SESAR 2020 Solution 115 SPR-INTEROP/OSED for V3 - Part IV - HPAR - Human Performance Assessment Report

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ERICA

ENABLE RPAS INSERTION IN CONTROLLED AIRSPACE

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Abstract

This document contains the Human Performance (HP) assessment report for the PJ13 ERICA Solution 115 which consists of the HP assessment plan, the results of the HP activities conducted according to the HP assessment process, newly identified issues and the HP recommendations & requirements. It corresponds to the completion of the four steps of the Human Performance assessment process, namely: Step 1 – Understand the concept: Baseline, Solution and Assumptions, Step 2 – Understand the Human Performance Implications, Step 3 – Improve and Validate the concept and Step4 – Collate findings & conclude on transition to next V-phase.

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1 Executive Summary

This document contains the Human Performance (HP) assessment report for the PJ13 ERICA Solution 115 which consists of the HP assessment plan, the results of the HP activities conducted according to the HP assessment process, newly identified issues and the HP recommendations & requirements.
The outcomes come from the Real Time Simulation performed in March 2022 in Clermont-Ferrand and experts' judgement collected during dedicated workshop.
Real Time Simulation embedded 10 runs with 10 different executive controllers supervised by a Human Performance/factors expert, questionnaire, and debriefing to collect ATCO's opinion.
Runs were encompassing one RPAS flight amongst arrivals, transits, and departures with a frequency over what ATCOs were used to doing. In the last part of its flight, the RPAS triggered a command-and-control link loss.

The general feedback from ATCOs and analysis from the expert conclude the feasibility of the accommodation concept in controlled airspace class A to C.
Neither ATCO workload nor safety are affected by the RPAS transiting in the TMA.
There were not additional exchanges between the remote pilot and the ATCOs and duration of all messages, except the one that included the C2LL procedure, was not different to those with manned aircraft pilots. The procedure was deemed acceptable and not too long.

On safety point of view, no Near Mid-Air Collision was observed.

RTS and expert workshop led to propose the following and requirements and recommendations:

- A general information on RPAS functioning shall be provided to ATCO.

- RPAS number in one sector shall be limited to one at the same time unless both RPAS' flights are coordinated and guaranteed that C2LL trajectories are not in conflict.

- A ground link should allow the remote pilot and the ATCO to exchange in case of degraded modes of the ATM system. Validation highlighted that planner ATCO is in the best position to initiate the call in this role.

- The message sharing the C2LL procedure could/should be shorter once ATCOs are trained. Communication of diversion point, and destination could be enough. "C2LL" or "command-and-control link loss procedure" words could be removed.

- Remote pilot should use "remote" added to callsign at the first radio contact.

- Depending on flight route, a national or multi-states common transponder code should be adopted until 7400 is in place.

Finally, recommendations for further investigation are:

- One second latency was emulated by the remote pilot, but further validation could investigate impact of very high latencies.

- Non-nominal situation with a RPAS in emergency state should be assessed.

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2 Introduction

2.1 Purpose of the document

The purpose of this document is to describe the result of the activities conducted according to the Human Performance (HP) assessment process in order to derive the HP assessment report for Solution 115 including requirements and recommendations.

2.2 Intended readership

The intended audience for this document is the other team members of the SESAR Solution 115 and members of solution 117.

HP practitioners at the level of the transversal areas are also expected to have an interest in this document.

Other stakeholders that may be interested in this document are to be found among:

- RPAS operators including remote pilot
- ANS providers
- Airspace users

2.3 Structure of the document

This Human Performance Assessment Report encompasses the following parts:

Section 3 describes with details the Human Performance Assessment process, its different steps and the inputs required.

Section 4 provides:

- The reference and the solution scenario,

- The list of the validation assumptions,

- How the solution affects the different HP argument branches,

- Human Performance activities conducted during the project and

- The results

2.4 Acronyms and Terminology

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

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	& 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 also depends on aspects related to Recruitment, Training, Competence, and Staffing (RTCS) as well as Social Factors and Change Management.
HP activity	An HP activity is an evidence-gathering activity carried out as part of Step 3 of the HP assessment process. An HP activity can relate to, among others, task analyses, cognitive walkthroughs, and experimental studies.
HP argument	An HP argument is an HP claim that needs to be proven through the HP Assessment Process.
HP assessment	An HP assessment is the documented result of applying the HP assessment process to the SESAR Solution-level. HP assessments provide the input for the HP case.
HP assessment process	The HP assessment process is the process by which HP aspects related to the proposed changes in SESAR are identified and addressed. The development of this process constitutes the scope of Project 16.04.01. It covers the conduct of HP assessments on the Solution-level as well as the HP case building over larger clusters of Solutions.
HP benefit	An HP benefit relates to those aspects of the proposed ATM concept that are likely to have a positive impact on human performance.
HP case	An HP case is the documented result of combining HP assessments from Solutions into larger clusters (SESAR Projects, deployment packages) in SESAR.
HP issue	An HP issue relates to those aspects in the ATM concept that need to be resolved before the proposed change can deliver the intended positive effects on Human Performance.
HP impact	An HP impact relates to the effect of the proposed solution on the human operator. Impacts can be positive (i.e., leading to an increase in Human Performance) or negative (leading to a decrease in Human Performance).
HP recommendations	HP recommendations propose means for mitigating HP issues related to a specific operational or technical change. HF recommendations are proposals that require additional analysis (i.e., refinement and validation). Once this additional analysis is performed, HF recommendations may be transformed into HF requirements.
HP requirements	HP requirements are statements that specify required characteristics of a solution from an HF point of view. HP requirements should be integrated into the DOD, OSED, SPR, or specifications. HF requirements can be seen as the stable

| | result of the HF contribution to the Solution, leading to a redefinition of the operational concept or the specification of the technical solution. |

Table 1: Acronyms and terminology

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3 The Human Performance Assessment Process: Objective and Approach

The purpose of the HP assessment process 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.

