be sent to go-around.	ISGS_HPREC_001 ISGS_HPREC_023	ISGS_HPREQ_002 ISGS_HPREQ_003

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HPI Arg 3.3.1_ISGS02	The potential case of multiple go-arounds require additional coordination between the ATCOs and FC, which might have a negative impact on workload.	Closed	ISGS-HP-OBJ 25	RTS	No concerns were raised during the RTS about the level of coordination between ATCOs and pilots.	EAP_HPREC_OPS09 ISGS_HPREC_002	ISGS_HPREQ_009
Arg. 3.3.2: The phraseology supports communication in all operating conditions.							
HPI Arg 3.3.2_ISGS01	Phraseology needs to be revised for abnormal conditions.	Closed	ISGS-HP-OBJ 26	RTS	During each exercise, the participants found the phraseology to be adequate. During the debriefs, the participants expressed that there is a risk for confusion between ILS and GLS, especially when there is a lot of traffic and the instructions are spoken quickly. The participants found the phraseology for the TWR ATCO to be too long and time consuming, especially if the ATCO also manages departures on the same frequency. The participants suggested that if two aircraft are	ISGS_HPREC_015	ISGS_HPREQ_009

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					expected to land using the same runway aiming point then the ATCO should not have to provide the runway in the message. In case of glide alert, regarding phraseology, it has been concluded that ATCO should always ask the pilot to confirm the type of approach and the landing runway as it is important that the ATCOs are aware of the situation and the pilots are aware of the reason for possible go-arounds.		
Arg. 4.1.1: Changes in roles and responsibilities are acceptable to the affected human actors.							
HPI Arg 4.1.1_ISGS01	The new abnormal procedures could have an impact on acceptability for both ATCOs and pilots.	Closed	ISGS-HP-OBJ 27	RTS	The participants expressed that the defined procedures were feasible, acceptable and can be resolved safely with a tolerable workload and sufficient situational awareness.	EAP_HPREC_OPS09	EAP_HPREQ_OPS01 EAP_HPREQ_OPS04 EAP_HPREQ_OPS05

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Arg. 4.5.1: The content of training for each actor group is specified.

HPI Arg 4.5.1_ISGS01	ATCOs and pilots are not sufficiently familiar with the novel ISGS operations and associated changes (e.g. runway marking and lighting, glide alerts, abnormal conditions).	Open	ISGS-HP-OBJ 22	RTS	The participants also stated that they occasionally mistook between the speed indicator and the wake category on the aircraft's electronic label; this was due to lack of training and unfamiliarity when working with electronic labels as the participants are working with paper strips.	EAP_HPREC_OPS09 RTS14_2019_(IGS)_Operational_Recommendation_01 ISGS_HPREC_004 ISGS_HPREC_005	EAP_HPREQ_OPS01 EAP_HPREQ_OPS04 EAP_HPREQ_OPS05

275 **Table 9: Summary of the HP results and recommendations/ requirements for each identified issue & related argument**

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277 ### 4.4.2 Maturity of the Solution

Maturity checklist for finalising the V3 assessment			
ID	**Question**	**Answer**	**Comments**
1	Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported?	Yes	The consolidated list of identified arguments, issues, requirements and recommendations can be found in Table 9.
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	The consolidated list of identified arguments, issues, requirements and recommendations can be found in Table 9.
3	Have all the parts of the solution/concept been considered?	Yes	All OI steps described in the final OSED have been addressed in several validation exercises and considered in the HP assessment.
4	Have potential interactions with related projects/concepts been considered and addressed?	Yes	The interaction other PJ.02-W2-14 solutions has been considered.
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes	The results can be found in Table 9 of the HP assessment report.
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	Yes the HP issues are addressed and recommendations and requirements are formulated to reach anticipated targets. (Appendix B and Appendix C).
7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes	Different simulation exercises were conducted under both abnormal and degraded conditions for ATC. Normal conditions were validated in Wave 1. Flight Deck simulations have been conducted for the airborne side.
8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	The results can be found in Table 9 of the HP assessment report.
9	Has all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	The HP requirements are crosschecked with safety and OSED.
10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	The outcome of the HP activities can be found in Appendix B and Appendix C (Recommendations and Requirements).

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11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation, and training?	Yes	The requirements and recommendations are listed in Appendix B and Appendix C of the HP assessment report.
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	Training Requirements have been formulated and are listed in Appendix C (Requirements).
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.	N/A	No regulatory impact is expected to be introduced through the ISGS solution.
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	N/A	The HP assessment has proven that the solution has, from the HP point of view, reached the end of V3 ready to go into the next V phase. Most relevant issues are closed.

278 **Table 10: V3 HP Maturity checklist**

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5 References

Human Performance

[1] SESAR Human Performance Assessment Process V1 to V3 - including VLD, 00.03.01

Reference Documents

[2] PJ.02-W2-14.3 OSED V3 – Part I_D4.3.002_SJU, 01.00.00

[3] PJ.02-W2-14.3 VALR V3 – D4.3.006_SJU, 01.00.00

[4] PJ.02-02 D2.1.04 SESAR PJ02-02 VALR, Edition 00.01.00.

