

# SESAR VLD1-W2 DREAMS

## Demo Report - Part II - Safety

<b>Deliverable ID:</b>	<b>D1.4</b>
<b>Dissemination Level:</b>	<b>PU</b>
<b>Project Acronym:</b>	<b>VLD01 DREAMS</b>
<b>Grant:</b>	<b>874469</b>
<b>Call:</b>	<b>H2020-SESAR-2019-1</b>
<b>Topic:</b>	<b>GBAS/SBAS precision approaches including variable approach paths</b>
<b>Consortium Coordinator:</b>	<b>INDRA</b>
<b>Edition Date:</b>	<b>09 December 2022</b>
<b>Edition:</b>	<b>00.01.02</b>
<b>Template Edition:</b>	<b>00.00.04</b>

## Authoring & Approval

### Authors of the document

Beneficiary	Date
DBL (ENAV LTP)	09/12/2022

### Reviewers internal to the project

Beneficiary	Date
HONEYWELL	14/06/2022
ECTL	14/06/2022
NLR	14/06/2022

### Reviewers external to the project

Beneficiary	Date

### Approved for submission to the S3JU By - Representatives of all beneficiaries involved in the project

Beneficiary	Date
AIRBUS	04/11/2022
DASSAULT	04/11/2022
DFS	04/11/2022
DLR	04/11/2022
ENAV	04/11/2022
EUROCONTROL	04/11/2022
HONEYWELL	04/11/2022
INDRA	04/11/2022
NLR	04/11/2022

### Rejected By - Representatives of beneficiaries involved in the project

Beneficiary	Date

### Document History

Edition	Date	Status	Beneficiary	Justification
---------	------	--------	-------------	---------------

00.00.01	10/03/2022	Draft	DBL (ENAV LTP)	Initial draft of SAR
00.00.02	21/04/2022	Draft	DBL (ENAV LTP)	Initial draft of SAR integrating SRAP and IGS-to-SRAP results
00.00.03	12/05/2022	Draft	EUROCONTROL NLR	Updates and edits regarding section 4.1.1 & 4.1.3
00.00.04	14/06/2022	Draft	DBL (ENAV LTP)	Intermediate version internal review comments' integration
00.00.05	19/07/2022	Draft	DBL (ENAV LTP)	Integration of EXE3 and 4 results
00.00.06	02/08/2022	Draft	DBL (ENAV LTP)	Integration of SJU Comments
00.00.70	25/10/2022	Draft	DBL (ENAV LTP)	Integration of Frankfurt results
00.01.00	02/11/2022	Final	DBL (ENAV LTP)	Final version for formal approval
00.01.01	07/11/2022	Final	DBL (ENAV LTP)	Final Version approved for the submission to SJU
00.01.02	09/12/2022	Final	DBL (ENAV LTP)	Final Version to integrate SJU comments

**Copyright Statement** © 2022 – EUROCONTROL, INDRA, NLR, ENAV, DFS, Dassault, Honeywell, DLR, Airbus. All rights reserved. Licensed to SESAR3 Joint Undertaking under conditions.

# VLD01 DREAMS

## VLD01 DREAMS

This SAR is part of a project that has received funding from the SESAR3 Joint Undertaking under grant agreement No 874469 under European Union's Horizon 2020 research and innovation programme.



### Abstract

---

This document contains the safety assessment report for the DEMO 01 which consists of the safety plan, the results of the safety activities conducted according to the safety assessment process, safety recommendations & requirements.

## Table of Contents

<b>Abstract .....</b>	<b>4</b>
<b>1 Executive Summary.....</b>	<b>7</b>
<b>2 Introduction.....</b>	<b>8</b>
2.1 Twente SRAP, IGS-to-SRAP Demo (EXE-001) .....	9
2.2 Frankfurt ISGS Demo (EXE-002) .....	9
2.3 Ciampino ISGS Demo (EXE-003).....	10
2.4 Twente ISGS Demo (EXE-004).....	10
<b>3 VLD safety argument and assurance activities.....</b>	<b>11</b>
3.1 SRAP & IGS-to-SRAP VLD.....	11
3.2 ISGS VLD.....	17
<b>4 VLD safety Results.....</b>	<b>42</b>
4.1 Suitability of the SESAR solution(s) for deployment .....	42
4.2 Safety impact of the VLD on current operations.....	88
<b>5 References .....</b>	<b>89</b>

## List of Tables

Table 1 List of Validation Activities for VLD1.....	9
Table 2 Safety Requirements applicable to Twente SRAP Trial .....	14
Table 3 Safety Requirements applicable to Twente IGS-to-SRAP Trial .....	16
Table 4 Safety Assumptions applicable to Twente Trial.....	17
Table 5 Safety Requirements applicable to Frankfurt ISGS Trial.....	24
Table 6 Safety Requirements applicable to Ciampino ISGS Trial .....	30
Table 7 Safety Assumptions applicable to Ciampino ISGS Trial .....	31
Table 8 Ciampino Local Safety Assessment Assumptions .....	33
Table 9 Ciampino Local Safety Assessment Requirements .....	33
Table 10 Safety Requirements applicable to Twente ISGS Trial .....	41

## List of Figures

Figure 1 Overall Safety Argument for Twente SRAP Trial .....	11
--	----

Figure 2 Sub-argument 1 for Twente SRAP Trial .....	12
Figure 3 Sub-argument 2 for Twente SRAP Trial .....	17
Figure 4 Overall Safety Argument for Frankfurt ISGS Trial.....	18
Figure 5 Sub-argument 1 for Frankfurt ISGS Trial .....	18
Figure 6 Sub-argument 2 for Frankfurt ISGS Trial .....	19
Figure 7 Overall Safety Argument for Ciampino ISGS Trial .....	24
Figure 8 Sub-argument 1 for Ciampino ISGS Trial .....	25
Figure 9 Sub-argument 2 for Ciampino ISGS Trial .....	31
Figure 10 Overall Safety Argument for Twente ISGS Trial .....	34
Figure 11 Sub-argument 1 for Twente ISGS Trial .....	35
Figure 12 Sub-argument 2 for Ciampino ISGS Trial .....	41

# 1 Executive Summary

---

This document provides a summary of the VLD safety assurance activities conducted in accordance with the DEMO Plan Part II (Safety Plan), including the VLD safety demonstration with regards to the suitability of the SESAR Solution for the deployment and the safety acceptability of the VLD impact on current operations.

## 2 Introduction<sup>1</sup>

The VLD1-W2 DREAMS project focuses on the Enhanced Arrival Procedures (EAP) solutions supported by advanced GNSS navigation technologies (GBAS / SBAS). The aim of VLD1 is to progress the solution maturity and to demonstrate its feasibility in the operational environment and ultimately support solution industrialisation and (pre)deployment.

The VLD1-W2 DREAMS project covers the following SESAR Solutions:

- Second Runway Aiming Point (SRAP) – PJ02-W2-14.2
- Increased Second Glide Slope (ISGS) – PJ02-W2-14.3
- Increased Glide Slope to Second Runway Aiming Point (IGS-to- SRAP) – PJ02-W2-14.5

The objectives of the project are to:

- Enable airborne and ground sub-systems to support the implementation of ISGS, SRAP and IGS-to-SRAP operations;
- Enable and improve GNSS deployment around Europe by the introduction of GBAS CAT II/III implementation;
- Demonstrate operational feasibility into real environments (providing interoperability with standard operations) and measuring Key Performance Indicators (KPIs);
- Disseminate and communicate on results and performance benefits of the demonstration exercises.

Validation activities will be conducted on several airports, at different geographical locations. The following table offers a summary of the environmental characteristics.

EAP	Airport	Enabler	Aircraft	Type	Number of approaches
<b>ISGS</b>	Ciampino	SBAS RAIM	ENAV P180 FI DAV Falcon 7/8X HNW Embraer 170-100LR	Flight Inspection pilots  Test pilots	~62

<sup>1</sup> For Acronyms and Glossary of terms see DEMOR -Part I



<b>ISGS</b>	Frankfurt	GBAS GAST-C	Airbus family Boeing B748 (backup) Boeing B777x (backup)	Commercial pilots	~50
<b>SRAP</b>	Twente	GBAS GAST-D (temporary installation)	NLR - Cessna Citation II	Test pilots	07 experiment approaches in total;  18 SRAP, 22 IGS-to-SRAP 3.5 deg, 23 IGS-to-SRAP 4.0 deg, 19 IGS-to-SRAP 4.49 deg, 25 conventional
<b>IGS-to-SRAP</b>	Twente	GAST-D (temporary installation)	NLR Cessna Citation II	Test pilots	
<b>ISGS</b>	Twente	SBAS	NLR Cessna Citation II	Test pilots	~150 planned

**Table 1 List of Validation Activities for VLD1**

For more detailed information please see DEMOP/DEMOR Part I.

More specifically, the Demonstration Objectives of each of the Trial are summarised in the next sub-sections.

## 2.1 Twente SRAP, IGS-to-SRAP Demo (EXE-001)

1. Published SRAP and IGS-to-SRAP approaches and corresponding charts (for trial purpose) enable a safe final approach phase of flight;
2. SRAP markings enable a safe landing for both SRAP and IGS-to-SRAP operations;
3. Second PAPI enables a safe landing for both SRAP and IGS-to-SRAP operations.

## 2.2 Frankfurt ISGS Demo (EXE-002)

1. Published ISGS approaches and corresponding charts (for trial purpose) enable a safe final approach phase of flight;

2. The absence of a 2<sup>nd</sup> PAPI OR the discrepancy between available PAPI and the ISGS glide path angle allows a safe landing.

## **2.3 Ciampino ISGS Demo (EXE-003)**

1. ISGS approaches and corresponding charts (for trial purpose) enable a safe final approach phase of flight;
2. The available PAPI guidance and the glide path angle allow for a safe landing at Ciampino airport.
3. Demonstrate operational feasibility into real environment and measuring Key Performance Indicators (KPIs).

## **2.4 Twente ISGS Demo (EXE-004)**

1. Published ISGS approaches and corresponding charts (for trial purpose) enable a safe final approach phase of flight;
2. Second PAPI enables a safe landing for ISGS operations.

## 3 VLD safety argument and assurance activities

The main objective of the safety demonstration is to show that the VLD1 operations, taking into account both participating and non-participating flights, are acceptably safe. The next subsections show the more detailed safety argument for each one of the Trial exercises.

### 3.1 SRAP & IGS-to-SRAP VLD

SRAP and IGS-to-SRAP solutions were demonstrated in Twente test environment. The following sections describe the safety arguments and assurance activities for the SRAP and IGS-to-SRAP solutions. More details about the scope of the assessment at safety level are provided in DEMOP Part II.

#### 3.1.1 Twente SRAP, IGS-to-SRAP VLD

The following safety argument has been developed for the Twente SRAP Trial:

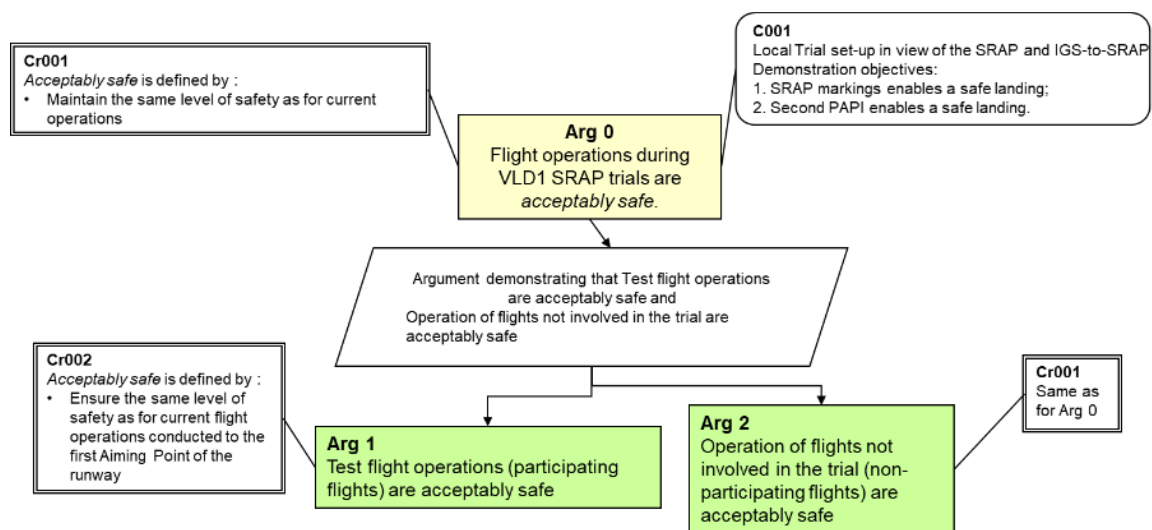


Figure 1 Overall Safety Argument for Twente SRAP Trial

Sub-arguments 1 and 2 are further developed into:

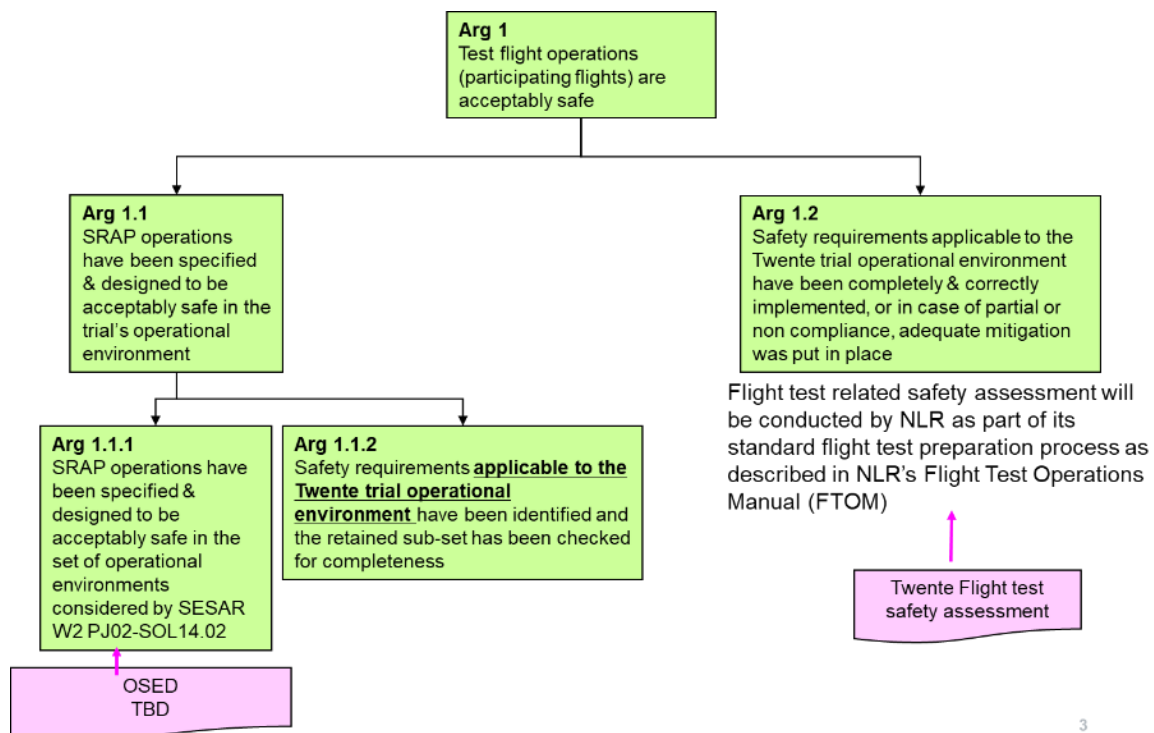


Figure 2 Sub-argument 1 for Twente SRAP Trial

Note that for Argument 1.1 in Figure 2, the safety assessment will make extensive use of the outcomes from SESAR Wave 1 Enhanced Arrival Procedures (EAP) Safety Assessment Report (SAR) and SPR-INTEROP/OSD Part I. Using the outcomes of these two documents, Table 2 has been filled with the relevant SESAR Safety requirements applicable in principle to the Twente SRAP trial and which have to be implemented in order to ensure the required level of safety performance. As per “Argument 1.2”, in case of partial or full non-compliance, adequate mitigations (or acceptably safe work-around solutions or alleviated constraints) have to be put in place.

ID	Requirement text	Mitigation
REQ-14.2-SPRINTEROP-CTL.1001	Approach Supervision shall decide when a published SRAP becomes active/inactive for operations, considering the conditions for application are and remain met: 1. No operational ATC & weather limitations 2. Necessary navigation guidance means are serviceable	No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.  Trial conditions and awareness of participating aircraft known before the start of the approach.
REQ-14.2-SPRINTEROP-CTL.1101	Information about a published SRAP being active to a given runway QFU shall be available to Flight deck in	Awareness of trial conditions and airport / runway environment by participating

	order to prepare expected approach briefing (e.g. via ATIS)	aircraft / Flight Crews known before the start of the approach
REQ-14.2-SPRINTEROP-CTL.1201	The SRAP approach chart shall be specific to one final approach path (i.e. touchdown aiming point) and supporting navigation guidance mean. The position and colour of the associated PAPI shall be indicated on the chart.	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (SRAP 3.0° ) will be issued and available to participating aircraft / Flight Crews
REQ-14.2-SPRINTEROP-CTL.1208	The SRAP approach chart shall include altitude/distance information for the applicable runway aiming point to facilitate Flight Deck procedure check during the approach	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (SRAP 3.0° ) will be issued and available to participating aircraft / Flight Crews
REQ-14.2-SPRINTEROP-CTL.1209	When designing the SRAP local procedure and the location of the second threshold and aiming point, the current and future taxiway layout of the aerodrome shall be taken into consideration for facilitating runway vacation	Not possible at EHTW due to the limited taxiway system. There is no RWY occupancy pressure for those test a/c which will landing (e.g. test a/c are free to back-track if needed).
REQ-14.2-SPRINTEROP-CTL.1210	When designing the SRAP local procedure, the location of the second runway aiming point shall provide sufficient landing distance available for all eligible aircraft at that specific airport	For all participating aircraft during the tests at Twente, the required runway length was always within the available landing distance, even in cases where only go arounds were planned.
REQ-14.2-SPRINTEROP-APT.1301	Flight Deck shall be supported by appropriate approach and landing visual aids to acquire the references for determining if approach and landing can be continued below CAT I decision height.	SRAP is supported by runway markings and dedicated PAPI and threshold number. No Approach Lighting System (ALS) will be available, however the approaches will be conducted in VMC conditions and not down to CAT I minima
REQ-14.2-SPRINTEROP-APT.1302	In case of SRAP, Flight Deck shall be able to clearly distinguish between each threshold and aiming point and be supported by appropriate landing visual aid references (e.g. location and	SRAP is supported by runway markings and dedicated PAPI and threshold number.

	identification of the second runway threshold and aiming point, a second PAPI).	
REQ-14.2-SPRINTEROP-ACFT.2101	Before contacting APP Control, Flight Deck shall assess the feasibility of the probable SRAP operation under the expected flight and weather conditions	Trial conditions and awareness of participating aircraft known before the start of the approach.
REQ-14.2-SPRINTEROP-ACFT.2103	Flight Deck shall recall during approach briefing the specific visual references (runway marking and lighting, VASI/PAPI, etc) that are expected in SRAP operation.	Part of the trial Flight Deck operating procedure
REQ-14.2-SPRINTEROP-ACFT.2104	Flight Deck shall recall during approach briefing the reduced landing distance available from the second aiming point to the expected runway exit in SRAP operation	Part of the trial Flight Deck operating procedure
REQ-14.2-SPRINTEROP-ACFT.2105	Flight Deck shall be able to fly a SRAP operation in both manual and AP/FD modes	Supported by flight control modes
REQ-14.2-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly a SRAP operation in a similar way (HMI, SOP, etc.) as when an approach with single aiming point is flown	Trial flights will be flown based on SOPs

**Table 2 Safety Requirements applicable to Twente SRAP Trial**

The table below has been filled with the relevant SESAR Safety requirements applicable in principle to the Twente IGS-to-SRAP trial.

ID	Requirement text	Mitigation
REQ-14.2-SPRINTEROP-CTL.1001	<p>Approach Supervision shall decide when a published IGS-to-SRAP becomes active/inactive for operations, considering the conditions for application are and remain met:</p> <ol style="list-style-type: none"> <li>1. No operational ATC &amp; weather limitations</li> <li>2. Necessary navigation guidance means are serviceable</li> </ol>	<p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.</p> <p>Trial conditions and awareness of participating aircraft known before the start of the approach.</p>

REQ-14.2-SPRINTEROP-CTL.1101	Information about a published IGS-to-SRAP being active to a given runway QFU shall be available to Flight deck in order to prepare expected approach briefing (e.g. via ATIS)	Awareness of trial conditions and airport / runway environment by participating aircraft / Flight Crews known before the start of the approach
REQ-14.2-SPRINTEROP-CTL.1201	The IGS-to-SRAP approach chart shall be specific to one final approach path (i.e. touchdown aiming point) and supporting navigation guidance mean. The position and colour of the associated PAPI shall be indicated on the chart.	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (4.49°/4.0°/3.5°) will be issued and available to participating aircraft / Flight Crews
REQ-14.2-SPRINTEROP-CTL.1211	The IGS-to-SRAP approach chart shall include altitude/distance information for the applicable runway aiming point to facilitate Flight Deck procedure check during the approach	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (4.49°/4.0°/3.5°) will be issued and available to participating aircraft / Flight Crews
REQ-14.2-SPRINTEROP-CTL.1208	When designing the IGS-to-SRAP local procedure and the location of the second threshold and aiming point, the current and future taxiway layout of the aerodrome shall be taken into consideration for facilitating runway vacation	Not possible at EHTW due to the limited taxiway system. There is no RWY occupancy pressure for those test a/c which will landing (e.g. test a/c are free to back-track if needed).
REQ-14.2-SPRINTEROP-CTL.1213	When designing the IGS-to-SRAP local procedure, the location of the second runway aiming point shall provide sufficient landing distance available for all eligible aircraft at that specific airport	For all participating aircraft during the tests at Twente, the required runway length was always within the available landing distance, even in cases where only go arounds were planned.
REQ-14.2-SPRINTEROP-APT.1301	Flight Deck shall be supported by appropriate approach and landing visual aids to acquire the references for determining if approach and landing can be continued below CAT I decision height.	IGS-to-SRAP is supported by runway markings and dedicated PAPI and threshold number. No Approach Lighting System (ALS) will be available, however the approaches will be conducted in VMC conditions and not down to CAT I minima

REQ-14.2-SPRINTEROP-APT.1302	In case of IGS-to-SRAP, Flight Deck shall be able to clearly distinguish between each threshold and aiming point and be supported by appropriate landing visual aid references (e.g. location and identification of the second runway threshold and aiming point, a second PAPI).	IGS-to-SRAP is supported by runway markings and dedicated PAPI and threshold number.
REQ-14.2-SPRINTEROP-ACFT.2108	Before contacting APP Control, Flight Deck shall assess the feasibility of the probable IGS-to-SRAP operation under the expected flight and weather conditions	Trial conditions and awareness of participating aircraft known before the start of the approach.
REQ-14.2-SPRINTEROP-ACFT.2104	Flight Deck shall recall during approach briefing the specific visual references (runway marking and lighting, VASI/PAPI, etc) that are expected in IGS-to-SRAP operation.	Part of the trial Flight Deck operating procedure
REQ-14.2-SPRINTEROP-ACFT.2105	Flight Deck shall recall during approach briefing the reduced landing distance available from the second aiming point to the expected runway exit in IGS-to-SRAP operation	Part of the trial Flight Deck operating procedure
REQ-14.2-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly a IGS-to-SRAP operation in both manual and AP/FD modes	Supported by flight control modes
REQ-14.2-SPRINTEROP-ACFT.2107	Flight Deck shall be able to fly a IGS-to-SRAP operation in a similar way (HMI, SOP, etc.) as when an approach with single aiming point is flown	Trial flights will be flown based on SOPs

**Table 3 Safety Requirements applicable to Twente IGS-to-SRAP Trial**

To be noted that, in solutions PJ.02-W2-14.2, 14.3 and 14.5, safety requirements have only been derived if a change was introduced by the concepts and if there was a safety need. Where there was no change introduced by the concepts, it was assumed that the current operations apply. These assumptions shall also be taken forward in the Trial in order to try and validate/confirm (or otherwise) them in a live environment (but where the constraints are alleviated compared to the real operational environment, in order to mitigate the risk associated to the partially validated assumptions or safety requirements). Based on the SESAR Wave 1 PJ02-and SPR-INTEROP/OSD Part I, the assumption in Table 4 was found to be relevant to the Twente Trial.

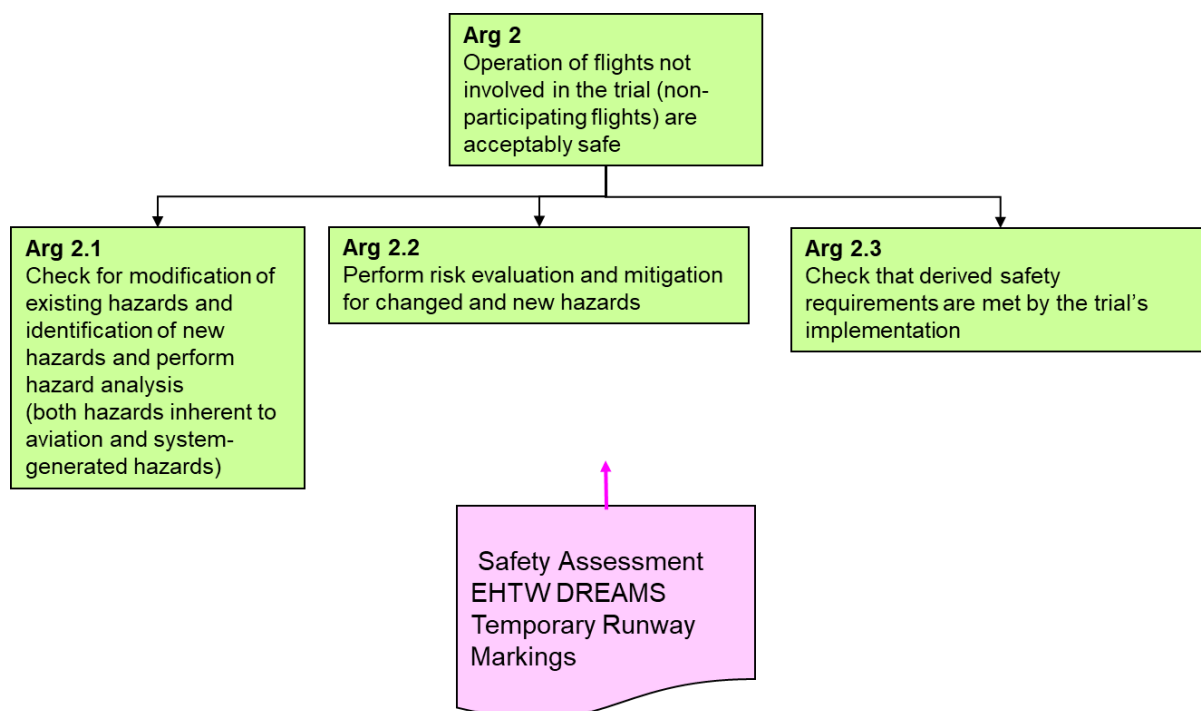
### Assumptions



It is assumed that the Aerodrome Operator will verify that in case of a closed approach associated to a specific runway aiming point, the associated navigation aid:

- does not transmit the FAS Data Block, for approaches using GBAS
- is not active, for approaches using ILS

**Table 4 Safety Assumptions applicable to Twente Trial**



To provide traceability between the Twente risk mitigations (regarding impact on flights not involved in the trials) and the SESAR safety requirements, where relevant

4

**Figure 3 Sub-argument 2 for Twente SRAP Trial**

Note that for Argument 1.1.2, 1.2 (both in Figure 2) and Argument 2 (in Figure 3), a local safety assessment has to be done.