The HP assessment process is a four-step process. Figure 1 provides an overview of these four steps with the tasks to be carried out and the two main outputs (i.e., HP plan and HP assessment report.
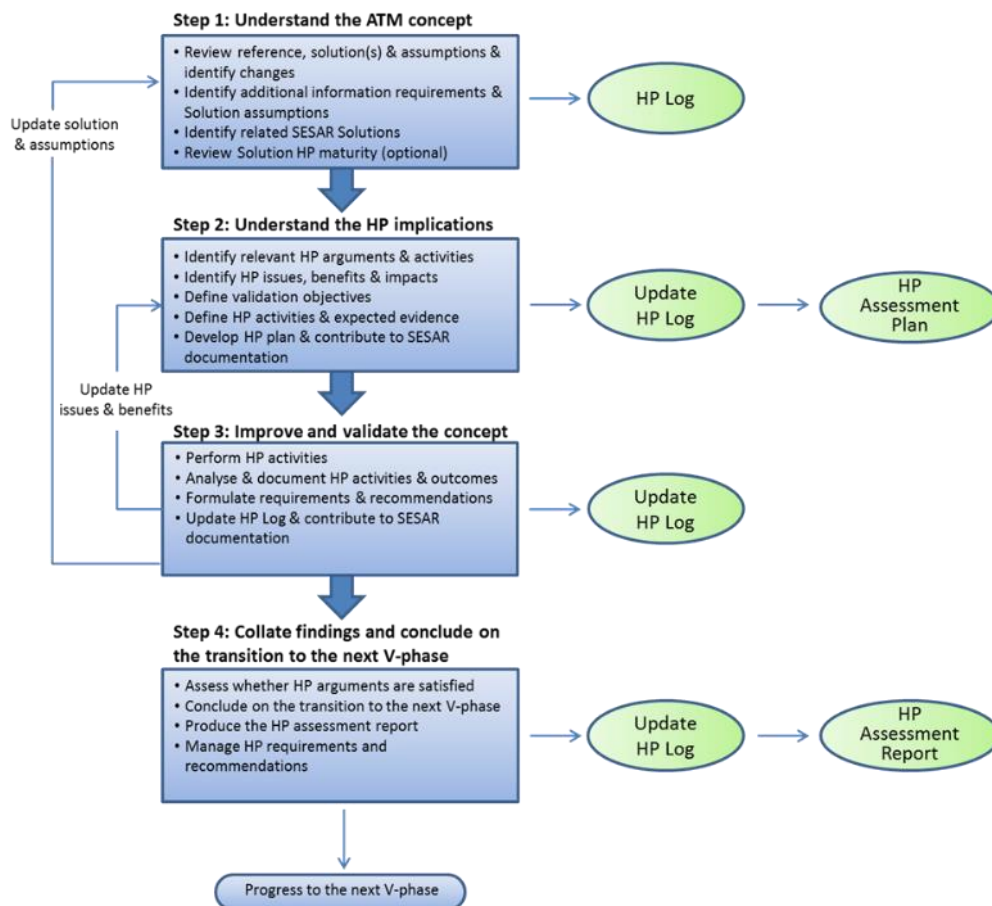
Figure 1 Steps of the HP assessment process

4 Human Performance Assessment

4.1 Step 1 Understand the ATM concept

4.1.1 Description of reference scenario

Due to COVID-19 pandemic, DSNA was not able to divide RTS 115 and 117 RTS runs on October 2021 and March 2022, respectively. Hence, both RTS were conducted during the same period in March 2022, with limited availabilities. To be able to run both RTS, we cancelled the reference scenario run for Solution 115 before the solution scenario and based the reference on the qualified Clermont Ferrand ATCOs usual experience in managing IFR flights. S115 and S117 RTS scenarios were however separate specific runs.

The environment of the Clermont-Ferrand airport was chosen because the usual traffic density is medium. The reference scenario date is 16th of April 2019 real traffic.
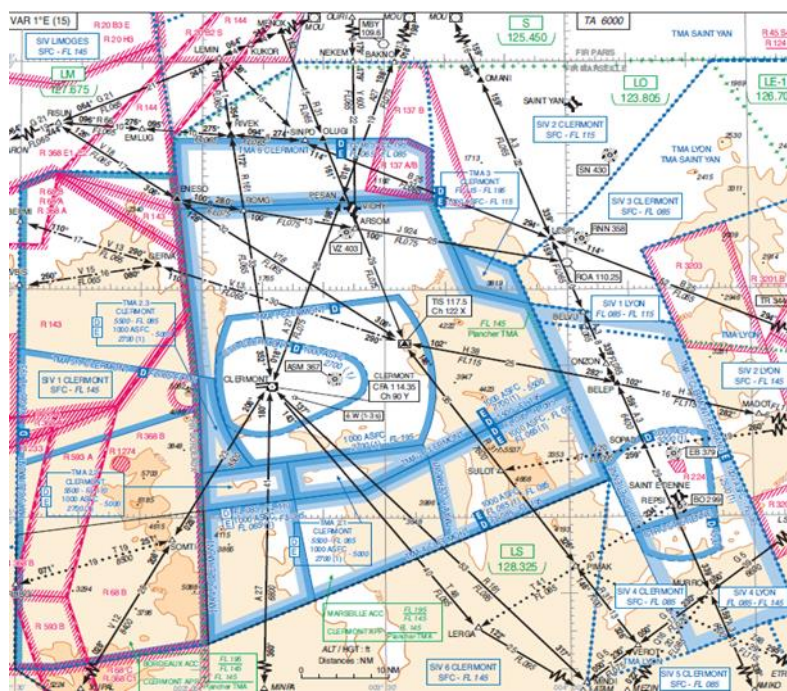
Figure 2 IFR map of Clermont-Ferrand area

4.1.2 Description of solution scenario

The solution scenario is based on a traffic sample derived from the reference scenario traffic dated on 16th of April 2019.
All the flights have been rearranged in time to increase arrivals and departures frequencies. The rearranged traffic rate per hour was 30 Arrivals/hour; 17 departures/hour; 7 transit/hour.
A traffic peak was proposed. The argument, explained to ATCOs was bad meteorological conditions at the beginning of the day.