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Appendix A – Additional HP activities conducted

A.1 Wave 1 PJ.02-02 Audio-based Flare Assistant Validation

Wave 1 RTS validation exercises were conducted by Airbus that addressed the AFA function. The findings of the following exercises have been used as evidence against Wave 2 'HPI Arg 2.3.3 ISGS01':

- EXE-PJ2.02-V3-VALP-RTS11;
- EXE-PJ2.02-V3-VALP-RTS14.

The full findings of these exercises can be found in the PJ.02-02 VALR [4].

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Appendix B – HP Recommendations Register

As per the HPA guidance [1], the statuses for HP recommendations are defined as follows:

- Accepted – The recommendation has been agreed and accepted by the project team;
- Rejected – The recommendation has been rejected by the project team and a rationale has been provided;
- To be analysed – The recommendation is awaiting agreement from the project team.

Note: All 'EAP_', 'RTS11_' and 'RTS14_' recommendations marked as 'rejected' were done so in Wave 1 and have been left as such in Wave 2.

HP Recommendations Register						
Reference	**Type of recommendation**	**Recommendation**	**Rationale**	**Assessment source + Reference report**	**Recommendation status**	**Rationale in case of rejection**
EAP_HPREC_OPS01	OPS (operating methods / procedures)	In case of high traffic a "sequencer role" is recommended (It is already implemented in certain environments)	No potential impact on the existing roles and responsibilities and task sharing within the team involving ATCOs and pilots has been identified. A sequencer role might be required for traffic optimisation purposes.	Validation Report of EXE-02.02-V3-VALP-R01 Workshop	Rejected	Not accepted in Wave 1
EAP_HPREC_OPS02	OPS (operating methods / procedures)	A set of working methods / guidelines to cover the IGS procedure/ concept and associated tools should be locally defined.	The validation activities did not include scenarios in which the IGS procedure was instructed without a support tool under high traffic densities. However, the results of the validation activities conducted showed that under high traffic densities, the ATCOs considered it as impossible to work without a support tool (i.e. ORD tool).	Validation report of EXE-02.02-V3-VALP-R01 Workshop	Accepted	
EAP_HPREC_VAL01	Validation activities	Future validation exercises should include more non-nominal and	Due to the more complex procedures and a higher traffic sample, the ATCOs agreed they did not have the same	Validation report ofEXE-	Accepted	

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		degraded modes of operations, in addition to nominal cases.	level of SA as in normal operations and that in case of a degraded mode of operations they would not be aware of all the details of the traffic	02.02-V3-VALP-R02		
EAP_HPREC_OPS03	OPS (operating methods / procedures)	Transitions should not be instructed on the base leg.	The results of the flight deck simulation revealed that transition instructions given on the base leg, could negatively increase workload on the flight crew side.	Validation report of Mock up Flight deck simulation (IGS)	Accepted	
EAP_HPREC_OPS04	OPS (operating methods / procedures)	A test case with a new perimeter taxiway should be tested, without departures in the simulation	Normal ILS operating conditions have been considered acceptable under certain conditions.	Validation report of EXE-02.02-V3-VALP-R01	Accepted	
EAP_HPREC_OPS05	OPS (operating methods / procedures)	The Approach should be supported by a Separation Delivery and Monitoring function providing indications about applicable separation minima between arrival aircraft pairs onto final approach segment, taking into account the expected and cleared approach procedures (48 OSED)	The results of the validation activities conducted showed that under high traffic densities, the ATCOs considered it as impossible to work without a support tool (i.e. ORD tool).	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREC_DSG01	DSG (System design)	A support tool or a sequencer role should support the ATCO in finding the optimal sequence.	The ATCOs requested an additional support tool or a refinement of the ORD tool, that would help them to optimise the sequence. In high densities traffic, the workload of the INI position would not allow the evaluation of the most “optimal” pairs, at all times.	Validation report of EXE-02.02-V3-VALP-R02	Rejected	Not accepted in Wave 1

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EAP_HPREC_OPS06	OPS (operating methods / procedures)	For IGS operations, the Approach Controllers should be supported by a Separation Delivery function providing indications about optimum spacing to applied for achieving the minima separation at the separation delivery point (49 OSED)	The results of the validation activities conducted showed that under high traffic densities, the ATCOs considered it as impossible to work without a support tool (i.e. ORD tool).	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREC_OPS07	OPS (operating methods / procedures)	For IGS operations, the Tower Controllers should be supported by a Separation Delivery and Monitoring function providing indications about applicable separation minima between arrival aircraft pairs onto final approach segment, taking into account the expected and cleared approach procedures (50 OSED)	The results of the validation activities conducted showed that under high traffic densities, the ATCOs considered it as impossible to work without a support tool (i.e. ORD tool).	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREC_OPS09	OPS (operating methods / procedures)	Pilots should be involved in information campaigns before local deployments, in order to gain the trust and the acceptability of the IGS associated procedure.	The results of the flight deck simulations (IGS) showed acceptability of normal operating procedures, with no change with regard to the responsibilities of the pilots.	Flight deck simulations (IGS)	Accepted	
EAP_HPREC_DSG01	Design	A tool should be implemented that acts as a reminder about the un-steady flow of arrivals, reducing the complexity of the environment (CSPR_ST)	For the CSPR-ST procedure the situational awareness of the tower controller was lower than in the reference scenario. This result is attributed to the arrivals on the second runway were prone to be forgotten as they were not many and that some HMI support would be needed.	Validation report of EXE-02.02-V3-VALP-R01 EXE-02.02-V3-VALP-R02 EXE-02.02-V3-VALP-R04	Rejected	Not accepted in Wave 1