## 3.2 ISGS VLD

ISGS solution were demonstrated in Frankfurt, Ciampino and Twente test environment. The following sections describe the safety arguments and assurance activities for the ISGS solutions. More details about the scope of the assessment at safety level are provided in DEMOP Part II.

### 3.2.1 Frankfurt ISGS VLD

The following safety argument has been developed for the Frankfurt ISGS Trial:

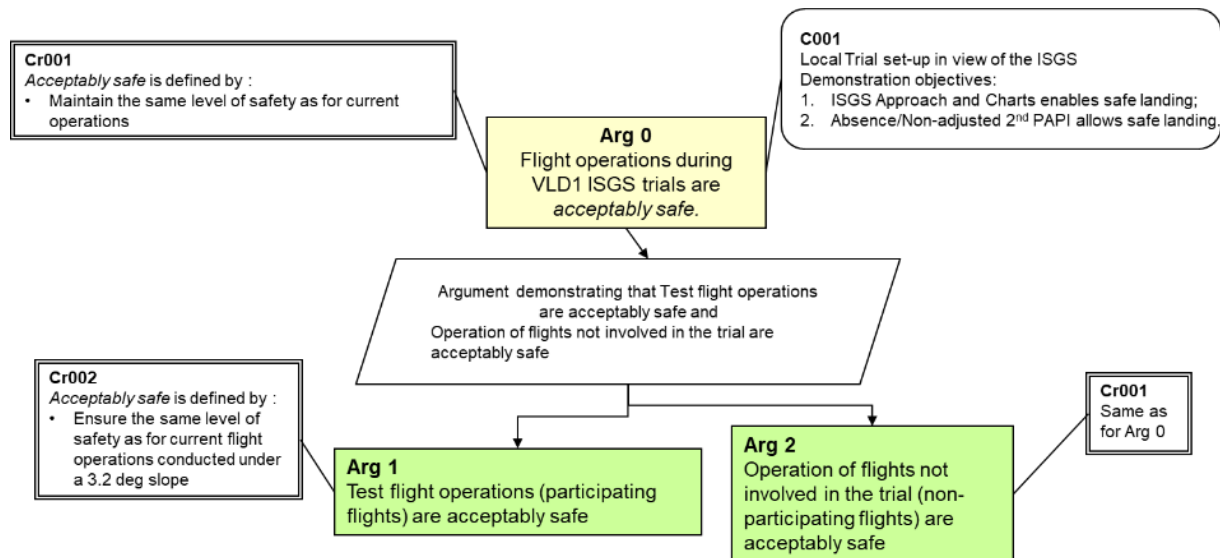


Figure 4 Overall Safety Argument for Frankfurt ISGS Trial

Sub-arguments 1 and 2 are further developed into:

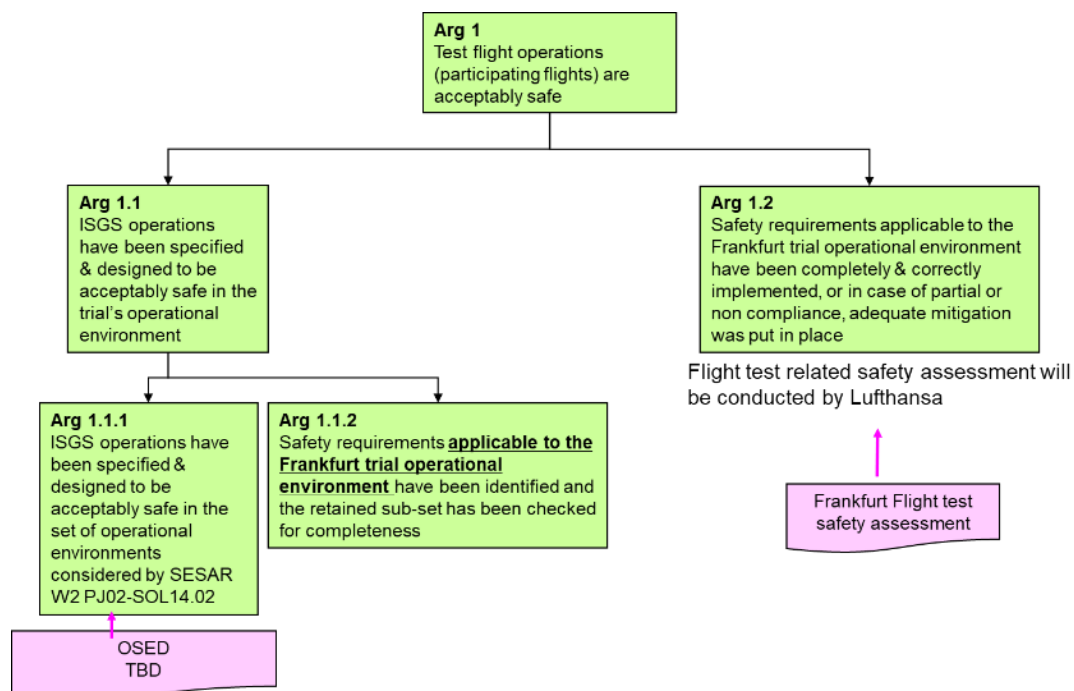


Figure 5 Sub-argument 1 for Frankfurt ISGS Trial

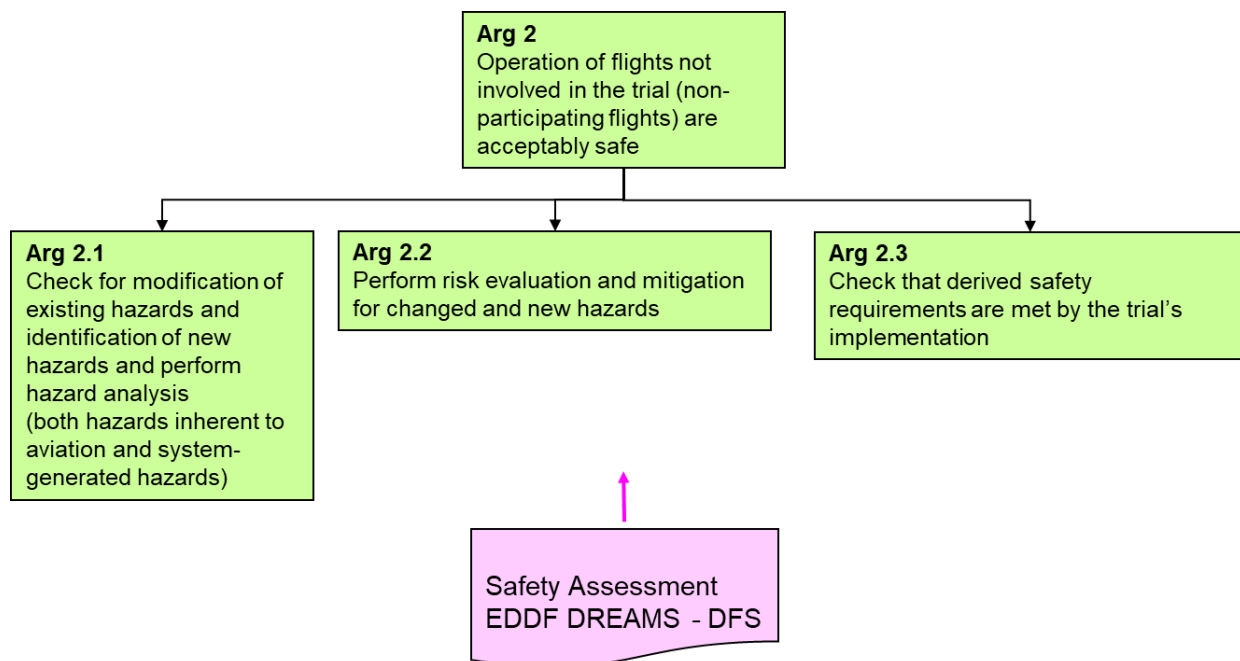


Figure 6 Sub-argument 2 for Frankfurt ISGS Trial

Note that for Argument 1.1.2, 1.2 (both in Figure 8) and Argument 2 (in Figure 9), a local safety assessment has to be done.

Table 6 has been filled with the relevant SESAR Safety requirements applicable in principle to the Frankfurt ISGS trial in view of ensuring the required level of safety performance. As per “Argument 1.2”, in case of partial or full non-compliance, adequate mitigations (or acceptably safe work-around solutions or alleviated constraints) have to be put in place.

ID	Requirement text	Mitigation
REQ-14.3-SPRINTEROP-CTL.1001	<p>Approach Supervision shall decide when a published ISGS becomes active/inactive for operations, considering the conditions for application are and remain met:</p> <ol style="list-style-type: none"> <li>1. No operational ATC &amp; weather limitations</li> <li>2. necessary navigation guidance means are serviceable</li> </ol>	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-CTL.1004	Approach / Tower Supervision shall inform the Approach / Tower Control about the list of active approach procedures	Trial conditions are known before the start of the approach.

REQ-14.3-SPRINTEROP-CTL.1006	At first call from an incoming traffic with APPROACH, Approach Executive Control shall provide an information to the arrival aircraft about the expected approach procedure, taking in account the traffic eligibility to ISGS, local working methods for traffic assignment (e.g. Heavies left on conventional approach), and using related standard phraseology (e.g. BLUEBIRD 123, Expect GLS Z approach runway 28L)	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-CTL.1008	After an aircraft has been cleared to intercept the final approach, if Flight Deck informs ATC that they are no longer able to fly the expected approach (ISGS), Approach Executive Control shall instruct a go-around	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1009	After Flight Deck has been informed of an expected approach procedure, if a change is needed from ATC, Approach Executive Control shall consider the time needed for the Flight Deck to re-configure for the new approach procedure, shall inform Flight Deck at the earliest opportunity and with sufficient time before instructing final approach axis interception (special consideration should be given to the transition from ILS/GLS to RNP APCH which is demanding and time consuming for the pilot)	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM. Therefore, there will be no operational need for the ATCO to change the procedure flown by the test aircraft during the trial.
REQ-14.3-SPRINTEROP-CTL.1010	Applicable Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control, when controllers are supported by a separation tool.	Current procedures apply in case of navigation guidance failure.  No tool needed by the ATCO to separate the test aircraft to aircraft non-participating to the trial.
REQ-14.3-SPRINTEROP-CTL.1011	Applicable Standard and Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control.	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with

		an increased spacing of 10/15 NM.
REQ-14.3-SPRINTEROP-CTL.1013	At each transfer on frequency, when contacting the next ATC unit, the Flight Deck shall indicate the expected or cleared approach procedure	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1014	<p>Approach Executive Control shall consider, when establishing and maintaining separation, that aircraft ability to respect ATC speed instructions may be limited during ISGS operations, especially for slope angles above 3.5 degrees, and aircraft's speed might need to be reduced earlier compared to standard approach.</p> <p>Note: the higher the slope angle the longer it takes for the aircraft to decelerate. However, this should not be a problem with slopes under 3.5 degrees.</p>	Test aircraft will be equipped with an Energy Management Function.
REQ-14.3-SPRINTEROP-CTL.1015	Approach Executive Control shall vector the aircraft onto ISGS approach such as to avoid final approach interception from above	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1101	Information about a published ISGS 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)	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-CTL.1109	Approach Executive Control shall be alerted when an aircraft is not complying / deviating from the assigned published final approach profile.	No such alert needed during the trial. In case of a deviation, the 10/15 NM spacing mitigates the impact on the leader or the follower aircraft.
REQ-14.3-SPRINTEROP-CTL.1110	The need for displaying to the Controllers the interception points respective for each procedure shall be evaluated as part of the local deployment, such that the visual references are operationally relevant and unambiguously presented without	

	e.g. cluttering on the controller air surveillance display	
REQ-14.3-SPRINTEROP-CTL.1201	Flight Crew shall be informed about discrepancies from visual aid references when not specifically adapted to increased glideslope procedures.	Flight crew will be briefed about how to use the current PAPI (adapted for 3.5 deg) installed at Ciampino airport for the 3.9 deg slope and about the lack of PAPI for the 4.4 deg slope.
REQ-14.3-SPRINTEROP-CTL.1202	The ISGS approach chart shall follow the following elements: - be specific to one final approach path (i.e. angle) and supporting navigation guidance mean, - highlight the glide path angle in case it is significantly increased (e.g. more than 3.5), - indicate the position and color of the associated PAPI.	
REQ-14.3-SPRINTEROP-CTL.1203	ISGS shall be published approach procedures flown based on ILS or GLS or RNP APCH with vertical guidance	
REQ-14.3-SPRINTEROP-CTL.1204	This may allow to increase the usage of IGS, since the level of aircraft equipment may be limited for given navigation technologies, and a limited IGS use may be detrimental to capacity.	Only a single SBAS based ISGS procedure will be tested during the trial.
REQ-14.3-SPRINTEROP-CTL.1205	Approach Executive Control shall apply longitudinal wake turbulence distance-based separation minima for the following combinations:  o Leader and follower on same glideslope  o Leader upper glide - follower lower glide  o Leader lower glide - follower upper glide  when both aircraft are descending on their respective glide slope.	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.