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One RPAS flight was added, with a transit from northeast to vertical Clermont Ferrand airport (heading 200 approximately), hold for several minutes for instrument calibration (further along the route at the time), then heading southeast. During this last leg, the remote pilot requested to change heading of 20° left to avoid an isolated storm cell. The Command-and-Control link loss (C2LL) was simulated while on this heading.
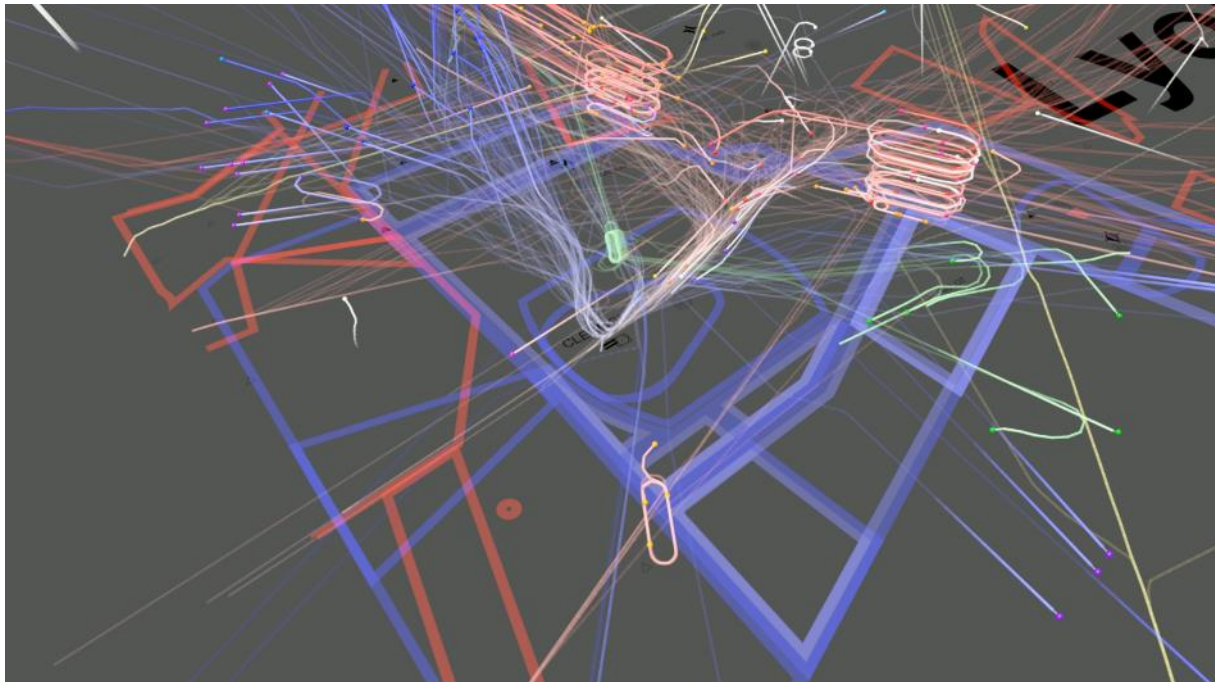
Figure 3 Solution 115 RPAS trajectories in green

4.1.3 Consolidated list of assumptions

Validation plan and validation report assumptions:

Identifier	Title	Description	Justification	Impact on Assessment
ASS- PJ13-V3-VALP-001	RPAS compliance with ATC requirements	The RPAS capabilities (within accommodation limitations) and pilot in command IFR qualifications is responsible for compliance with ATC requirements and the accommodation procedures.	The SESAR solution focuses on IFR RPAS accommodation	Safety, Human performance
ASS-PJ13-V3-VALP-002	RP – ATC communication	There is a continuous two-way VHF communication between the remote pilot and the ATC (except in C2 link loss conditions) and the possibility to contact the remote pilot through a phone line.	The SESAR solution focuses on IFR RPAS accommodation	Interoperability, Safety, Human performance

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ASS-PJ13-V3-VALP-003	RPAS in transit phase	RPAS will be transiting across a controlled class A-C airspace (terminal manoeuvring area for the RTS).	The SESAR solution focuses on the accommodation of IFR RPAS in transiting in en-route phase.	Interoperability, Safety, Human performance. The RPAS will fly in an environment where some other aircraft are proceeding to arrival and departure.
ASS-PJ13-V3-VALP-004	RPAS non-compliant with full ICAO regulation	RPAS considered are state RPAS. Initial future civil RPAS (unknown today) could also be accommodated under the same level of accommodated constraints and in the same operational environment.	The SESAR solution considers the accommodation of existing RPAS with current systems; these are mainly state aircraft.	Interoperability, Safety, Human performance.