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EAP_HPREC_DSG02	Design	If colour coding is used for the flight list to differentiate the different approaches the same colour should be reflected in the aircraft label	In order to ensure that ATCOs were able to quickly connect the information displayed.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREC_DSG03	DSG (System design)	The ATCOs should be able to tailor HMI features according to personal preferences.	The HMI display can enhance usability and even SA, depending on the ATCOs preferences.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREC_DSG04	Design	With regard to alerts on the tower position it was suggested that in case there is an infringement of the FTD in the last miles there should be a warning on the tower HMI	To ensure an appropriate reaction/ situation awareness for the APP ATCO.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREC_TRN01	TRN (training)	Local training plans should be feasible in order for all ATCOs to be trained to the required standard before IGS is used in operations	Training requirements have to be extensively covered in local implementation programs.	Validation report of EXE-02.02-V3-VALP-R01 Workshop Flight deck simulation	Rejected	Not accepted in Wave 1
RTS11_2019 (IGS)_ Operational_ recommendation_01	Operational	Operational_recommendation_01: It is recommended to provide airlines with a clear operational training in order to inform airlines' pilots about the use of the audio-based flare assistant	Even if some pilots perceived very well the audio-based flare assistant concept and encountered no difficulty to understand the behaviour of the function, a need of training was identified	Validation report of EXE-02.02-V3-VALP-R11	Rejected	Not accepted in Wave 1
RTS11_2019 (IGS)_ Design_recommendation_01	Design	In order to avoid pilot's disturbance and provide better integration in the Radio Altitude callouts list, it is recommended to perform fine tuning regarding flare sound duration.	The sounds last too long and may have a high impact on radio Altitude callouts. Therefore, a design improvement should be performed regarding the flare sound duration in order to be	Validation report of EXE-02.02-V3-VALP-R11	Rejected	Not accepted in Wave 1

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			better integrated with the Radio Altitude callouts list.			
RTS14_2019_(IGS)_Operational_Recommendation_01	Operational	IGS training: It is recommended to provide to airlines' pilots a clear operational training in order to inform airlines' pilots about specificity of IGS approach operations.	During all scenarios, it was observed that the stabilization criteria was reached thanks to the fact that pilots applied current SOPs and thanks to adequate enablers to help the crew manage the aircraft energy. Pilots underlined that higher slopes values (4° and more) could potentially induce a higher risk of over-energy, over-flare, hard landing.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Operational_Recommendation_02	Operational	IGS approach operations feasibility: It is recommended that the crew is informed on the operational conditions for flying increased glideslopes, as function of the slope angle, in order to know the aircraft capability.	Airbus should identify a maximal slope for IGS approach operations per aircraft type, above which the aircraft will not fly for noise abatement reasons.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Operational_Recommendation_03	Operational	Energy Management assistant training: It is recommended to provide airlines with a clear operational description in order to inform airlines' pilots about the use of the Energy Management assistant and hypotheses associated to the function.	The pilots need to be aware of the strategy hypothesis used by the energy management assistant function in order to use it adequately.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Design_Recommendation_03	Design	Flare assistant triggering logics: It is recommended to identify all non-nominal cases in order to study the audio-based flare assistant associated triggering logic.	The existing crew task is not negatively impacted by the integration of audio-based flare assistant function, but the function should be robust to degraded cases (ditching, landing gear-up, slats/flaps failure).	Validation report of EXE-02.02-V3-VALP-R14	Accepted	