REQ-14.3-SPRINTEROP-CTL.1207	Procedure design for ISGS operation shall use a glide path angle limited to 4.49°.	The glide path angles tested during the trial will be less than 4.49 deg (i.e. 3.9 deg and 4.4 deg).
REQ-14.3-SPRINTEROP-CTL.1208	<p>ISGS Approach separation minima shall be specified for each combination of published approach procedure with different glideslopes, taking into account the associated navigation means and corresponding vertical accuracy around the published profile, for</p> <ul style="list-style-type: none"> <li>o Leader and follower on same glideslope</li> <li>o Leader upper glide - follower lower glide</li> <li>o Leader lower glide - follower upper glide</li> </ul>	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.
REQ-14.3-SPRINTEROP-ACFT.2101	Flight Crew shall recall during approach briefing the possible differences in visual references (VASI/PAPI, runway aspect, etc) that are expected in ISGS operation	Taken as it is as a procedure during the trial.
REQ-14.3-SPRINTEROP-ACFT.2102	Flight Deck shall be able to decelerate the aircraft during final approach, even under flight conditions that reduce deceleration capability (e.g. anti-ice system ON)	
REQ-14.3-SPRINTEROP-ACFT.2103	Flight Deck shall be able to execute flare during ISGS operations without increasing the risk of hard landing or long landing	If needed, test aircraft will be equipped with flare management assistant.
REQ-14.3-SPRINTEROP-ACFT.2104	Upon initiating the approach briefing, in case the aircraft is eligible for the ISGS approach (possible from ATC point of view and taking into account aircraft capabilities) and the ATIS informs that the ISGS approach is active, the Flight Deck shall assess the feasibility of the ISGS operation under	Trial conditions are known before the start of the approach.

	the expected flight and weather conditions.	
REQ-14.3-SPRINTEROP-ACFT.2105	Upon cleared for ISGS Approach, Flight Deck shall confirm the feasibility of the instructed ISGS operation under the actual flight and weather conditions	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly an ISGS operation in both manual and AP/FD modes	
REQ-14.3-SPRINTEROP-ACFT.2107	Flight Deck shall be able to fly an ISGS operation in a similar way (IHM, SOP, etc) as when an approach with standard slope is flown	

Table 5 Safety Requirements applicable to Frankfurt ISGS Trial

### 3.2.2 Ciampino ISGS VLD

The following safety argument has been developed for the Ciampino ISGS Trial:

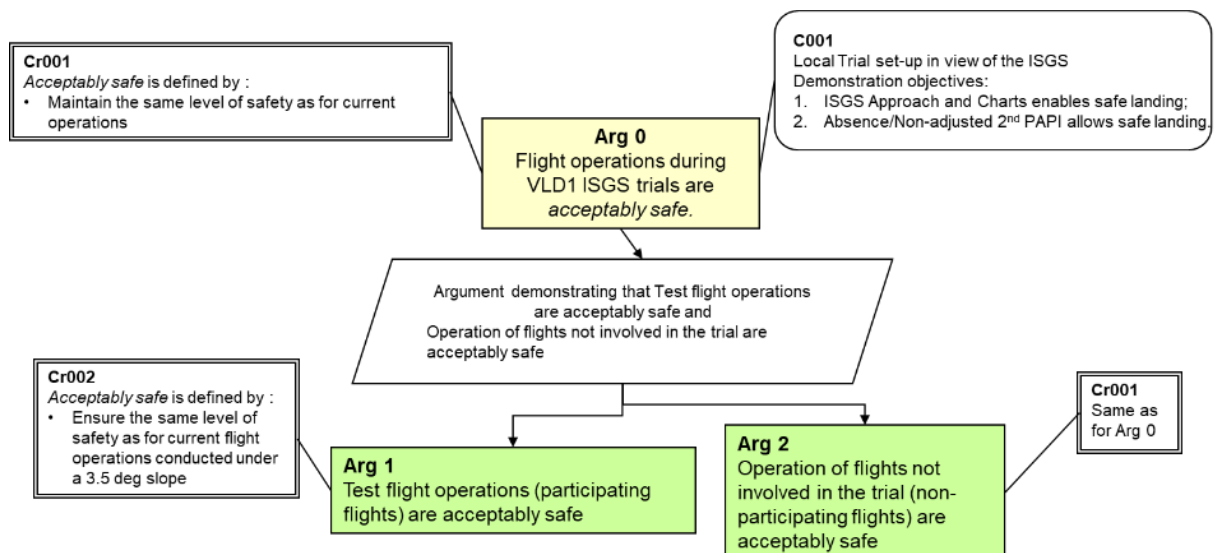
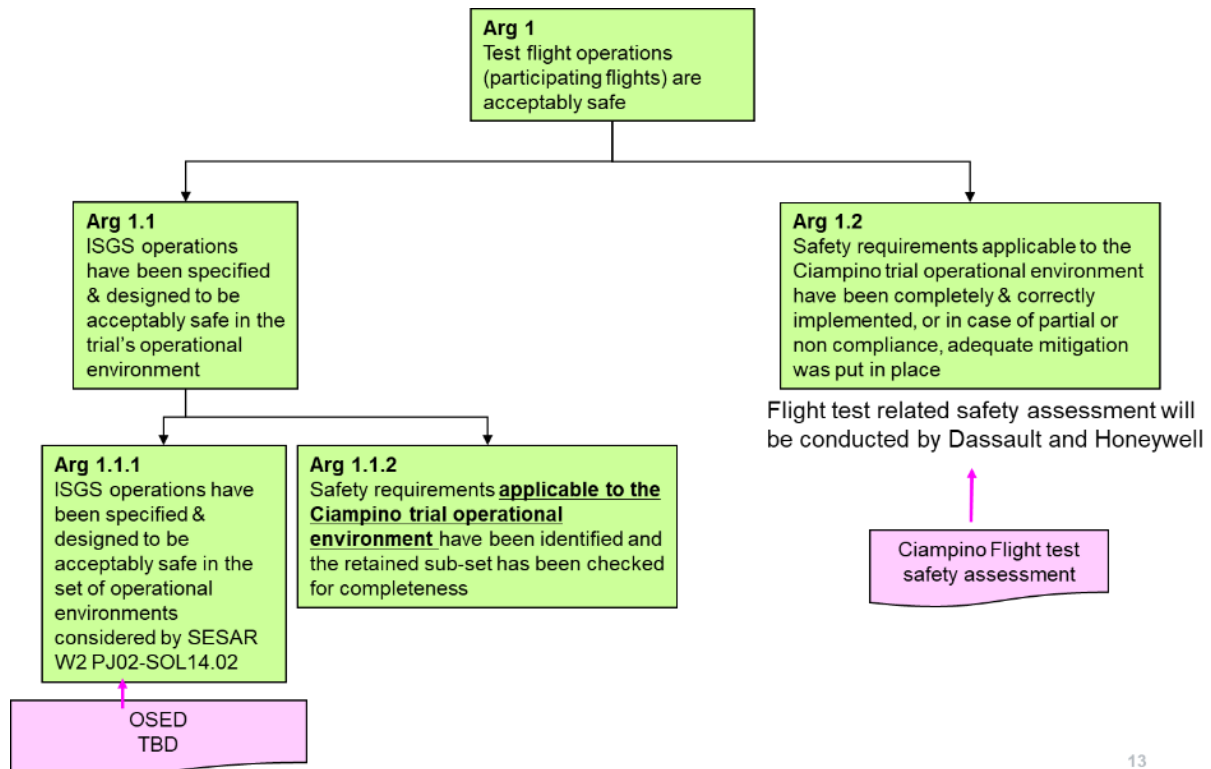


Figure 7 Overall Safety Argument for Ciampino ISGS Trial



Sub-arguments 1 and 2 are further developed into:



13

Figure 8 Sub-argument 1 for Ciampino ISGS Trial

Note that for Argument 1.1 in Figure 8, the safety assessment will make extensive use of the outcomes from SESAR Wave 1 Enhanced Arrival Procedures (EAP) Safety Assessment Report (SAR) and SPR-INTEROP/OSED Part I. Using the outcomes of these two documents, Table 6 has been filled with the relevant SESAR Safety requirements applicable in principle to the Ciampino ISGS trial and which have to be implemented in order to ensure the required level of safety performance. As per “Argument 1.2”, in case of partial or full non-compliance, adequate mitigations (or acceptably safe work-around solutions or alleviated constraints) have to be put in place.

ID	Requirement text	Mitigation
REQ-14.3-SPRINTEROP-CTL.1001	<p>Approach Supervision shall decide when a published ISGS becomes active/inactive for operations, considering the conditions for application are and remain met:</p> <ol style="list-style-type: none"> <li>1. No operational ATC &amp; weather limitations</li> <li>2. necessary navigation guidance means are serviceable</li> </ol>	<p>Trial conditions and awareness of participating aircraft known before the start of the approach.</p> <p>At Frankfurt, the trial on GLS CAT II 3.2deg procedure will be performed under CAT I minimal weather conditions only.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.</p>

		Simulated ATC approach and landing clearances were provided in the test aircraft.
REQ-14.3-SPRINTEROP-CTL.1004	Approach / Tower Supervision shall inform the Approach / Tower Control about the list of active approach procedures	<p>Trial conditions are known before the start of the approach.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.</p>
REQ-14.3-SPRINTEROP-CTL.1006	At first call from an incoming traffic with APPROACH, Approach Executive Control shall provide an information to the arrival aircraft about the expected approach procedure, taking in account the traffic eligibility to ISGS, local working methods for traffic assignment (e.g. Heavies left on conventional approach), and using related standard phraseology (e.g. BLUEBIRD 123, Expect GLS Z approach runway 28L)	<p>Trial conditions are known before the start of the approach.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. Simulated ATC approach and landing clearances were provided in the test aircraft.</p>
REQ-14.3-SPRINTEROP-CTL.1008	After an aircraft has been cleared to intercept the final approach, if Flight Deck informs ATC that they are no longer able to fly the expected approach (ISGS), Approach Executive Control shall instruct a go-around	<p>Taken into account as a procedure in the trial.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. The test flight transition from IFR to VFR on approach and will then take their own decision.</p>
REQ-14.3-SPRINTEROP-CTL.1009	After Flight Deck has been informed of an expected approach procedure, if a change is needed from ATC, Approach Executive Control shall consider the time needed for the Flight Deck to re-configure for the new approach procedure, shall inform Flight Deck at the earliest opportunity and with sufficient time before instructing final approach axis interception (special consideration should be given to the transition from ILS/GLS to RNP APCH which is demanding and time consuming for the pilot)	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM. Therefore, there will be no operational need for the ATCO to change the procedure flown by the test aircraft during the trial.

REQ-14.3-SPRINTEROP-CTL.1010	Applicable Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control, when controllers are supported by a separation tool.	Current procedures apply in case of navigation guidance failure.  No tool needed by the ATCO to separate the test aircraft to aircraft non-participating to the trial.
REQ-14.3-SPRINTEROP-CTL.1011	Applicable Standard and Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control.	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.
REQ-14.3-SPRINTEROP-CTL.1013	At each transfer on frequency, when contacting the next ATC unit, the Flight Deck shall indicate the expected or cleared approach procedure	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1014	Approach Executive Control shall consider, when establishing and maintaining separation, that aircraft ability to respect ATC speed instructions may be limited during ISGS operations, especially for slope angles above 3.5 degrees, and aircraft's speed might need to be reduced earlier compared to standard approach.  Note: the higher the slope angle the longer it takes for the aircraft to decelerate. However, this should not be a problem with slopes under 3.5 degrees.	The GLS procedure to be flown by A320 family aircraft types (as used at Frankfurt) is up to 3.2deg, with no specific impact expected on ATC side.  Test aircraft at Ciampino will be equipped with an Energy Management Function.  No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. The participating aircraft is segregated for normal traffic.
REQ-14.3-SPRINTEROP-CTL.1015	Approach Executive Control shall vector the aircraft onto ISGS approach such as to avoid final approach interception from above	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1101	Information about a published ISGS being active to a given runway QFU shall be available to the Flight Deck in	Trial conditions are known before the start of the approach.

	order to prepare expected approach briefing (e.g. via ATIS)	
REQ-14.3-SPRINTEROP-CTL.1109	Approach Executive Control shall be alerted when an aircraft is not complying / deviating from the assigned published final approach profile.	No such alert needed during the trial as the ATC separation will not be affected. In case of a deviation, the 10/15 NM spacing mitigates the impact on the leader or the follower aircraft.
REQ-14.3-SPRINTEROP-CTL.1110	The need for displaying to the Controllers the interception points respective for each procedure shall be evaluated as part of the local deployment, such that the visual references are operationally relevant and unambiguously presented without e.g. cluttering on the controller air surveillance display	
REQ-14.3-SPRINTEROP-CTL.1201	Flight Crew shall be informed about discrepancies from visual aid references when not specifically adapted to increased glideslope procedures.	<p>At Frankfurt, as the slope will be up to 3.2deg, only one PAPI is used and tuned to serve both conventional 3.0deg and ISGS, like already in operations with GLS X RWY 25L/R CAT I approach.</p> <p>At Ciampino, Flight crew will be briefed about how to use the current PAPI (adapted for 3.5 deg) installed at Ciampino airport for the 3.9 deg slope and about the lack of PAPI for the 4.4 deg slope.</p>
REQ-14.3-SPRINTEROP-CTL.1202	<p>The ISGS approach chart shall follow the following elements:</p> <ul style="list-style-type: none"> <li>- be specific to one final approach path (i.e. angle) and supporting navigation guidance mean,</li> <li>- highlight the glide path angle in case it is significantly increased (e.g. more than 3.5),</li> <li>- indicate the position and color of the associated PAPI.</li> </ul>	

REQ-14.3-SPRINTEROP-CTL.1203	ISGS shall be published approach procedures flown based on ILS or GLS or RNP APCH with vertical guidance	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1204	This may allow to increase the usage of IGS, since the level of aircraft equipage may be limited for given navigation technologies, and a limited IGS use may be detrimental to capacity.	Only a single SBAS based ISGS procedure will be tested during the trial.
REQ-14.3-SPRINTEROP-CTL.1205	<p>Approach Executive Control shall apply longitudinal wake turbulence distance-based separation minima for the following combinations:</p> <ul style="list-style-type: none"> <li>o Leader and follower on same glideslope</li> <li>o Leader upper glide - follower lower glide</li> <li>o Leader lower glide - follower upper glide</li> </ul> <p>when both aircraft are descending on their respective glide slope.</p>	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.
REQ-14.3-SPRINTEROP-CTL.1207	Procedure design for ISGS operation shall use a glide path angle limited to 4.49°.	The glide path angles tested during the trial will be less than 4.49 deg (i.e. 3.9 deg and 4.4 deg).
REQ-14.3-SPRINTEROP-CTL.1208	<p>ISGS Approach separation minima shall be specified for each combination of published approach procedure with different glideslopes, taking into account the associated navigation means and corresponding vertical accuracy around the published profile, for</p> <ul style="list-style-type: none"> <li>o Leader and follower on same glideslope</li> <li>o Leader upper glide - follower lower glide</li> <li>o Leader lower glide - follower upper glide</li> </ul>	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.