Table 2 List of VALR and VALP assumptions

The following assumptions related to Human Performance have been identified as requirements in the OSED (section 4):

Identifier	Title	Description
REQ-PJ13.115-SPRINTEROP-0270	RPAS -Training and Methods for non-nominal RPAS	RP shall be trained and shall be able to apply new procedures including specific RPAS preparation procedures and operating methods for RPAS non-nominal situations. RP will be able to conduct diversion preparation in case of changes during a C2LL.
REQ-PJ13.115-SPRINTEROP-0290	ATC - Conflicts Detection Tools for RPAS	ATC shall be able to use the usual tools as used for manned aircraft to detect possible conflicts: • Mid-Term Conflict Detection (MTCD) probe. • Short-Term Conflict Alert (STCA) safety net.
REQ-PJ13.115-SPRINTEROP-0380	RPAS - Traffic density limitation	RPAS accommodation phase operational environment is low-medium traffic density.
REQ-PJ13.115-SPRINTEROP-0410	RPAS - Speed Flight Limitation	RPAS shall fly low speeds (below 200 knots) in order to allow ATCO sufficient time to update the RPA clearance or re-organize the traffic around RPAS after C2LL occurrence.

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	ATC - RPAS ordinary flight management	From an ATC environment point of view, the flight of the RPAS shall be considered an ordinary flight in the sectors or groups of sectors concerned. Therefore, the current training of the ATCOs prepares them to manage technical failures related to the ATSU like radio failures, CWP failures...”
REQ-PJ13.115-SPRINTEROP-0370		

Table 3 OSED list of assumptions related to Human Performance

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

SESAR Solution PJ13-W2-115 "IFR RPAS accommodation in Airspace Class A to C" has no direct dependencies.

4.1.5 Identification of the nature of the change

HP argument branch	Change & affected actors
1. ROLES & RESPONSIBILITIES	
1.1 ROLES & RESPONSIBILITIES	No change in roles or general air traffic controller responsibilities
1.2 OPERATING METHODS	An existing manned aircraft operating method is introduced to manage nominal and non-nominal RPAS flight in en-route and TMA environment. New procedures are introduced to manage RPAS in non-nominal situation (these procedures shall be as much as possible close to those used for manned aviation and harmonized at a european level
1.3 TASKS	Air traffic controller's tasks remain the same as before in nominal situation Controller's workload may be affected by additional tasks in case of non-nominal situation
2. HUMAN & SYSTEM	
2.1 ALLOCATION OF TASKS (HUMAN & SYSTEM)	There is no change in the current allocation of tasks at ATC level

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2.2 PERFORMANCE OF TECHNICAL SYSTEM	Air traffic controller shall be able to use existing systems
2.3 HUMAN – MACHINE INTERFACE	Air traffic controller shall be provided with the information that the aircraft to be managed is an RPAS and other information specific to an RPAS flight management (e.g., Remote pilot direct phone line if necessary)
3. TEAMS & COMMUNICATION	
3.1 TEAM COMPOSITION	No change in the team composition
3.2 ALLOCATION OF TASKS	No change (may depend on local organization)
3.3 COMMUNICATION	Existing phraseology with new elements to support the newly defined procedures between the executive controller and the remote pilot. Backup telephone communication means (direct phone line with the remote pilot) in case of C2 link loss Communication quality and load affected by an increase of the communication latency between the air traffic controller and the remote pilot.
4. HP RELATED TRANSITION FACTORS	
4.1 ACCEPTANCE & JOB SATISFACTION	Air traffic controller acceptance and satisfaction. ATCO acceptance of change regarding introduction of new type of aircraft.
4.2 COMPETENCE REQUIREMENTS	The solution does not introduce new operating methods except in the way to manage non-nominal situations which may be different to manned aviation (e.g., C2 link loss). Confirmation from Air Traffic Controller that their current skills are adequate to manage RPAS flight in nominal and non-nominal situation.
4.3 STAFFING REQUIREMENTS & STAFFING LEVELS	No change
4.4. RECRUITMENT AND SELECTION	No change
4.5. TRAINING NEEDS	ATCO feedback to highlight future training needs to manage specific RPAS behaviour (e.g., speed).

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

This information is already available in the SESAR 2020 Solution 115 VALP Part IV, in table 6.

All issues were covered.

4.3 Step 3 Improve and validate the concept

4.3.1 Description of HP activities conducted

The following table describes with details the activity conducted during the Real Time Simulation.

The tables afterwards are activities conducted around the Human Performance domain before the Real time simulations.

Activity 1.	
Description	Real Time Simulation - EXE_115_001 (DSNA)
Arguments & related issues addressed	Arguments: • Arg. 1.2.1: Operating methods (procedures) cover operations in normal operating conditions. • Arg. 1.2.2: Arg. 1.2.2: Operating methods (procedures) cover operations in abnormal operating conditions. • Arg. 1.2.3: Operating methods(procedures) cover degraded modes of the ATM system. • Arg. 1.2.4: The content of operating methods (procedures) is clear and consistent (in V1: non-contradictory). • Arg. 1.2.5: Operating methods (procedures) can be followed in an accurate, efficient, and timely manner. • Arg. 1.3.1: The potential for human error is reduced to a tolerable level. • Arg. 1.3.2: Tasks can be achieved in a timely manner. • Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable. • Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate. • Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness. • Arg. 1.3.6.1: Safety requirements on human performance are satisfied. • Arg. 2.2.2: The timeliness of information provided by the system is adequate for carrying out the task. • Arg. 2.3.1: The type of information provided satisfies the information requirements of the human.