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RTS14_2019_(IGS)_Design_Recommendation_04	Design	Need for an adapted external visual aid: It is recommended to provide to the crew an adapted external visual aid (VASI/PAPI) for IGS approach operations in order to avoid pilot's confusion.	Pilots expressed that providing two different VASI/PAPI for the same runway could be confusing for the flight crew because the pilot will see a VASI/PAPI on each side of the runway and how the crew can be sure which one they must follow.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Design_Recommendation_05	Design	Need for a flare assistant: In order to help pilots to perform the manual flare manoeuvre when flying IGS approach operations. It is recommended to provide them with a flare assistance which gives an indication about when to initiate the flare manoeuvre, which covers the variability of pilots' practices and which let the possibility to adapt the manoeuvre to the current situation (conditions of the day).	Pilots' feedbacks on this topic were closely linked to the slope value. They think that the increase of the glideslope could potentially lead to more hard landing and to dispersion on touchdown location, which on short runways could lead, in the worst case, to runway excursion.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Design_Recommendation_06	Design	Need for an energy management assistant in order to help pilots to manage the aircraft energy when flying IGS approach operations. It is recommended to provide them with an energy management assistant, which gives indication about the aircraft energy in the current situation (conditions of the day).	According to pilots, for slopes inferior or equal to 3,5°, IGS did not negatively impact the energy management and flare, but an appropriate training is necessary. Above this slope value, several pilots think that, in addition to the training, adapted tools are necessary to avoid excessive energy during approach, unnecessary go-around and hard or long landings.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Design_recommen	Design	Energy Management clutter: It is recommended to re-evaluate the Energy Management function display combined with other visually similar	The usability of Energy Management HMI is considered as acceptable by flight crews, but should be reassessed	Validation report of EXE-02.02-V3-VALP-R14	Accepted	

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dation_EM_01		data in order to assess the risk of confusion between visually similar information.	with the updated final design and logic function			
RTS14_2019_(IGS)_Design_recommendation_EM_01.a	Design	Energy Management integration in the cockpit environment: It is recommended to evaluate the Energy Management assistant with other energy related functions in order to confirm it still will be legible.	All pilots agreed that it was difficult to assess the legibility of the function without it being presented with all (exhaustively) other data possibly displayed on the same area.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Design_recommendation_EM_02	Design	Energy Management usability: The calibration should be reviewed and re-assessed in the future in order to be compliant with operational tasks and to avoid mistakes and misunderstanding.	The current tuning of the function seems not to totally correspond to the operational tasks (in terms of hypothesis and in terms of dynamic adaptation). Once reviewed, its tuning will be adapted to allow pilots to do actions according to the aircraft energy situation, preventing spurious go-arounds due to the information provided by the function to the pilots. Evaluations showed that at this stage, the function did not bring precise information to facilitate the decision-making in case of IGS approach operations. As is, the calibration of the function did not take into account some parameters and did not provide sufficient predictability to the pilots.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
RTS14_2019_(IGS)_Design_recommendation_EM_02b	Design	Energy Management usability: It is recommended to have a sufficiently dynamic system in order to allow anticipation of actions to take and	Flight crew did not encounter difficulties to find relevant information and understood the feedback of the function in some cases, but it should be reviewed in order to allow pilots to	Validation report of EXE-02.02-V3-VALP-R14	Accepted	

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		make pilots able to see the consequence of their action.	trust it. In particular, a more dynamic adaptation to current aircraft energy dissipation capability would be needed to improve the Energy Management function.			
RTS14_2019_(IGS)_Design_recommendation_EM_03	Design	Energy Management usability: It is recommended to have a system that dynamically adapt to aircraft situation (including deceleration capability), particularly in high-energy situations, in order to allow pilots to rely on it.	Pilots needs to anticipate the energy management well before the final approach segment to reach the appropriate energy level at stabilization. So, the function has to provide a good level of predictability to support pilots with necessary information to allow sufficient anticipation prior to the final approach segment. However, the current Energy Management prototype did not succeed to provide sufficient information to anticipate the actions to take.	Validation report of EXE-02.02-V3-VALP-R14	Accepted	
ISGS_HPREC_001	OPS (operating methods / procedures)	In the case of separation tool failure, there should be communication between the sectors about which aircraft have been sent around and a communication to the Tower Runway Control informing them of the final aircraft in the sequence that will be flying on the upper glideslope and performing a ISGS arrival procedure.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_002	OPS (operating methods /	The separation delivery tool failure procedure should remain simple, as it is an emergency procedure with no time for optimisation.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	

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	procedures)					
ISGS_HPREC_003	OPS (operating methods / procedures)	The separation delivery tool failure procedure should be treated as a rare, emergency procedure.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_004	TRN (training)	The procedure to manage the failure of the separation delivery tool should be included in the regular non-nominal/emergency training.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_005	TRN (training)	The procedure to manage an alert caused by an aircraft intercepting the wrong glideslope should be regularly briefed and included in the refresher training.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_006	Validation activities	The need for additional information for ATCOs to visualise the vertical position of the aircraft on the glide, such as Vertical Speed information or Approach Path Monitoring, should be further investigated locally.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_007	Validation activities	The interception points for the two glideslopes on the HMI should be locally considered to ensure that they are clear and distinguishable.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_008	Validation activities	It should be further investigated locally if a vertical profile-plotting tool is necessary for the Tower and Approach controllers.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	