REQ-14.3-SPRINTEROP-ACFT.2101	Flight Crew shall recall during approach briefing the possible differences in visual references (VASI/PAPI, runway aspect, etc) that are expected in ISGS operation	Taken as it is as a procedure during the trial.
REQ-14.3-SPRINTEROP-ACFT.2102	Flight Deck shall be able to decelerate the aircraft during final approach, even under flight conditions that reduce deceleration capability (e.g. anti-ice system ON)	
REQ-14.3-SPRINTEROP-ACFT.2103	Flight Deck shall be able to execute flare during ISGS operations without increasing the risk of hard landing or long landing	If needed, test aircraft will be equipped with flare management assistant.
REQ-14.3-SPRINTEROP-ACFT.2104	Upon initiating the approach briefing, in case the aircraft is eligible for the ISGS approach (possible from ATC point of view and taking into account aircraft capabilities) and the ATIS informs that the ISGS approach is active, the Flight Deck shall assess the feasibility of the ISGS operation under the expected flight and weather conditions.	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-ACFT.2105	Upon cleared for ISGS Approach, Flight Deck shall confirm the feasibility of the instructed ISGS operation under the actual flight and weather conditions	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly an ISGS operation in both manual and AP/FD modes	
REQ-14.3-SPRINTEROP-ACFT.2107	Flight Deck shall be able to fly an ISGS operation in a similar way (IHM, SOP, etc) as when an approach with standard slope is flown	

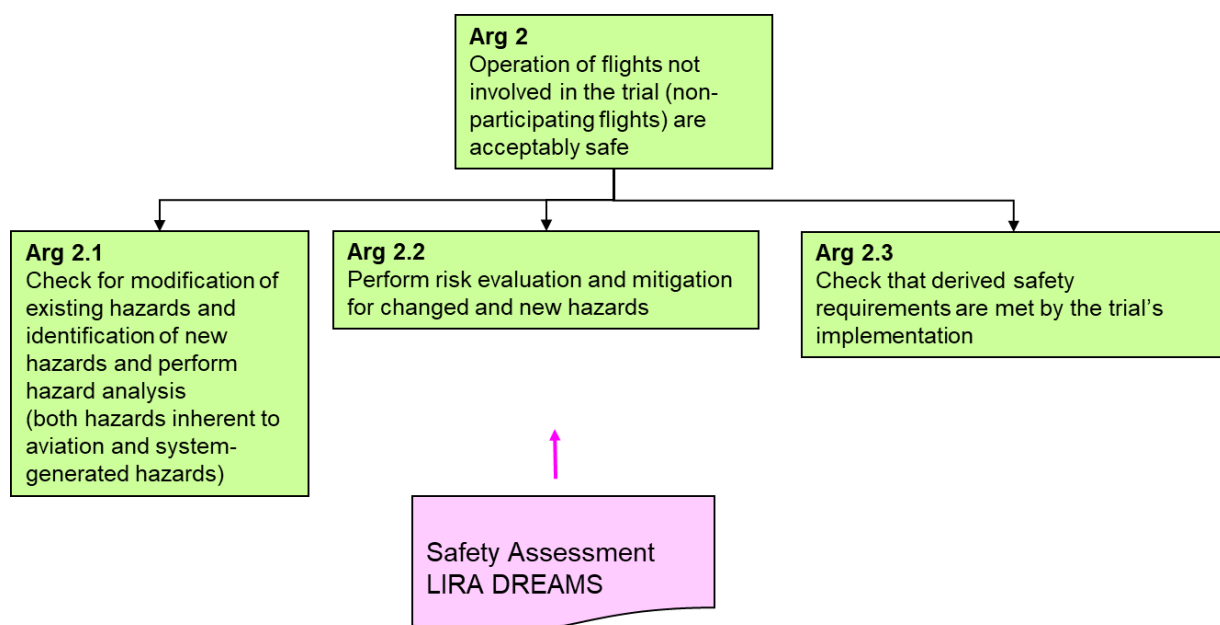
**Table 6 Safety Requirements applicable to Ciampino ISGS Trial**

To be noted that, in solution PJ.02-W2-14.3, safety requirements have only been derived if a change was introduced by the concept and if there was a safety need. Where there was no change introduced by the concepts, it was assumed that the current operations apply. These assumptions shall also be taken forward in the Trial in order to try and validate/confirm (or otherwise) them in a live environment

(but where the constraints are alleviated compared to the real operational environment, in order to mitigate the risk associated to the partially validated assumptions or safety requirements). Based on the SESAR Wave 1 PJ02-02 SAR and SPR-INTEROP/OSED Part, the assumption in Table 7 was found to be relevant to the Ciampino Trial.

Assumptions
<p>It is assumed that the Aerodrome Operator will verify that in case of a closed approach associated to a specific glide slope, the associated navigation aid:</p> <ul style="list-style-type: none"> <li>• does not transmit the FAS Data Block, for approaches using SBAS</li> <li>• is not active, for approaches using ILS</li> </ul>

**Table 7 Safety Assumptions applicable to Ciampino ISGS Trial**



**Figure 9 Sub-argument 2 for Ciampino ISGS Trial**

Note that for Argument 1.1.2, 1.2 (both in Figure 8) and Argument 2 (in Figure 9), a local safety assessment has to be done.

Local ATC related safety assessment is produced by ENAV and National Authority is notified about the trial as for the in place process; indeed there is a live coordination process initiated since the beginning of the flight trials preparation as a standard process of ENAV safety department, but regulatory approval is not required according to the applicable regulatory framework.

### 3.2.2.1 Ciampino ISGS VLD - Local Safety Assessment Abstract

This section embeds the Local Safety assessment abstract made for the ISGS trials scheduled at Ciampino airport.



The scope of this safety assessment exclusively considers the impact of these trials on the ATM functional system.



CIAMPINO-SAP.pdf

### Local Safety Assessment Assumptions

ID	Requirement text
AS-01	The procedures will not be published on AIP
AS-02	The procedures have been designed in accordance with QMS-P-AAND.1.1 Design of flight instrument procedures (IFP), airspace and routes ATS ver. 9.0 (out of scope)
AS-03	The procedures have been successfully assessed via Ground Validation in accordance with SGQ-P-AAND.1.1 Design of flight instrumental procedures (IFP), airspace and routes ATS ver. 9.0 (out of scope)
AS-04	The procedures have been successfully assessed via Flight Validation in accordance with SGQ-P-FIV.1.2 PLANNING AND EXECUTION OF FLIGHT ACTIVITIES (out of scope)
AS-05	The PAPI RWY 33 settings will not be modified in preparation of the TRIALS execution
AS-06	The minimum spacing between subsequent IFR traffic for RWY 33, as prescribed in IPI, will be maintained between flight trial aircraft and other IFR traffic: 15NM / 10NM in case of coordination between ACC Rome TNR / ARR sector and Ciampino TWR
AS-07	ROMA ATZ and CTR, where the procedures are defined, are classified as class D airspaces, with mandatory radio contact and ATC clearance
AS-08	The maximum separation for distance-based wake turbulence is 8NM. This distance is less onerous than the separation applied between subsequent IFR traffic (defined in AS-06).
AS-09	The Regulator has requested that the Trials need to be carried out during daylight hours (as specified by local ephemeris) and in VMC conditions (as reported in the meteorological bulletin in force at Ciampino airport).
AS-10	The airport radar service is available during trial execution
AS-11	Approach radar service is available during trial execution
AS-12	The procedures will be not included in Rome ACC radar maps or in the FDP



AS-13	During the trial, involved traffics will maintain the IFR flight status. They will therefore be provided with the applicable separations/spacing with respect to other traffic in accordance with the class of airspace concerned
-------	---

**Table 8 Ciampino Local Safety Assessment Assumptions****Local Safety Assessment Requirements**

ID	Requirement text
SR-01	A temporary Service order shall be issued to inform ROMA ACC and Ciampino TWR operational personnel about the management and operational procedures to be applied during the execution of the Flight Trials
SR-02	<p>The instrumental flight procedures:</p> <ul style="list-style-type: none"> <li>-RNP Z RWY 33</li> <li>-RNP Y RWY 33</li> <li>-RNP X RWY 33</li> </ul> <p>shall be available to ROMA ACC and Ciampino TWR operational personnel</p>
SR-03	The compatibility between the Trial flight procedures, the current VRPs in use at Ciampino airport and surrounding areas affected by the trial procedures shall be verified in order to handle VFR traffic in the CTR/ATZ.
SR-04	The compatibility between the Trial flight procedures and the ATS geography shall be verified
SR-05	<p>Flight Trials shall:</p> <ul style="list-style-type: none"> <li>- be planned in a time slot that minimizes the impact on normal operations (sector loads)</li> <li>- be carried out exclusively with RWY in use 33 (LIRA). If the weather conditions on the airport are such to require the use of runway 15 instead, the trials will be suspended</li> </ul>
SR-06	A NOTAM about the experimental activity shall be issued to inform the AUs
SR-07	The change management process with ADR must be activated to inform the airport operator about the Flight Trials

**Table 9 Ciampino Local Safety Assessment Requirements**

### 3.2.3 Twente ISGS VLD

The following safety argument has been developed for the Twente ISGS Trial:

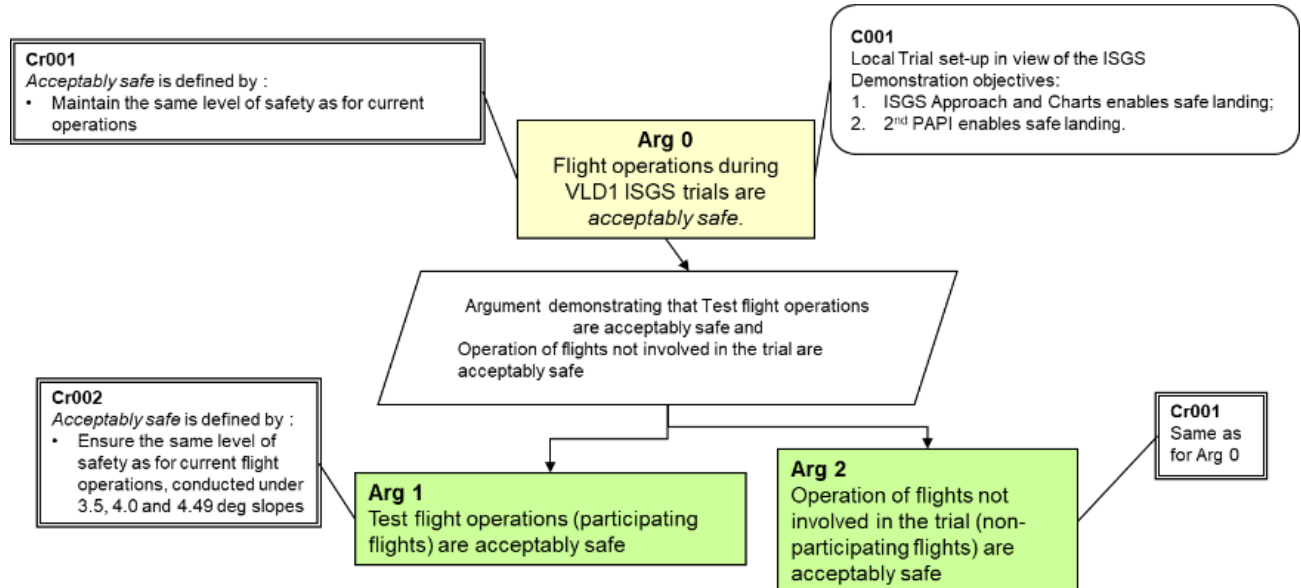
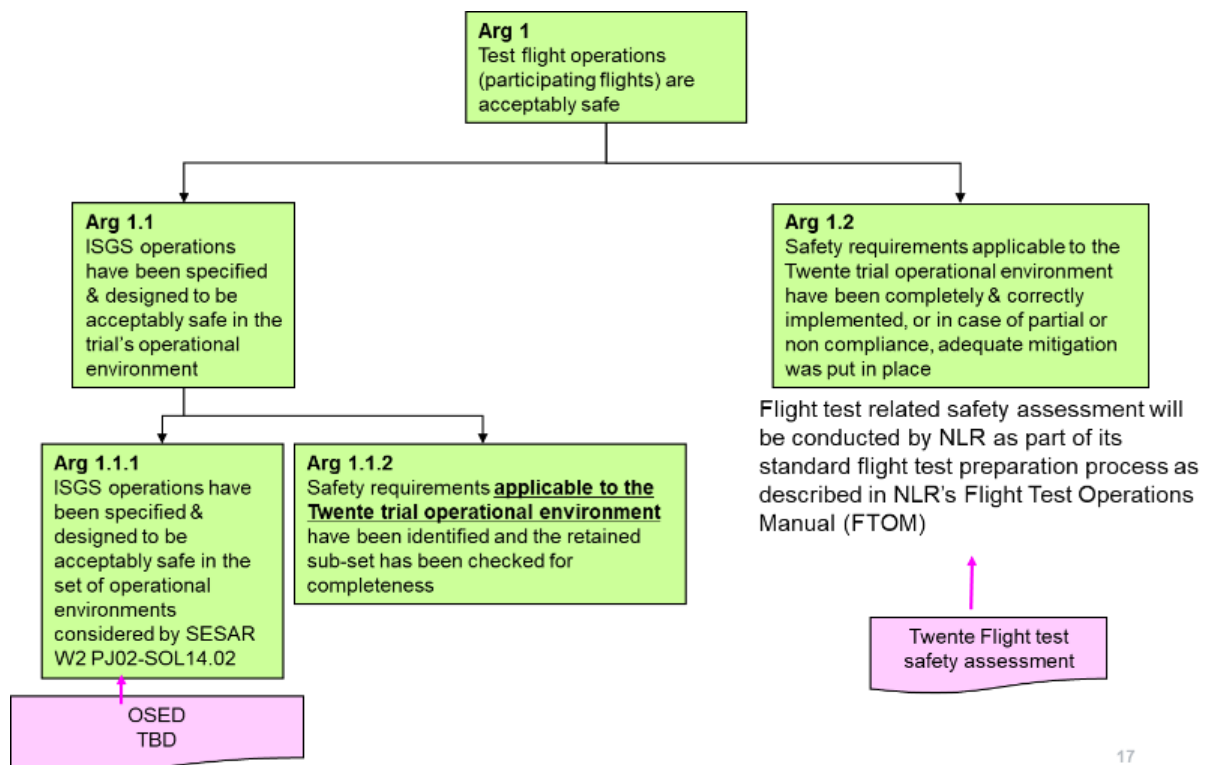


Figure 10 Overall Safety Argument for Twente ISGS Trial

Sub-arguments 1 and 2 are further developed into:



17

Figure 11 Sub-argument 1 for Twente ISGS Trial

Note that for Argument 1.1 in Figure 11, the safety assessment will make extensive use of the outcomes from SESAR Wave 1 Enhanced Arrival Procedures (EAP) Safety Assessment Report (SAR) and SPR-INTEROP/OSD Part I. Using the outcomes of these two documents, Table 10 has been filled with the relevant SESAR Safety requirements applicable in principle to the Twente SRAP trial and which have to be implemented in order to ensure the required level of safety performance. As per “Argument 1.2”, in case of partial or full non-compliance, adequate mitigations (or acceptably safe work-around solutions or alleviated constraints) have to be put in place.