	- Arg. 3.3.2: The phraseology supports communication in all operating conditions. - Arg. 3.3.4: The communication load of team members is acceptable in normal and abnormal conditions and degraded mode of operations. - Arg. 3.3.5: Team members can maintain a sufficient level of shared situation awareness. - Arg. 4.1.2: The impact of changes on the job satisfaction of affected human actors has been considered. Issues: 121-001 122-001 and 122-002 123-001 124-001 and 124-002 125-001 131-001 and 131-002 132-001 and 132-002 133-001 134-001 and 134-002 135-001 136-100 136-101 222-001 231-001 332-001 334-001 335-001 412-001 421-001
HP objectives	- OBJ-13-V2-115-HPAP-0001 - OBJ-13-V2-115-HPAP-0002 OBJ-13-V2-115-HPAP-0003 - OBJ-13-V2-115-HPAP-0004 - OBJ-13-V2-115-HPAP-0005 and OBJ-13-V2-115-HPAP-0006 - OBJ-13-V2-115-HPAP-0007 - OBJ-13-V2-115-HPAP-0008 and OBJ-13-V2-115-HPAP-0009 - OBJ-13-V2-115-HPAP-0010 and OBJ-13-V2-115-HPAP-0011 - OBJ-13-V2-115-HPAP-0012 - OBJ-13-V2-115-HPAP-0013 and OBJ-13-V2-115-HPAP-0014 - OBJ-13-V2-115-HPAP-0015 - OBJ-13-V2-115-HPAP-0016 and OBJ-13-V2-115-HPAP-0017 - OBJ-13-V2-115-HPAP-0018 - OBJ-13-V2-115-HPAP-0019 - OBJ-13-V2-115-HPAP-0020 - OBJ-13-V2-115-HPAP-0021 - OBJ-13-V2-115-HPAP-0022

	• OBJ-13-V2-115-HPAP-0023 • OBJ-13-V2-115-HPAP-0024
Tools / Methods selected out of the HP repository	Observations, questionnaire, and debriefing
Summary of the HP activity	<u>RTS general description:</u> 10 runs were conducted with 10 different air traffic controllers at the executive working position. One RPAS was involved in the simulation, transiting in the TMA. It had a specific trajectory amongst the arrivals and departures, making patterns between FL80 and FL100, in holding pattern areas of arrivals. This RPAS simulated a command-and-control link loss. Three pseudo pilots with IFR experience (also licenced air traffic controllers) were steering manned aircraft and one real remote pilot was steering the RPAS from a simulated Remote Pilot station. <u>Activity 1</u>: each run of RTS 115 was observed by a Human Performance expert and a former Air traffic controller in the military. Notes were taken during each run pointing out specific or abnormal air traffic controller action. Observations were performed by one HP expert and one former air traffic controller (approach and tower) in the French Air Force. <u>Activity 2</u>: after each run, time was taken to debrief with the air traffic controller, in presence of the Human Performance expert and controllers involved in the simulation (e.g., pseudo-pilots). Direct exchanges with air traffic controller took place to collect feedbacks on issues or difficulties he/she may have encountered during the simulation. It was also the occasion to share information on RPAS behaviour specificities. A debriefing was conducted at the end of each of the 10 runs. The whole team was composed of the HP expert, three air traffic controllers involved as pseudo-pilot, one air traffic controller as observer during the runs, the remote pilot and two engineers from Thales. We discussed all issues and difficulties the ATCO met during the run, provided explanations if necessary and collected feedbacks especially on the fields of our interest (e.g., workload, phraseology, situational awareness). <u>Activity 3</u>: after each run, a questionnaire of 18 questions was submitted to the air traffic controller to collect feedbacks on how he/she experienced the simulation, how hard was the sequence, what is his/her first impression on new functionality, just to name a few. Analysis of the responses is done after the RTS period by the HP expert.

Table 5 RTS activities

ACTIVITY 2.	Safety and Human Performance scoping and change assessment workshop (4.2.2 of SESAR 2020 Solution 115 VALP Part IV)
Description	This activity aimed at defining how the solution could impact ATM on Human Performances and safety. In details this activity included: • Identification of the change and the impact of the change for HP • Identification of the main safety & HP issues associated to the Solution • Definition of the extent to which the safety assessment must be conducted and first proposal of safety criteria • An initial assessment of the safety implications of the Solution • The objectives of the Solution linked with the Key Performance Areas (KPA) (access/equity, HP, safety, development impact), with a first analysis on how KPA selected are impacted (decreased, neutral or increased).
HP OBJECTIVES	Identify the scope of the change on a Human Performance point of view.
Tool selected out of the HP repository	Online Safety and Human Performance workshop with solution leader and Safety and HP experts.
Planning and Approach	Workshop dedicated to this activity owing to online tool.
timeline	February 2021.

Table 6 Description of activity 1 - SAF and HP scoping and change assessment workshop

ACTIVITY 3.	Human Performance argument selection and issue/benefit identification (4.2.2 of SESAR 2020 Solution 115 VALP Part IV)
Description	Referring to the SESAR Human Performance Assessment Process V1 to V3 document [1] , HP arguments impacted by the solution have been selected.
HP objectives	Identification of the Human Performance arguments impacted by the solution.
Tool selected out of the HP repository	Online meeting.
Planning and Approach	Dedicated online meetings with Human Performance DSNA expert. Each HP argument was considered to assess whether it was concerned by the solution.
timeline	February 2021.

Table 7 Description of activity 2 - Human Performance argument selection and issue/benefit identification

ACTIVITY 4.	Human Performance validation activities definition (4.2.2 OF SESAR 2020 SOLUTION 115 VALP PART IV)
Description	This activity aimed at defining the methodology that will be used during the exercise to validate the objectives.
HP objectives	Identification of the methodology that will be used to assess the Human performance related to each HP argument (e.g., RTS, questionnaire, HP expert).
Tool selected out of the HP repository	Online meeting.
Planning and Approach	Dedicated online meetings with Human Performance DSNA expert. Each HP argument selected during the previous activity was linked to a validation activity.
timeline	May 2021.