ISGS_HPREC_009	Validation activities	For the wrong glideslope alert, the rule where heavy aircraft should be assessed and improved in terms of whether they should be able to intercept the upper glideslope for ISGS operations such that the rule is less penalising.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_010	Validation activities	ANSPs should locally consider the necessary tools and information required in order to best detect deviations from the glideslopes during deployment phases.	These should help during the non-nominal situations: go-around/missed approach and wrong glideslope alert.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_011	Design	For the separation delivery tool, additional information has been recommended. The participants the wake/MRS indicator to always be shown is desired.	When the ROT indicator is the most constraining time separation, the wake/MRS indicator should also be shown because wake is a safety issue whereas ROT is useful but it is not safety related.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_012	Design	An additional PAPI for the ISGS should be available.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_013	TRN (training)	In the cockpit, special focus has to be put on the briefing: • Which approach is flown – increased slope or standard; • Special briefing is needed in case of 3.5°approach; • PAPI position and colour (if different colour is available).	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	

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ISGS_HPREC_014	OPS (operating methods / procedures)	ATC should communicate the approach type of the previous aircraft.		Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_015	Validation activities	Further investigation into the phraseology is required for two items: 1. the confusion between the terms GLS and ILS, in particular during busy times where the actors speak quickly; 2. the length of the phraseology at the TWR sector.	A workshop with ATCOs is recommended to investigate terms that are not so similar and how and, if, it is possible to reduce the phraseology at the TWR. The workshop should involve ATCOs that have different TWR operations. This is because CDG controllers transfer traffic to the TWR early and it would be interesting to include ATCOs that transfer traffic to the TWR much later as well.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_016	Validation activities	A prototyping session should be conducted involving all required actors, all traffic and reintroducing aircraft into the sequence that were sent around. It is recommended that the prototyping be conducted with all defined non-nominal procedures; in particular the separation delivery tool failure. For the case of CDG, the ACC and DEP actors were missing.	This will allow a human performance assessment on all relevant stakeholders, particularly for measuring the workload and situational awareness during the non-nominal situations with ISGS approach operations.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_017	Validation activities	Degraded modes due to the failure of ISGS enablers such as GBAS and SBAS should be assessed to understand the	These failures were not assessed in the Wave 2 RTS or flight sim activities.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	

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		impact on ATCO and Pilot task performance.				
ISGS_HPREC_018	Validation activities	Errors in the weather information provided by ATIS should be assessed to understand the impact on the potential for ATCO human error.	These errors were not assessed in the Wave 2 RTS or flight sim activities.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_019	DSG (System design)	Heavy aircraft should be assigned to the lower glide.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_020	Validation activities	The timing of transition instructions should be assessed to understand the impact on flight crew workload.	This workload impact was not assessed in the Wave 2 flight sim activity.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_021	Validation activities	Test flight activities should be conducted to understand the impact on flight crew workload due to the flare assistant sound.	This workload impact was not assessed in the Wave 2 activities.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_022	Validation activities	The energy management assistant function should be assessed to understand the potential benefits for pilots.	This function was not assessed in the Wave 2 flight sim activity.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREC_023	Operational	Additional staffing should be available so that in peak (non-nominal) conditions, an Assistant can support the Approach Executive Control position.	The Supervisor will decide when an Assistant is needed, in coordination with Approach Runway Control.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	

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Appendix C – HP Requirements Register

As per the HPA guidance [1], the statuses for HP requirements are defined as follows:

- Accepted – The requirement has been agreed and accepted by the project team;
- Rejected – The requirement has been rejected by the project team and a rationale has been provided;
- To be analysed – The requirement is awaiting agreement from the project team.

Note: All 'EAP_' and 'RTS11_' requirements marked as 'rejected' were done so in Wave 1 and have been left as such in Wave 2.

HP Requirements Register						
Reference	**Type of requirement**	**Requirement**	**Rationale**	**Assessment source + Reference report if available**	**Requirement status**	**Rationale in case of rejection**
EAP_HPREQ_OPS01	Operational	A set of clearly defined parameters shall be defined in local implementation, with regard to when (e.g. peak hours, duration of peak hours) ATCOs shall be supported by a Separation Delivery and Monitoring function.	In order to ensure harmonisation upon implementation.	Validation report of EXE-02.02-V3-VALP-R01 Workshop	Accepted	
EAP_HPREQ_OPS03	Operational	Transitions shall not be instructed after giving the clearance for the interception of the localiser	The results of the flight deck simulation reveal that transition instructions given on the base leg, could negatively increase the workload on the flight crew side.	Mock up Flight deck simulation (IGS)	Rejected	Not accepted in Wave 1
EAP_HPREQ_OPS04	Operational	Clear procedures for non-nominal modes of operations shall be defined (e.g. until which phase of the flight can the transition mode take place?)	In order to ensure clarity and acceptability amongst all actors involved, prior to implementation.	Validation report of EXE-02.02-V3-VALP-R01	Accepted	