ID	Requirement text	Mitigation
REQ-14.3-SPRINTEROP-CTL.1001	<p>Approach Supervision shall decide when a published ISGS becomes active/inactive for operations, considering the conditions for application are and remain met:</p> <ol style="list-style-type: none"> <li>1. No operational ATC &amp; weather limitations</li> <li>2. necessary navigation guidance means are serviceable</li> </ol>	<p>Trial conditions and awareness of participating aircraft known before the start of the approach.</p> <p>At Frankfurt, the trial on GLS CAT II 3.2deg procedure will be performed under CAT I minimal weather conditions only.</p>

		No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. Simulated ATC approach and landing clearances were provided in the test aircraft.
REQ-14.3-SPRINTEROP-CTL.1004	Approach / Tower Supervision shall inform the Approach / Tower Control about the list of active approach procedures	<p>Trial conditions are known before the start of the approach.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.</p>
REQ-14.3-SPRINTEROP-CTL.1006	At first call from an incoming traffic with APPROACH, Approach Executive Control shall provide an information to the arrival aircraft about the expected approach procedure, taking in account the traffic eligibility to ISGS, local working methods for traffic assignment (e.g. Heavies left on conventional approach), and using related standard phraseology (e.g. BLUEBIRD 123, Expect GLS Z approach runway 28L)	<p>Trial conditions are known before the start of the approach.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. Simulated ATC approach and landing clearances were provided in the test aircraft.</p>
REQ-14.3-SPRINTEROP-CTL.1008	After an aircraft has been cleared to intercept the final approach, if Flight Deck informs ATC that they are no longer able to fly the expected approach (ISGS), Approach Executive Control shall instruct a go-around	<p>Taken into account as a procedure in the trial.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. The test flight transition from IFR to VFR on approach and will then take their own decision.</p>
REQ-14.3-SPRINTEROP-CTL.1009	After Flight Deck has been informed of an expected approach procedure, if a change is needed from ATC, Approach Executive Control shall consider the time needed for the Flight Deck to re-configure for the new approach procedure, shall inform Flight Deck at the earliest opportunity and with sufficient time before instructing final approach axis interception (special consideration should be given to the transition from ILS/GLS to RNP APCH	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM. Therefore, there will be no operational need for the ATCO to change the procedure flown by the test aircraft during the trial.

	which is demanding and time consuming for the pilot)	
REQ-14.3-SPRINTEROP-CTL.1010	Applicable Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control, when controllers are supported by a separation tool.	Current procedures apply in case of navigation guidance failure.  No tool needed by the ATCO to separate the test aircraft to aircraft non-participating to the trial.
REQ-14.3-SPRINTEROP-CTL.1011	Applicable Standard and Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control.	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.
REQ-14.3-SPRINTEROP-CTL.1013	At each transfer on frequency, when contacting the next ATC unit, the Flight Deck shall indicate the expected or cleared approach procedure	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1014	<p>Approach Executive Control shall consider, when establishing and maintaining separation, that aircraft ability to respect ATC speed instructions may be limited during ISGS operations, especially for slope angles above 3.5 degrees, and aircraft's speed might need to be reduced earlier compared to standard approach.</p> <p>Note: the higher the slope angle the longer it takes for the aircraft to decelerate. However, this should not be a problem with slopes under 3.5 degrees.</p>	<p>The GLS procedure to be flown by A320 family aircraft types (as used at Frankfurt) is up to 3.2deg, with no specific impact expected on ATC side.</p> <p>Test aircraft at Ciampino will be equipped with an Energy Management Function.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. The participating aircraft is segregated for normal traffic.</p>
REQ-14.3-SPRINTEROP-CTL.1015	Approach Executive Control shall vector the aircraft onto ISGS approach such as to avoid final approach interception from above	Taken into account as a procedure in the trial.

REQ-14.3-SPRINTEROP-CTL.1101	Information about a published ISGS 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)	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-CTL.1109	Approach Executive Control shall be alerted when an aircraft is not complying / deviating from the assigned published final approach profile.	No such alert needed during the trial as the ATC separation will not be affected. In case of a deviation, the 10/15 NM spacing mitigates the impact on the leader or the follower aircraft.
REQ-14.3-SPRINTEROP-CTL.1110	The need for displaying to the Controllers the interception points respective for each procedure shall be evaluated as part of the local deployment, such that the visual references are operationally relevant and unambiguously presented without e.g. cluttering on the controller air surveillance display	
REQ-14.3-SPRINTEROP-CTL.1201	Flight Crew shall be informed about discrepancies from visual aid references when not specifically adapted to increased glideslope procedures.	<p>At Frankfurt, as the slope will be up to 3.2deg, only one PAPI is used and tuned to serve both conventional 3.0deg and ISGS, like already in operations with GLS X RWY 25L/R CAT I approach.</p> <p>At Ciampino, Flight crew will be briefed about how to use the current PAPI (adapted for 3.5 deg) installed at Ciampino airport for the 3.9 deg slope and about the lack of PAPI for the 4.4 deg slope.</p>
REQ-14.3-SPRINTEROP-CTL.1202	<p>The ISGS approach chart shall follow the following elements:</p> <ul style="list-style-type: none"> <li>- be specific to one final approach path (i.e. angle) and supporting navigation guidance mean,</li> <li>- highlight the glide path angle in case it is significantly increased (e.g. more than 3.5),</li> </ul>	

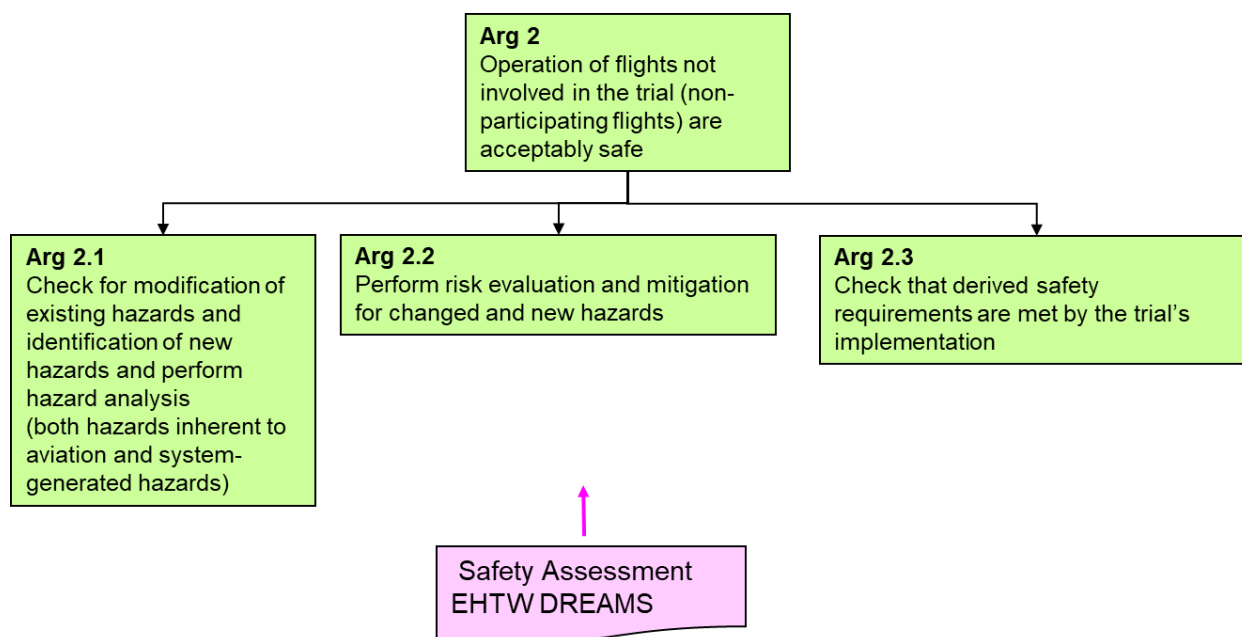
	- indicate the position and color of the associated PAPI.	
REQ-14.3-SPRINTEROP-CTL.1203	ISGS shall be published approach procedures flown based on ILS or GLS or RNP APCH with vertical guidance	Taken into account as a procedure in the trial.
REQ-14.3-SPRINTEROP-CTL.1204	This may allow to increase the usage of IGS, since the level of aircraft equipage may be limited for given navigation technologies, and a limited IGS use may be detrimental to capacity.	Only a single SBAS based ISGS procedure will be tested during the trial.
REQ-14.3-SPRINTEROP-CTL.1205	<p>Approach Executive Control shall apply longitudinal wake turbulence distance-based separation minima for the following combinations:</p> <ul style="list-style-type: none"> <li>o Leader and follower on same glideslope</li> <li>o Leader upper glide - follower lower glide</li> <li>o Leader lower glide - follower upper glide</li> </ul> <p>when both aircraft are descending on their respective glide slope.</p>	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.
REQ-14.3-SPRINTEROP-CTL.1207	Procedure design for ISGS operation shall use a glide path angle limited to 4.49°.	The glide path angles tested during the trial will be less than 4.49 deg (i.e. 3.9 deg and 4.4 deg).
REQ-14.3-SPRINTEROP-CTL.1208	ISGS Approach separation minima shall be specified for each combination of published approach procedure with different glideslopes, taking into account the associated navigation means and corresponding vertical	The test flights (trial participating flights) will be managed as single flights separated by other traffic (non-participating flights) with an increased spacing of 10/15 NM.

	<p>accuracy around the published profile, for</p> <ul style="list-style-type: none"> <li>o Leader and follower on same glideslope</li> <li>o Leader upper glide - follower lower glide</li> <li>o Leader lower glide - follower upper glide</li> </ul>	
REQ-14.3-SPRINTEROP-ACFT.2101	Flight Crew shall recall during approach briefing the possible differences in visual references (VASI/PAPI, runway aspect, etc) that are expected in ISGS operation	Taken as it is as a procedure during the trial.
REQ-14.3-SPRINTEROP-ACFT.2102	Flight Deck shall be able to decelerate the aircraft during final approach, even under flight conditions that reduce deceleration capability (e.g. anti-ice system ON)	
REQ-14.3-SPRINTEROP-ACFT.2103	Flight Deck shall be able to execute flare during ISGS operations without increasing the risk of hard landing or long landing	If needed, test aircraft will be equipped with flare management assistant.
REQ-14.3-SPRINTEROP-ACFT.2104	Upon initiating the approach briefing, in case the aircraft is eligible for the ISGS approach (possible from ATC point of view and taking into account aircraft capabilities) and the ATIS informs that the ISGS approach is active, the Flight Deck shall assess the feasibility of the ISGS operation under the expected flight and weather conditions.	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-ACFT.2105	Upon cleared for ISGS Approach, Flight Deck shall confirm the feasibility of the instructed ISGS operation under the actual flight and weather conditions	Trial conditions are known before the start of the approach.
REQ-14.3-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly an ISGS operation in both manual and AP/FD modes	



REQ-14.3-SPRINTEROP-ACFT.2107	Flight Deck shall be able to fly an ISGS operation in a similar way (IHM, SOP, etc) as when an approach with standard slope is flown
-------------------------------	--

**Table 10 Safety Requirements applicable to Twente ISGS Trial**



**Figure 12 Sub-argument 2 for Ciampino ISGS Trial**

Note that for Argument 1.1.2, 1.2 (both in Figure 11) and Argument 2 (in Figure 12), a local safety assessment has to be done.