Table 8 Description of activity 3- HP validation activities definition

Activity 5.	Human Performance argument and validation workshop (4.2.2 of SESAR 2020 Solution 115 VALP Part IV)
Description	HP arguments and validation activities are shared and discussed with Human Performance solution experts.
HP objectives	Get the validation from the HP expert of the Human Performance arguments selected.
Tool selected out of the HP repository	Online meeting.
Planning and Approach	Dedicated online meetings with Human Performance Solution experts (mainly Air Traffic Controllers). Each HP argument selected during the previous activity and the validation activity are shared and discussed for common agreement.
timeline	May 2021

Table 9 Description of activity 4 - HP argument and validation workshop

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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

Table 4 provides a summary of the HP argument and related issues / benefits along with the HP activities conducted.

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

Issue ID	HP issue / Benefit	HP Issue/ Benefit Status	HP/ Valid. Obj. ID	activity conducted	results / evidence	recommendations	requirements
Arg. 1.2.1: Operating methods cover operations in normal operating conditions.							
121-001	Benefit	Closed	OBJ-13-V2-115-HPAP-0001	RTS and questionnaire	RPAS is seen as a usual airspace IFR user.		
Arg. 1.2.2: Operating methods cover operations in abnormal operating conditions.							
122-001	Issue	Closed	OBJ-13-V2-115-HPAP-0002	RTS and questionnaire	The new procedure is seen as similar to radio communication loss procedure for manned aircraft.		
122-002	Benefit	Closed	OBJ-13-V2-115-HPAP-0003	RTS and questionnaire	ATCOs think it is important to know what RPAS behaviour will be when in C2LL state.		
Arg. 1.2.3: Operating methods cover degraded modes of the ATM system.							

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| 123-001 | Benefit | Closed | OBJ-13-V2-115-HPAP-0004 | RTS, questionnaire and expert judgment | There is no difference in the procedures and the ground communication means allows the ATCO to contact the remote pilot. | A ground link should allow the remote pilot and the ATCO to exchange in case of degraded modes of the ATM system. Validation highlighted that planner ATCO is in the best position to initiate the call in this role. | |

Arg. 1.2.4: The content of operating methods is clear and consistent (in V1: non-contradictory).

| 124-001 | Benefit | Closed | OBJ-13-V2-115-HPAP-0005 | RTS and questionnaire | RPAS has been managed by ATCO with no difference with manned traffic. | | A general information on RPAS functioning shall be provided to ATCO. |
| 124-002 | Issue | Open | OBJ-13-V2-115-HPAP-0006 | RTS and questionnaire | Operating method is clear for C2LL, but a RPAS in other states of emergency should be assessed. | Non-nominal situation with a RPAS in emergency state should be assessed. | |

Arg. 1.2.5: Operating methods (procedures) can be followed in an accurate, efficient, and timely manner.

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125-001	Issue	Open	OBJ-13-V2-115-HPAP-0007	RTS and questionnaire	ATCOs were able to follow the procedure. Transponder code 7400 is not relevant in France for the while.	Depending on flight route, a national or multi-states common transponder code should be adopted until 7400 is in place.	

Arg. 1.3.1: The potential for human error is reduced to a tolerable level.

131-001	Benefit	Closed	OBJ-13-V2-115-HPAP-0008	RTS	Transiting RPAS was managed as usual IFR traffic. It has not generated any error.		
131-002	Issue	Closed	OBJ-13-V2-115-HPAP-0009	RTS and questionnaire	The procedure was understood and did not induce any error.		

Arg. 1.3.2: Tasks can be achieved in a timely manner.

132-001	issue	Closed	OBJ-13-V2-115-HPAP-0010	Questionnaire, previous project feedbacks and operational expert feedback	Previous project suggested that latency shall not exceed 4 to 5 seconds in en-route. One second, which is approximately the	One second latency was emulated by the remote pilot; further Vx validation could investigate impact of very high latencies	

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					maximum technical latency usually observed, does not impact operations		
132-002	Issue	Closed	OBJ-13-V2-115-HPAP-0011	RTS, questionnaire, previous project feedback and operational expert feedback	A delay of one second was added in remote pilot's communication. Neither step-on nor issues were observed		

Arg. 1.3.3: The level of workload (induced by cognitive and/or physical task demands) is acceptable

133-001	Issue	Closed	OBJ-13-V2-115-HPAP-0012	RTS and questionnaire	It makes the first message slightly longer, but workload is not considered increased	The message could be shorter once ATCOs are trained. Communication of diversion point, and destination could be enough. C2LL or command-and-control link loss procedure words could be removed	

Arg. 1.3.4: The level of trust in the new concept/the new procedures is appropriate.

134-001	Benefit	Closed	OBJ-13-V2-115-	Questionnaire	RPAS flight in IFR does not bring complexity in traffic management		

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			HPAP-0013		both in nominal and non-nominal situation		
134-002	Issue	Closed	OBJ-13-V2-115-HPAP-0014	RTS and questionnaire	The proposed C2LL procedure is sufficient for RPAS accommodation in low-medium traffic density airspace		

Arg. 1.3.5: Human actors can maintain a sufficient level of situation awareness.

135-001	Benefit	Closed	OBJ-13-V2-115-HPAP-0015	RTS and questionnaire	In C2LL state, the comfort provided by the direct telephone line is deemed very useful and brings confidence in RPAS behaviour	A ground link should allow the remote pilot and the ATCO to exchange in case of C2LL	

Arg. 1.3.6.1: Safety requirements on human performance are satisfied.