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			Abnormal and degraded modes of operations require further investigation.			
EAP_HPREQ_OPS05	Operational	Clear procedures for degraded modes of operations shall be defined (e.g. until which phase of flight can the transition mode take place?)	In order to ensure clarity and acceptability amongst all actors involved, prior to implementation. Abnormal and degraded modes of operations require further investigation.	Validation report of EXE-02.02-V3-VALP-R01	Accepted	
EAP_HPREQ_DSG04	Design	The applicable approach separation minima shall be available on display to the Controllers at the Control Working Position (CWP) (51 OSED)	The results of the validation activities conducted show that under high traffic densities, the ATCOs consider it is impossible to work without a support tool (i.e. ORD tool).	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG06	Design	Alarms and alerts shall indicate erroneous information (e.g. weather information) displayed on the HMI.	To ensure an appropriate support for the ATCOs in terms of situation awareness.		Rejected	Not accepted in Wave 1
EAP_HPREQ_TRG01	Training	The training shall extensively cover the new working methods associated with the ORD tool (if applicable) in order to ensure high trust in the tool and acceptability of the related IGS procedure.	The results of the questionnaires and debrief discussions showed that the ATCOs had a good level of trust in the ORD/separation tool, when working all positions.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG07	Design	The display of information (a/c labels, TDIs etc) shall not clutter the ATCOs' screens.	In order to ensure ATCOs can easily find relevant information, without having to search for items or without having the potential of mixing up the information displayed.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1

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EAP_HPREQ_OPS06	Operational	The Approach controller shall be the master of the arrival sequence and be able to update the sequencing tool in a simple and timely way in accordance with her/his strategy for the interception with no adverse impact on workload.	The target distance indicators were also reported not to only reduce workload but also make it easier to identify potential separation infringements and this helps to reduce the effort required, it contributes to lower stress levels when working these positions.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_OPS07	Operational	The ATIS report shall be checked by the flight crew, in order to help to decide whether IGS will be accepted or not.	In order to ensure an appropriate decision making process.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG08	Design	The HMI shall comply with automation and adhere to human factors principles.	Local implementation shall ensure human factors principles are taken into account upon implementation.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG09	Design	The flight list for the different approaches shall be easily distinguishable	To ensure an appropriate level of SA.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG10	Design	The dynamic threshold highlight has to be improved; the timing has to be more accurate of when to switch from one threshold to the other.	The HMI did not support the CSPR-ST procedure enough for it to be usable for Tower CWP. There were no alerts or any notifications to the Tower CWP for the aircraft that is on the CSPR-ST procedure. Thus the usability of the HMI for Tower CWP is found to be unacceptable. The proposed HMI for Tower CWP did not support the CSPR-ST procedure enough	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_VAL07	Validation	The perception of the ATCO in terms of the position of the aircraft in	Further evaluations are required.	Validation report of	Rejected	Not accepte

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		relation to the SRAP has to be further investigated		EXE-02.02-V3-VALP-R01		d in Wave 1 and not specific to ISGS
EAP_HPREQ_DSG11	Design	In case of an A-IGS the aircraft label shall be highlight-able	Due to the fact that the request for an A-IGS approach comes from the pilot exclusively, there shall be an option on the HMI of the ATCO to indicate the A-IGS approach once acknowledged.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG12	Design	The aircraft labels shall allow for a clear distinction between the instructed approach procedures.	For an appropriate level of SA.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG14	Design	Alarms and alerts shall be refined according to the local available approach procedures, in order to avoid nuisance alerts as much as possible.	Overall there was a positive feedback with regard to the usability of different ORD tool. Room for improvement for alerts functions	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG15	Design	An alert shall be made available highlighting an aircraft that is not complying / deviating from the intended final approach profile (using the Approach Path Monitoring – APM function) (55 OSED)	Overall there was a positive feedback with regard to the usability of different ORD tool. Room for improvement for alerts functions.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_DSG16	Design	Approach and Tower require access to the same information (on their CWP HMI) to be able to communicate effectively with each other.	A set of relevant questions from the STQ questionnaire were used to assess various aspects of team work. The four aspects assessed using the STQ were team prioritization of tasks, synchronicity, sharing of	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1

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			information between the two positions and identification of possible mistakes made by the other position. All aspects were rated positively, supporting the idea that the ORD tool enhances the performance of the ATCOs when instructing EAP (i.e. SRAP or IGS to SRAP) procedures.			
EAP_HPREQ_OPS08	Operational	The phraseology shall clearly indicate the expected arrival procedure and the cleared arrival procedure, without any potential for confusion between “expect” and “cleared”.	The proposed phraseology was clear and without a potential to lead to errors by both ATCOs.	Validation report of EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_OPS09 REQ-02-02-SPRINTEROP-CPST.1005	Operational	The Approach Controller shall provide an information to the arrival aircraft about the expected approach procedure	The proposed phraseology was clear and without a potential to lead to errors by both ATCOs	EXE-02.02-V3-VALP-R01	Rejected	Not accepted in Wave 1
EAP_HPREQ_OPS10	Operational	Upon information from ATC about the expected IGS, the Flight Crew shall acknowledge and read-back to ATC in case they accept such approach type, or shall refuse and inform ATC in case they reject such approach type (42 OSED)	The proposed phraseology was clear and without a potential to lead to errors by both ATCOs	Validation report of EXE-02.02-V3-VALP-R01 Workshop, mock up flight deck simulation	Rejected	Not accepted in Wave 1
EAP_HPREQ_OPS11 REQ-02-02-SPRINTEROP-IGS.1012	Operational	When the lead aircraft flying on final conventional approach is executing a missed approach and a following traffic is flying on final IGS spaced at or close to the separation minimum, the Approach or Tower Controller	The proposed phraseology was clear and without a potential to lead to errors by both ATCOs	Validation report of EXE-02.02-V3-VALP-R01 Workshop	Rejected	Not accepted in Wave 1

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		shall also instruct the following aircraft flying an EAP to execute a missed approach, either with a "Turn left/right immediately" instruction or ensure that the follower is maintained above the lead traffic (taking into account sufficient climb performance) (60 OSED)		Mock up flight deck simulation		
EAP_HPREQ_TRG02	Training	New recruits shall be trained to work with conventional modes of operations without tool support as well as IGS procedures with the support of the ORD tool.	Training requirements have to be extensively covered in local implementation programs.	Validation report of EXE-02.02-V3-VALP-R01 Workshop Mock up flight deck simulation	Rejected	Not accepted in Wave 1
EAP_HPREQ_TRG03	Training	ATCOs and Supervisors shall receive training on contingency procedures in case of abnormal and degraded modes of operations	Training requirements have to be extensively covered in local implementation programs.	Validation report of EXE-02.02-V3-VALP-R01 Workshop Mock up flight deck simulation	Rejected	Not accepted in Wave 1
EAP_HPREQ_TRG04	Training	The training shall extensively cover the new IGS working methods associated with the ORD tool (if applicable) in order to ensure high trust in the tool and acceptability of the related procedures.	Training requirements have to be extensively covered in local implementation programs.	Validation report of EXE-02.02-V3-VALP-R01 Workshop Mock up flight deck simulation	Rejected	Not accepted in Wave 1

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RTS11_RTS14_2018 (IGS)_ Operational_ requirement _01 REQ-02-02-SPRINTEROP-IGS.2101	Operational	Flight Crew shall recall during approach briefing the possible differences in visual references (VASI/PAPI, runway aspect, etc) that are expected in IGS operations	Pilots succeeded to accomplish IGS operations and approach task including a manual landing without any difficulty. The pilot task performance when flying an approach with IGS procedure is not negatively impacted.	Validation report of EXE-02.02-V3-VALP-R11 EXE-02.02-V3-VALP-R14	Rejected	Not accepted in Wave 1
RTS11_ RTS14_2018 (IGS)_ Operational_ requirement _02 REQ-02-02-SPRINTEROP-IGS.2103	Operational	Flight Deck shall be able to execute flare during IGS operations without increasing the risk of hard landing or long landing	The existing crew task is not negatively impacted by the integration of audio-based Flare Assistant.	Validation report of EXE-02.02-V3-VALP-R11 EXE-02.02-V3-VALP-R14	Rejected	Not accepted in Wave 1
RTS11_ RTS14_2018 (IGS)_ Operational_ requirement _03 REQ-02-02-SPRINTEROP-IGS.1101	Operational	Information about a published IGS being active to a given runway QFU shall be available to the Flight Deck in order to prepare expected approach briefing (e.g. via ATIS)	The current information provided to the crew to prepare and fly an IGS procedure is validated.	Validation report of EXE-02.02-V3-VALP-R11 EXE-02.02-V3-VALP-R14	Rejected	Not accepted in Wave 1
RTS11_ RTS14_2018	Operational	Flight Deck shall be able to decelerate the aircraft during final approach,	Pilots succeeded to accomplish IGS operations and approach task	Validation report of	Rejected	Not accepte

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(IGS)_ Operational_ requirement _04 REQ-02-02-SPRINTEROP-IGS.2102		even under flight conditions that reduce deceleration capability (e.g. anti-ice system ON)	including a manual landing without any difficulty.	EXE-02.02-V3-VALP-R11 EXE-02.02-V3-VALP-R14		d in Wave 1
RTS11_ RTS 14_ 2018 (IGS)_ Operational_ requirement _05 REQ-02-02-SPRINTEROP-IGS.2103	Operational	Flight Deck shall be able to execute flare during IGS operations without increasing the risk of hard landing or long landing	It is confirmed that manual flare assistance adequacy to manage the flare is validated to perform increase glide slope procedures Even if some pilots perceived very well the audio-based flare assistant concept and encountered no difficulty to understand the behaviour of the function, a need of training was identified.	Validation report of EXE-02.02-V3-VALP-R11 EXE-02.02-V3-VALP-R14	Rejected	Not accepted in Wave 1
RTS11_ RTS14_2018 (IGS)_ Operational_ requirement _06 REQ-02-02-SPRINTEROP-IGS.2107	Operational	Flight Deck shall be able to fly IGS operations in a similar way (HMI, SOP, etc) as when an approach with standard slope is flown	To confirm that HMI is usable and acceptable for IGS operations	Validation report of EXE-02.02-V3-VALP-R11 EXE-02.02-V3-VALP-R14	Rejected	Not accepted in Wave 1
RTS11_RTS14_ 2018 (IGS)_ Operational_	Operational	Upon cleared for IGS Approach, Flight Deck shall confirm the feasibility of the instructed IGS operations under the actual flight and weather conditions	There is no need to add a specific phraseology linked to the IGS procedure.	Validation report of EXE-02.02-V3-VALP-R11	Rejected	Not accepted in Wave 1