136-100	Benefit	Closed	OBJ-13-V2-115-HPAP-0016	Debriefing and questionnaire	Communication during the first radio contact of the C2LL procedure is easy to understand and clear. The content could be improved once		

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					ATCOs are informed/trained		
136-101	Benefit	Closed	OBJ-13-V2-115-HPAP-0017	RTS, debriefing and expert judgment (also linked to safety assessment)	RTS encompassed one RPAS only, matching the requirement of one RPAS by controlled sector.		RPAS number in one sector shall be limited to one at the same time unless both RPAS' flights are coordinated and guaranteed that C2LL trajectories are not in conflict.

Arg. 2.2.2: The timeliness of information provided by the system is adequate for carrying out the task.

222-001	Benefit	Closed	OBJ-13-V2-115-HPAP-0018	RTS and questionnaire	Available ATCO's system during RTS allow to manage RPAS flight efficiently	

Arg. 2.3.1: The type of information provided satisfies the information requirements of the human

231-001	Issue	Closed	OBJ-13-V2-115-HPAP-0019	RTS and questionnaire	Aircraft type is mentioned on paper strip, but this information is not observed in particular when workload is high. No other information that the aircraft	Remote pilot should use "remote" added to callsign at the first radio contact

					managed was a RPAS was provided to ATCOs		

Arg. 3.3.2: The phraseology supports communication in all operating conditions

332-001	Issue	Closed	OBJ-13-V2-115-HPAP-0020	RTS and questionnaire	The phraseology was deemed clear and adapted		

Arg. 3.3.4: The communication load of team members is acceptable in normal and abnormal conditions and degraded mode of operations

334-001	Issue	Closed	OBJ-13-V2-115-HPAP-0021	RTS, questionnaire and expert judgment	The radio occupancy of the C2LL contingency procedure communication is quite longer than a usual message but is acceptable	C2LL contingency procedure phraseology should be reduced to the diversion point and the destination	

Arg. 3.3.5: Team members can maintain a sufficient level of shared situation awareness.

335-001	Issue	Closed	OBJ-13-V2-115-HPAP-0022	RTS and questionnaire	Direct phone line was deemed very useful. This tool is a plus compared to manned aviation. Hence, absence of this	A ground link should allow the remote pilot and the ATCO to exchange in case of C2LL	

					communication means is not sensitive		

Arg. 4.1.2: The impact of changes on the job satisfaction of affected human actors has been considered.

412-001	Issue	Closed	OBJ-13-V2-115-HPAP-0023	Questionnaire	ATCO knows that more RPAS will need to fly in the future. They seem happy to welcome these new airspace users		

Arg. 4.2.1: Knowledge, skill and experience requirements for human actors have been identified

421-001	Issue	Closed	OBJ-13-V2-115-HPAP-0024	RTS and questionnaire	ATCOs need information and explanations about RPAS functioning and specificities. Training is required for most of them. Pre-programmed flight, C2L characteristics and the C2LL proposed procedure are the most important points		A general information on RPAS functioning shall be provided to ATCO

Table 10: Summary of the HP results and recommendations/ requirements for each identified issue & related argument

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4.4.2 Maturity of the Solution

This section contains the HP maturity review at the end of the validation activity to give advice on the transition to the next V-phase. Based on the assessment of whether sufficient evidence has been produced to support the HP arguments, advice will be formulated on whether the Solution's transition to the next V-phase from an HP point of view is recommended. When answering the questions, the responses should be based on the comparison between required and actual evidence related to an HP argument.

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ID	Question	Answer *Fill in 'yes' or 'no'.*	Comments *Please substantiate your answer.*
	Maturity checklist for finalising the V3 assessment		
1	Has a Human Performance Assessment Report been completed? Have all relevant arguments been addressed and appropriately supported?	Yes	*-Arguments addressed and associated evidence: HPAR section 4.1.5* *-Outcomes of the HP activities: HPAR sections 4.3.1 and 4.4.*
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	*- Arguments addressed and associated evidence: HPAR section 4.4.1.* *- Identified HP benefits and issues: HPAR section 4.4.1.* *- Outcomes of HP activities (including validation exercises): HPAR sections 4.3.1 and 4.4.*
3	Have all the parts of the solution/concept been considered?	Yes	*- Description of the solution/concept and related assumption: VALP section 4.1, OSED section 3* *- List of assumption that have a link with the HP issue/benefits: HPAR 4.1.3* *- List of issues/benefits and associated validation objectives: VALP Part IV section 4.2.1.*
4	Have potential interactions with related projects/concepts been considered and addressed?	N/A	*N/A*
5	Is the level of human performance needed to achieve the desired system performance for the proposed solution consistent with human capabilities?	Yes	*- Outcomes of HP activities on HP related measures (workload, situational awareness, human error, task efficiency): VALR section 4.2.6*
6	Are the assessments results in line with what is targeted for that concept? If not, has the impact on the overall strategic performance objectives/targets been analysed?	Yes	*- Arguments addressed and associated actual evidence: VALP Part IV section 4.2.1, VALR section 4.2.6 and HPAR section 4.*
7	Has the proposed solution been tested with end-users and under sufficiently realistic conditions, including abnormal and degraded conditions?	Yes	*- Description of HP activities (in particular, validation activities), including details on participants and test conditions/operational scenarios: HPAR section 4.3.1.*