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requirement _07 REQ-02-02-SPRINTEROP-IGS.2105			The flight crews validated that standard phraseology is also applicable for IGS procedures.	EXE-02.02-V3-VALP-R14		
ISGS_HPREQ_001 (REQ-14.3-SPRINTEROP-ORDF.0008)	Operational	When the separation delivery tool returns to operations, the Approach Executive Control shall communicate to the Tower Runway Control the first aircraft in the sequence that is performing ISGS arrival procedure.	This is important for the Tower Runway Control to know that the ISGS is back in operation.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREQ_002 (REQ-14.3-SPRINTEROP-ORDF.0004)	Operational	In peak traffic, in case of loss of separation tool, the coordinator/assistant shall aid the Approach Executive Control for checking the separations between aircraft and suggesting which aircraft should be sent around.	Self-explanatory	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREQ_003 (REQ-14.3-SPRINTEROP-ORDF.0005)	Operational	In case of loss of separation tool, Approach Executive Control should inform Tower Runway Control about the last aircraft flying the ISGS procedure until the tool is running again and the situation back to nominal.	That would improve Tower Runway Control situational awareness and avoid Tower Runway Control to be surprised if an aircraft flying on ISGS arrives after a number of aircraft on standard approach.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREQ_004 (REQ-14.3-SPRINTEROP-CTL.1112)	Design	The wrong glide alert shall be sufficiently reliable, the level of reliability being defined locally at each airport.	This increases the workload and communication load of the Controller.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREQ_005	Design	The need for displaying to	This should be further investigated locally.	Validation report of	Accepted	

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(REQ-14.3-SPRINTEROP-CTL.1110)				EXE-14.3-V3-VALP-R01		
ISGS_HPREQ_006 (REQ-14.3-SPRINTEROP-ACFT.2108)	Operational	Flight Deck shall pay particular attention to the transition of frequencies from APP to TWR and shall not delay it.	To avoid an aircraft being in between two frequencies where they are unable to communicate a missed approach or, conversely, the ATCO to not be able to communicate a go-around.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREQ_007	Operational	Additional staffing shall be available so that in peak (non-nominal) conditions, an Assistant can support the Approach Executive Control position.	The Supervisor will decide when an Assistant is needed, in coordination with Approach Runway Control.	Validation report of EXE-14.3-V3-VALP-R01	Rejected	Converted to HP recommendation
ISGS_HPREQ_008 (REQ-14.3-SPRINTEROP-CTL.1010)	Design	Applicable Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control, when controllers are supported by a separation tool.	In case of loss of the separation tool, the applicable standard baseline separation table (for same slope pairs) and a simplified mixed slope pairs table (e.g. leader on the higher and follower on the lower slope) shall be available to the ATCOs. These tables are to be used only when the tool is off. As an example, if RECAT-EU is the standard baseline separation to be applied for same slope pairs, the RECAT-EU table shall be available to the controllers. An additional table to cover mixed slope pairs when the separation tool is off, this could be RECAT-EU + 3NM.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	

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ISGS_HPREQ_009 (REQ-14.3-SPRINTEROP-GALT.0001)	Operational	When a wrong glide alert is activated, Approach Executive Control shall ask Flight Crew to confirm the flown approach procedure.	It is important that the ATCOs are aware of the situation and the pilots are aware of the reason for possible go-arounds.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREQ_010 (REQ-14.3-SPRINTEROP-GALT.0003)	Operational	After a glide alert procedure, Approach Executive Control shall coordinate with Tower Runway Control about the aircraft that triggered the glide alert when ISGS is active.	To maintain the situational awareness of Tower Runway Control. This is particularly important when an aircraft is finally not flying the procedure it would normally fly (for example if a Heavy aircraft is flying the ISGS Approach).	Validation report of EXE-14.3-V3-VALP-R01	Accepted	
ISGS_HPREQ_011 (REQ-14.3-SPRINTEROP-ORDF.0002)	Operational	In case of loss of separation tool, for all lower-upper and same slope pairs which are not stabilised at 160kts or not on (or behind) the ITD, Approach Executive Control or Tower Runway Control shall apply reference separation minima. It that is not possible, Approach Executive Control or Tower Runway Control shall instruct a go around to the aircraft flying the ISGS procedure.	The Approach Executive Control or Tower Runway Control needs to be confident that aircraft are stabilised before allowing them to continue on final.	Validation report of EXE-14.3-V3-VALP-R01	Accepted	

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