8	Do validation results confirm that the interactions between human and technology are operationally feasible, and consistent with agreed human performance requirements?	Yes	*- Arguments addressed and associated actual evidence: HPAR section 4.4.1.* *- Outcomes of the validation exercises: VALR section 4.2 and section 5.*
9	Have all relevant SESAR documentation been updated according to the HP activities outcomes (OSED, SPR)?	Yes	*Compare the HP table and last version of OSED and SPR*
10	Do the outcomes satisfy the HP issues/benefits in order to reach the expected KPA?	Yes	*- Arguments addressed and associated evidence: VALP Part IV section 4.2.1, VALR section 4.2.6 and HPAR section 4.* *- Identified HP benefits and issues: HPAR section 4.4.1.* *- Outcomes of HP activities (including validation exercises): VALR section 4.2.*
11	Have HP recommendations and HP requirements correctly been considered in HMI design, procedures/documentation and training?	Yes	*- Outcomes of HP activities (including validation exercises): VALR section 4.2.*
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	*- Arguments on task allocation human-machine, on impacts on the organizational level: VALR section 4.2.6 and section 5.* *- Requirements and recommendations for concept implementation: HPAR 4.4.1, appendix B and C.*
13	Have any impacts been identified that may require changes to regulation in the area of HP/ATM? This includes changes in roles & responsibilities, competence requirements, or the task allocation between human & machine.	Yes	*- Arguments on roles & responsibilities, task allocation human-machine, impediments to implementation: VALR section 4.2.6, section 5 and HPAR section 4.4.1.*
14	Has the next V-phase sufficiently been prepared (additional testing conditions, open HP issues to be addressed)?	Yes	*- List of open issues/benefits and associated validation objectives not yet validated: None* *- Recommendation for further research: VALR section 5.2.2.*

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5 References

Human Performance

[1]   SESAR Human Performance Assessment Process V1 to V3

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Appendix A   – Additional HP activities conducted

Non applicable

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Appendix B   – HP Recommendations Register

HP Recommendations Register										
Reference	Type of recommendation	Recommendation	Rationale	Assessment source + Reference report	Scope (Air, Air/Ground, Ground)	Concept/ solution Involved	Recommendation status	Rationale in case of rejection	Comments
REC-115-V3-EXE115-001	OPS (Operating methods/procedures)	A ground link should allow the remote pilot and the ATCO to exchange in case of degraded modes of the ATM system. Validation highlighted that planner ATCO is in the best position to initiate the call in this role.	This is probably linked to the novelty of managing RPAS traffic, but telephone link reassured ATCOs about RPAS behaviour when loosing C2L. Lack of confidence, knowledge, and experience in managing RPAS probably requires a remote pilot-	Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report	Ground	PJ13 Solution 115 RPAS accommodation	Accepted		

			ATCO communication link at the beginning						
REC-115-V3-EXE115-002	OPS (Operating methods/procedures)	Non-nominal situation with a RPAS in emergency state should be assessed.	This was not assessed during DSNA's RTS. Specificities of RPAS design and emergency procedure(s) may lead the RPAS to ditch instead of finding an emergency landing site	Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report	Air/ground	PJ13 Solution 115 RPAS accommodation	Accepted		
REC-115-V3-EXE115-003	OPS (Operating methods/procedures)	Depending on flight route, a national or multi-states common transponder code should be adopted until 7400 is in place.	Current code is already used in certain country (France) or do not reveal any unusual situation on ATCO's display	Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-INTEROP/OSED	Air/ground	PJ13 Solution 115 RPAS accommodation	Accepted		

			for V3 - Part IV - Human Performance Assessment Report			
REC-115-V3-EXE115-004	System design	One second latency was emulated by the remote pilot; further validation could investigate impact of very high latencies	Very high latencies are unusual operationally speaking. Nevertheless, such situation could be assessed	Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report	Air/ground	PJ13 Solution 115 RPAS accommodation	Accepted
REC-115-V3-EXE115-005	OPS (Operating methods/procedures)	The message could be shorter once ATCOs are trained. Communication of diversion point, and destination could be enough. C2LL	The shorter the message, the best is the communication for the ATCO	Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-	Air	PJ13 Solution 115 RPAS accommodation	Accepted

		or command-and-control link loss procedure words could be removed		INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report				
REC-115-V3-EXE115-006	OPS (Operating methods/procedures)	Remote pilot should use "remote" added to callsign at the first radio contact	This is linked by comparison with the reference scenario when "drone" was not used. Many ATCOs confirmed it would bring a valuable information.	Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report	Air	PJ13 Solution 115 RPAS accommodation	Accepted	

Table 11: HP recommendations

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Appendix C   – HP Requirements Register

HP Requirements Register									
Reference	Type of requirement	Requirement	Rationale	Assessment source + Reference report if available	Scope (Air, Air/Ground,Ground)	Concept/ solution Involved	Requirement status	Rationale in case of rejection	Comments
REQ-115-V3-EXE115-001	Training	A general information on RPAS functioning shall be provided to ATCO.	Most ATCOs do not have any RPAS/drone culture/experience. These aircraft are new for them, and their specificities shall be brought to their attention.	Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part IV - Human Performance Assessment Report	Ground	PJ13 Solution 115 RPAS accommodation	Accepted		

| REQ-115-V3-EXE115-002 | OPS (Operating methods/procedures) | RPAS number in one sector shall be limited to one at the same time unless both RPAS' flights are coordinated and guaranteed that C2LL trajectories are not in conflict. | Two RPAS on C2LL state may collide if C2LL trajectories are not coordinated in order to not cross. This is valid in the absence of Detect and avoid during accommodation phase | Real Time Simulation - EXE_115_001 (DSNA), SESAR 2020 PJ13 Solution 115 VALR, SESAR Solution 115 SPR-INTEROP/OSED for V3 - Part II – Safety assessment Report | Air | | PJ13 Solution 115 RPAS accommodation | Accepted | | |

Table 12: HP Requirements

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Appendix D   – HP Log

AS Solution 115 encompassed only one exercise, it has been deemed that no HP Log was required.

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