## 4 VLD safety Results

### 4.1 Suitability of the SESAR solution(s) for deployment

#### 4.1.1 SRAP

##### 4.1.1.1 The demonstration objectives

##### 4.1.1.1.1 OBJ-14.2-V3-VALP-0203 SRAP impact on safety crew perspective

The objective was addressed in relation to:

- The SRAP additional runway markings impact under VMC on nominal threshold
  - the safety criteria were aimed at collecting evidences that the additional SRAP runway markings do not negatively impact normal approach procedures to nominal threshold from the perspective of the crew.
- The SRAP additional PAPI impact under VMC on nominal threshold
  - the safety criteria were aimed at collecting evidences that the additional SRAP PAPI does not negatively impact normal approach procedures to nominal threshold from the perspective of the crew
- The nominal runway markings and nominal PAPI impact
  - the safety criteria were aimed at collecting evidences that the nominal runway markings and nominal PAPI are sufficiently distinguishable from SRAP markings and PAPI in order not to result in unacceptable safety from the perspective of the crew

The Objectives and Criteria were addressed in Twente demonstration through subjective feedback of the pilots involved in the demonstration (see DEMOR for more details) collected through post run questionnaires and post exercise questionnaires. The criteria were all successfully met as the most of the involved pilots agreed that the:

- the PAPI indications were acceptable
- the runway markings were acceptable
- the level of safety of a landing would have been acceptable
- there was never confusion regarding which runway threshold and aiming point to use
- the simultaneous use of two PAPIs (one for each threshold) is acceptable
- the runway markings and PAPI for the SRAP approaches to RWY06 are clearly distinguishable from the markings and PAPI for the conventional approaches to RWY05
- landing and roll out on the conventional RWY05 are not, or would not have been, unacceptably influenced by the additional SRAP runway markings

- landing and roll out on the conventional RWY05 are not, or would not have been, unacceptably influenced by the additional SRAP PAPI indications
- the impact of the SRAP PAPI on SRAP approaches is comparable to normal approaches to the conventional threshold/PAPI
- the impact of the SRAP runway markings on SRAP approaches is comparable to normal approaches to the conventional threshold/runway markings
- The SRAP RWY designation ("05" in the exercise) was acceptable

Despite the vast majority of responses were positive as above reported, some issues were mentioned by participating pilots in relation with the brightness of the portable PAPI affecting its visibility in the bright sunlight. The needs to provide adequate SRAP PAPI brightness (equal to the PAPI used for conventional threshold and aiming point) must further be reflected in the solution OSED / TS requirements.

Solution PJ.02-W2-14.2 has eventually been updated to have a minimum of 1100m between the two thresholds, which was slightly not the case in Twente (1020m) and led to a comment from the Lufthansa Crew about the recommendations to increase the minimum space between the end of the last Touchdown zone marker (922.5 m from first threshold in the case of Twente) and the second Transverse stripe marking. In Twente exercise zone markers were at 150, 300, 600, 750 and 900m and are 22.5 m in length; 2 sets in front and 3 sets behind the aiming markers.

The outputs from PJ.02-W2-14.2 validation activities show that the best marking of the second threshold is a complete duplication of the ICAO marking, which was the case in Twente (except for the second threshold's transverse stripe which was dashed instead of solid). Runway length at Twente is 2406m, remaining LDA from the SRAP at Twente was 1386m, therefore 3 pairs of touchdown zone markers were applied (ICAO Annex 14 section 5.2.6.3, runway length between 1200m and 1500m). On longer runways the marking scheme will include more than 3 touchdown zone markings.

In TWENTE demo SRAP markings were based on ICAO standard provision with white rectangles for the aiming point while in PJ.02-W2-14.2 a second design option with chequered shape was tested and also found acceptable by the participating test subjects (airline pilots). Additional tests with the chequered option of the ICAO marking, for the second threshold, should be conducted, even if from the flight simulations flown in PJ.02-W2-14.2, there is no preference between the standard ICAO marking and the chequered one.

Suggestions were also provided about the PAPI, in particular it was suggested to make visible only the PAPI relevant for the approach if technically and operationally feasible. However, in the foreseen SRAP concept it may happen that the first (heavy) aircraft makes an approach to the first threshold, and a second aircraft (medium) aircraft makes an approach to the SRAP. As both aircraft may be on the approach simultaneously, it follows that both PAPIs probably will have to be on simultaneously.

The phraseology was found to be useful. After mentioning the threshold to be used by the tower controller, pilots commented that it improved their understanding which threshold to aim for. This is corroborated by visual observations made by the engineer; without landing clearance instructions for the threshold (run 01), pilots appeared to have an increased scanning pattern which covered both thresholds and showed some signs of hesitation, at least in the first part of the approach, whereas with landing clearance instruction (runs 02-09), focus was immediately given to the correct threshold.

#### 4.1.1.2 Safety Requirements

ID	Requirement text	Workaround	Safety conclusion
REQ-14.2-SPRINTEROP-CTL.1001	Approach Supervision shall decide when a published SRAP becomes active/inactive for operations, considering the conditions for application are and remain met: 1. No operational ATC & weather limitations 2. Necessary navigation guidance means are serviceable	No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. In the test aircraft simulated SRAP clearances were provided.  Trial conditions and awareness of participating aircraft known before the start of the approach.	The Trial was successfully executed with six test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.
REQ-14.2-SPRINTEROP-CTL.1101	Information about a published SRAP being active to a given runway QFU shall be available to Flight deck in order to prepare expected approach briefing (e.g. via ATIS)	Awareness of trial conditions and airport / runway environment by participating aircraft / Flight Crews known before the start of the approach	The briefing was conducted and it was possible to successfully execute the trials involving six test subjects
REQ-14.2-SPRINTEROP-CTL.1201	The SRAP approach chart shall be specific to one final approach path (i.e. touchdown aiming point) and supporting navigation guidance mean. The position and colour of the associated PAPI shall be indicated on the chart.	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (SRAP 3.0° ) will be issued and available to participating aircraft / Flight Crews	Trial approach charts were designed prior the trial execution and made available for the participating aircraft. It was possible to successfully execute the trials involving six test subjects. Positive responses were collected on the designed approach procedures:

			the approach charts provided all required information and were acceptable
REQ-14.2-SPRINTEROP-CTL.1208	The SRAP approach chart shall include altitude/distance information for the applicable runway aiming point to facilitate Flight Deck procedure check during the approach	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (SRAP 3.0° ) will be issued and available to participating aircraft / Flight Crews	<p>Trial approach charts were designed prior the trial execution and made available for the participating aircraft. It was possible to successfully execute the trials involving six test subjects. Positive responses were collected on the designed approach procedures:</p> <p>the approach charts provided all required information and were acceptable</p>
REQ-14.2-SPRINTEROP-CTL.1209	When designing the SRAP local procedure and the location of the second threshold and aiming point, the current and future taxiway layout of the aerodrome shall be taken into consideration for facilitating runway vacation	Not possible at EHTW due to the limited taxiway system. There is no RWY occupancy pressure for those test a/c which will landing (e.g. test a/c are free to back-track if needed).	
REQ-14.2-SPRINTEROP-CTL.1210	When designing the SRAP local procedure, the location of the second runway aiming point shall provide sufficient landing distance available for all eligible aircraft at that specific airport	Available runway length at EHTW :2406m. The SRAP is located at minimum distance for full marking solution (1020m), maximising the remaining available landing distance. For all participating	

		aircraft during the tests at Twente, the required runway length was always within the available landing distance, even in cases where only go arounds were planned.	
REQ-14.2-SPRINTEROP-APT.1301	Flight Deck shall be supported by appropriate approach and landing visual aids to acquire the references for determining if approach and landing can be continued below CAT I decision height.	SRAP is supported by runway markings and dedicated PAPI and threshold number. No Approach Lighting System (ALS) will be available, however the approaches will be conducted in VMC conditions and not down to CAT I minima	<p>The trial was successfully executed in VMC involving six test subjects that were supported by dedicated runway markings and dedicated PAPI. Positive subjective responses were collected about the acceptability of the SRAP runway markings and PAPI. Specifically:</p> <ul style="list-style-type: none"> <li>• the PAPI indications were acceptable</li> <li>• the runway markings were acceptable</li> <li>• the level of safety of a landing would have been or was acceptable</li> <li>• there was never confusion regarding which runway threshold and aiming point to use</li> </ul>

			<ul style="list-style-type: none"> <li>• the simultaneous use of two PAPIs (one for each threshold) was acceptable</li> <li>• not having approach lighting/cross bars for SRAP RWY06 is acceptable under the conditions as present during the approaches</li> </ul> <p>Despite the main conclusion based on the collected questionnaires, further assessment might be needed: some issues were mentioned by participating pilots in relation with the brightness of the portable PAPI affecting its visibility in the bright sunlight.</p> <p>It was suggested to make visible only the PAPI relevant for the approach if technology allows as but this may be not feasible for the CONOPS developed for SRAP operations as in the SRAP concept two aircraft may be on different approaches simultaneously. .</p>
REQ-14.2-SPRINTEROP-APT.1302	In case of SRAP, Flight Deck shall be able to clearly distinguish between each threshold and aiming point and be supported by	SRAP and are supported by runway markings and dedicated PAPI and threshold number.	The trial was successfully executed in VMC involving six test subjects that were supported by runway markings and dedicated PAPI.

	appropriate landing visual aid references (e.g. location and identification of the second runway threshold and aiming point, a second PAPI).			Despite the positive subjective responses collected with the provided questionnaire, based on the trial set-up (without SRAP approaching lighting system) there might be benefit by better distinguishing the PAPI for different aiming points.
REQ-14.2-SPRINTEROP-ACFT.2101	Before contacting APP Control, Flight Deck shall assess the feasibility of the probable SRAP operation under the expected flight and weather conditions		Trial conditions and awareness of participating aircraft known before the start of the approach.	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the SRAP procedures in the Twente conditions
REQ-14.2-SPRINTEROP-ACFT.2103	Flight Deck shall recall during approach briefing the specific visual references (runway marking and lighting, VASI/PAPI, etc) that are expected in SRAP operation.		Part of the trial Flight Deck operating procedure	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the SRAP procedures in the Twente conditions
REQ-14.2-SPRINTEROP-ACFT.2104	Flight Deck shall recall during approach briefing the reduced landing distance available from the second aiming point to the expected runway exit in SRAP operation		Part of the trial Flight Deck operating procedure	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the SRAP procedures in the Twente conditions



REQ-14.2-SPRINTEROP-ACFT.2105	Flight Deck shall be able to fly a SRAP operation in both manual and AP/FD modes	Supported by flight control modes	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the SRAP procedures in the Twente conditions
REQ-14.2-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly a SRAP operation in a similar way (HMI, SOP, etc.) as when an approach with single aiming point is flown	Trial flights will be flown based on SOPs	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the SRAP procedures in the Twente conditions. Specifically the collected subjective feedback was that SRAP operations can be managed by applying existing SOPs

The crew commented that an additional disambiguation could be given in the landing clearance by mentioning the side of the runway on which the relevant PAPI is located (e.g. “first threshold, PAPI left” and “second threshold, PAPI right” at EHTW), provided that the airport geography allows the first and second PAPIs to be installed on opposite sides of the runway. This could be further reinforced if PAPI location could be standardized across airports (e.g. first threshold PAPI always on the left, second threshold PAPI always on the right, or vice-versa).

## 4.1.2 ISGS

### 4.1.2.1 The demonstration objectives

#### 4.1.2.1.1 OBJ-14.3-V3-VALP-0203 ISGS impact on safety crew perspective

The objective was addressed in relation to:

- There is evidence that Flight Crew's subjective and positive feedback concerning the level of safety for ISGS procedures is not degraded (EX3-OBJ- VLD-01-003-006)

The Objectives and Criteria were addressed in Ciampino and Twente demonstration through subjective feedback of the pilots involved in the demonstration (see DEMOR for more details) collected through post run questionnaires and post exercise questionnaires. The criteria were all successfully met as the most of the pilots agreed that the:

- The perceived overall level of safety was at least as the today operations during the execution of the ISGS operations
- The perceived level of safety per scenario was acceptable
- The potential for human error was not increased compared to current operations

The situation awareness perceived during the trials was always at an acceptable level

### 4.1.2.2 Safety Requirements

#### 4.1.2.3 Safety Requirements

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
REQ-14.3-SPRINTEROP-CTL.1001	<p>Approach Supervision shall decide when a published ISGS becomes active/inactive for operations, considering the conditions for application are and remain met:</p> <ol style="list-style-type: none"> <li>1. No operational ATC &amp; weather limitations</li> <li>2. necessary navigation guidance means are serviceable</li> </ol>	<p>Trial conditions and awareness of participating aircraft known before the start of the approach.</p> <p>At Frankfurt, the trial on GLS CAT II 3.2deg procedure will be performed under CAT I minimal weather conditions only.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. Simulated ATC approach and landing clearances were provided in the test aircraft.</p>	<p>The Trial was successfully executed with 28 test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.</p>	<p>The Trial was successfully executed with nine test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial. The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion</p>	<p>The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.</p>	<p>The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.</p>

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
REQ-14.3-SPRINTEROP-CTL.1004	Approach / Tower Supervision shall inform the Approach / Tower Control about the list of active approach procedures	<p>Trial conditions are known before the start of the approach.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.</p>	The Trial was successfully executed with 28 test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	<p>The Trial was successfully executed with nine test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.</p> <p>The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion</p>	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.
REQ-14.3-SPRINTEROP-CTL.1006	At first call from an incoming traffic with APPROACH, Approach Executive Control shall provide an information to the arrival aircraft about the expected approach	<p>Trial conditions are known before the start of the approach.</p> <p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.</p>	The Trial was successfully executed with 28 test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	<p>The Trial was successfully executed with nine test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.</p> <p>The ISGS approach</p>	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	procedure, taking in account the traffic eligibility to ISGS, local working methods for traffic assignment (e.g. Heavies left on conventional approach), and using related standard phraseology (e.g. BLUEBIRD 123, Expect GLS Z approach runway 28L)	Simulated ATC approach and landing clearances were provided in the test aircraft.		charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.		test subject prior to the trial.
REQ-14.3-SPRINTEROP-CTL.1008	After an aircraft has been cleared to intercept the final approach, if Flight Deck informs ATC that they are no longer able to fly the expected approach (ISGS), Approach Executive Control shall	Taken into account as a procedure in the trial.  No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. The test flight transition from IFR to VFR on approach and will	The trial was successfully executed involving x test subjects and positive responses were collected on the acceptability of the ISGS procedures in the Frankfurt conditions.	The trial was successfully executed involving nine test subjects and positive responses were collected on the acceptability of the ISGS procedures in the Ciampino conditions. The ISGS approach charts at	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	instruct a go-around	then take their own decision.		the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.		
REQ-14.3-SPRINTEROP-CTL.1009	After Flight Deck has been informed of an expected approach procedure, if a change is needed from ATC, Approach Executive Control shall consider the time needed for the Flight Deck to re-configure for the new approach procedure, shall inform Flight Deck at the earliest opportunity and with sufficient time before instructing	For Ciampino The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM (depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic,	n/a	The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.	n/a	In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	final approach axis interception (special consideration should be given to the transition from ILS/GLS to RNP APCH which is demanding and time consuming for the pilot)	that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.  No ATC service at Twente (EHTW).				
REQ-14.3-SPRINTEROP-CTL.1010	Applicable Contingency approach separation minima shall be available to Approach Executive Control and Tower Runway Control, when controllers are supported by a separation tool.	Current procedures apply in case of navigation guidance failure.  No tool needed by the ATCO to separate the test aircraft to aircraft non-participating to the trial.	n/a	The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM	n/a	In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. The flight trials have been managed applying current standard spacing required at Ciampino airport.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				(depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.		The testing aircraft have never been on the final approach segment at the same time of other daily traffic.
REQ-14.3-SPRINTEROP-CTL.1011	Applicable Standard and Contingency approach separation minima	The test flights (trial participating flights) will be managed as single flights separated by other	n/a	The ISGS approach charts at the time of the flights have not been published, the approach	n/a	In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the



ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	shall be available to Approach Executive Control and Tower Runway Control.	traffic (non-participating flights) with an increased spacing of 10/15 NM.		procedures have been flown by the live trials cleared at pilot discretion. The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM (depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an		approach procedures have been flown by the live trials cleared at pilot discretion. The flight trials have been managed applying current standard spacing required at Ciampino airport. The testing aircraft have never been on the final approach segment at the same time of other daily traffic.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				operational airport hosting commercial flights.		
REQ-14.3-SPRINTEROP-CTL.1013	At each transfer on frequency, when contacting the next ATC unit, the Flight Deck shall indicate the expected or cleared approach procedure	Taken into account as a procedure in the trial.	The trial was successfully executed involving x test subjects and positive responses were collected on the acceptability of the ISGS procedures in the Frankfurt conditions.	The trial was successfully executed involving nine test subjects and positive responses were collected on the acceptability of the ISGS procedures in the Ciampino conditions. The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	<p>The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.</p> <p>In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. The flight trials have been managed</p>

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
						applying current standard spacing required at Ciampino airport. The testing aircraft have never been on the final approach segment at the same time of other daily traffic.
REQ-14.3-SPRINTEROP-CTL.1014	Approach Executive Control shall consider, when establishing and maintaining separation, that aircraft ability to respect ATC speed instructions may be limited during ISGS operations, especially for slope angles above 3.5 degrees, and aircraft's speed might need to be reduced earlier	<p>The GLS procedure to be flown by A320 family aircraft types (as used at Frankfurt) is up to 3.2deg, with no specific impact expected on ATC side.</p> <p>Test aircraft at Ciampino will be equipped with an Energy Management Function.</p>	n/a	The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM (depending on local coordination): due	n/a	The proposed design of the ISGS procedure for both experimented angles of descent was very comfortable and fluid and the provided speed constraints were helpful to anticipate the management of the approach.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	<p>compared to standard approach.</p> <p>Note: the higher the slope angle the longer it takes for the aircraft to decelerate. However, this should not be a problem with slopes under 3.5 degrees.</p>	<p>No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach. The participating aircraft is segregated for normal traffic.</p>		<p>to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.</p> <p>The proposed design of the ISGS procedure for both experimented angles of descent was very comfortable and fluid and the provided speed</p>		

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				constraints were helpful to anticipate the management of the approach.		
REQ-14.3-SPRINTEROP-CTL.1015	Approach Executive Control shall vector the aircraft onto ISGS approach such as to avoid final approach interception from above	Taken into account as a procedure in the trial.	The trial was successfully executed involving 28 test subjects and positive responses were collected on the acceptability of the ISGS procedures in the Frankfurt conditions.	<p>The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.</p> <p>The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM (depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing</p>	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				<p>aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.</p> <p>The trial was successfully executed involving nine test subjects and positive responses were collected on the acceptability of the ISGS procedures in the Ciampino conditions</p>		

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
REQ-14.3-SPRINTEROP-CTL.1101	Information about a published ISGS 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)	Trial conditions are known before the start of the approach.	The briefing was conducted, and it was possible to successfully execute the trials involving 28 test subjects.	<p>The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.</p> <p>The briefing was conducted and it was possible to successfully execute the trials involving nine test subjects</p>	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.
REQ-14.3-SPRINTEROP-CTL.1109	Approach Executive Control shall be alerted when an aircraft is not complying / deviating from the assigned published final approach profile.	No such alert needed during the trial as the ATC separation will not be affected. In case of a deviation, the 10/15 NM spacing mitigates the impact on the	n/a	The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion, and since this affects the HP and SAF	n/a	In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. Since there were no

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
		leader or the follower aircraft.		assessment of ATC side and there were no other expected changes to approach and tower controllers working methods in the specific context of Ciampino, no ATC related objectives have been addressed and no measurement for ATC have been conducted.		other expected changes to approach and tower controllers working methods in the specific context of Ciampino, no ATC related objectives have been addressed and no measurement for ATC have been conducted.
REQ-14.3- SPRINTEROP- CTL.1110	The need for displaying to the Controllers the interception points respective for each procedure shall be evaluated as part of the local deployment, such that the visual references are operationally relevant and		n/a	The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion, and since this affects the HP and SAF assessment of ATC side and there were	n/a	In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. Since there were no other expected changes to



ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	unambiguously presented without e.g. cluttering on the controller air surveillance display			no other expected changes to approach and tower controllers working methods in the specific context of Ciampino, no ATC related objectives have been addressed and no measurement for ATC have been conducted.		approach and tower controllers working methods in the specific context of Ciampino, no ATC related objectives have been addressed and no measurement for ATC have been conducted.
REQ-14.3-SPRINTEROP-CTL.1201	Flight Crew shall be informed about discrepancies from visual aid references when not specifically adapted to increased glideslope procedures.	At Frankfurt, as the slope will be up to 3.2deg, only one PAPI is used and tuned to serve both conventional 3.0deg and ISGS, like already in operations with GLS X RWY 25L/R CAT I approach.  At Ciampino, Flight crew will be briefed about how to use	n/a	About PAPI set at 3.5° for RWY33, the ENAV and DASSAULT flight crew did not underline any issue for the lack of visual aids for the specific conditions of the trial: at 3.9° descent angle they had the 3 white lamps and 1 red lamp as guidance while at 4.4° descent angle	The ISGS approaches with a second active PAPI were acceptable and could be flown without any difficulty in VMC/daylight conditions. The test subjects indicated that they were confident in flying the ISGS operations. The existing SOP's could be used,	There were no issues regarding visual aids for the specific. In normal operations it must be synchronized" or "appropriately charted in navigation approach charts" and a crew briefing item on which PAPI to use should be added and trained

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
		the current PAPI (adapted for 3.5 deg) installed at Ciampino airport for the 3.9 deg slope and about the lack of PAPI for the 4.4 deg slope.		<p>they had no guidance at all. In contrary, Honeywell pilots strongly suggested having PAPI information charted in the navigational approach charts to prevent any confusion for the flight crew.</p> <p>While three out of seven pilots found it “acceptable only because it was a trial. In normal operations it MUST be synchronized” or “appropriately charted in navigation approach charts”, most pilots stated that this was not disturbing the approach as the flight crew was</p>	however, a crew briefing item on which PAPI to use, should be added and trained.	(in case of more than one PAPI).

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				already informed and briefed about that		
REQ-14.3-SPRINTEROP-CTL.1202	<p>The ISGS approach chart shall follow the following elements:</p> <ul style="list-style-type: none"> <li>- be specific to one final approach path (i.e. angle) and supporting navigation guidance mean,</li> <li>- highlight the glide path angle in case it is significantly increased (e.g. more than 3.5),</li> <li>- indicate the position and color of the associated PAPI.</li> </ul>		n/a	<p>The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. The ISGS experimental approach chart was specific to each tested final approach path (i.e. angle) and supporting navigation guidance mean,</p> <p>It was not possible to use a second PAPI in Ciampino due to safety risks impact on the operational environment and</p>	n/a	<p>In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.</p>

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				the impossibility to command 2 different PAPIs by an Air Traffic Controller. current PAPI configuration at 3.5°. ISGS approach procedure t 3.9° was flown with current PAPI set at 3.5° (3 white lamps and 1 red lamp). ISGS approach procedure at 4.4° without PAPI		
REQ-14.3-SPRINTEROP-CTL.1203	ISGS shall be published approach procedures flown based on ILS or GLS or RNP APCH with vertical guidance	Taken into account as a procedure in the trial.	Pilots succeeded to accomplish 3.2 deg ISGS operation without any impact on safety as positive responses were collected. All ISGS flights were successfully conducted without	The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion. Experimental approach charts were provided. ISGS	There is evidence that Flight Crew's subjective and positive feedback concerning the level of safety for ISGS procedures is not degraded.	The overall perception was that the procedures have no specific difficulties respect to the day-to-day operations and the reference scenario and, in the case of Ciampino, were even improving the final approach

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
			any special events or incidents.	procedure were flown using SBAS that provide precision vertical guidance and can be considered as a fundamental enabler for such kind of approaches. The overall perception was that the procedures have no specific difficulties respect to the day-to-day operations and the reference scenario and are even improving the final approach phase respect to the current approach procedure available for RWY33 at Ciampino airport.		phase respect to the current approach procedure available.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
REQ-14.3-SPRINTEROP-CTL.1204	A single ISGS procedure type may be supported by different navigation guidance systems and the same ISGS procedure type with different guidance means may be active at the same time	Only a single SBAS based ISGS procedure will be tested during the trial.	n/a	ISGS procedure were flown using SBAS that provide precision vertical guidance and can be considered as a fundamental enabler for such kind of approaches.	n/a	In Ciampino trial, ISGS procedure were flown using SBAS that provide precision vertical guidance and can be considered as a fundamental enabler for such kind of approaches.
REQ-14.3-SPRINTEROP-CTL.1205	Approach Executive Control shall apply longitudinal wake turbulence distance-based separation minima	For Ciampino The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM (depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never	n/a	The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.  The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport	n/a	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.  In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the

<p>for the following combinations:</p> <ul style="list-style-type: none"> <li>o Leader and follower on same glideslope</li> <li>o Leader upper glide - follower lower glide</li> <li>o Leader lower glide - follower upper glide</li> </ul> <p>when both aircraft are descending on their respective glide slope.</p>	<p>been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.</p> <p>No ATC service at Twente (EHTW).</p>	<p>that is 10/15 NM (depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.</p> <p>The trial was successfully executed involving nine test subjects and positive responses were collected on the acceptability of the ISGS procedures in</p>	<p>approach procedures have been flown by the live trials cleared at pilot discretion. The flight trials have been managed applying current standard spacing required at Ciampino airport. The testing aircraft have never been on the final approach segment at the same time of other daily traffic.</p>
---	---	--	--

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				the Ciampino conditions		
REQ-14.3-SPRINTEROP-CTL.1207	Procedure design for ISGS operation shall use a glide path angle limited to 4.49°.	The glide path angles tested during the trial will be less than 4.49 deg (i.e. 3.9 deg and 4.4 deg).	During the trial period, 37 approaches with 3.2° glideslope and 30 approaches with 3.0° glide slope were achieved.	17 approaches were performed to test the reference scenario at 3.5° in order to have reference point to measure the differences with the introduction of the solutions, 23 approaches were performed to assess the 3.9° ISGS solution and 20 approaches were performed to assess the 4.4° ISGS procedure.	In general, flights were as planned. However, on flight 7 (third flight of the day), the first four approaches were mistakenly flown with an ISGS PAPI alignment of 4.5 degrees instead of 3.5 degrees.	In general, flights were performed as planned. However, four approaches in the Twente trial were mistakenly flown with an ISGS PAPI alignment of 4.5
REQ-14.3-SPRINTEROP-CTL.1208	ISGS Approach separation minima shall be specified for each combination of published approach procedure with	For Ciampino The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport	n/a	The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM	n/a	In Ciampino trial, the ISGS approach charts at the time of the flights have not been published, the approach procedures have



ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	<p>different glideslopes, taking into account the associated navigation means and corresponding vertical accuracy around the published profile, for</p> <ul style="list-style-type: none"> <li>o Leader and follower on same glideslope</li> <li>o Leader upper glide - follower lower glide</li> <li>o Leader lower glide - follower upper glide</li> </ul>	<p>that is 10/15 NM (depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.</p> <p>No ATC service at Twente (EHTW).</p>		<p>(depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.</p>		<p>been flown by the live trials cleared at pilot discretion. The flight trials have been managed applying current standard spacing required at Ciampino airport. The testing aircraft have never been on the final approach segment at the same time of other daily traffic.</p>

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
REQ-14.3-SPRINTEROP-ACFT.2101	Flight Crew shall recall during approach briefing the possible differences in visual references (VASI/PAPI, runway aspect, etc) that are expected in ISGS operation	Taken as it is as a procedure during the trial.	The trial was successfully executed involving 28 test subjects and positive responses were collected on the acceptability of the ISGS procedures in the Frankfurt conditions.	<p>It was not possible to use a second PAPI in Ciampino due to safety risks impact on the operational environment and the impossibility to command 2 different PAPIs by an Air Traffic Controller. current PAPI configuration at 3.5°. ISGS approach procedure t 3.9° was flown with current PAPI set at 3.5° (3 white lamps and 1 red lamp). ISGS approach procedure at 4.4° without PAPI.</p> <p>The trial was successfully executed involving nine test subjects and positive</p>	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				responses were collected on the acceptability of the ISGS procedures in the Ciampino conditions		
REQ-14.3-SPRINTEROP-ACFT.2102	Flight Deck shall be able to decelerate the aircraft during final approach, even under flight conditions that reduce deceleration capability (e.g. anti-ice system ON)		n/a	<p>As the deceleration capability is reduced on a steeper flight path, the risk of an unstable approach increases if the pilot is required to maintain a speed greater than the required landing speed down to a too low height.</p> <p>Therefore, airport speed requirements such as « Maintain 160kt until 4 NM » are not recommended</p>	n/a	As the deceleration capability is reduced on a steeper flight path, the risk of an unstable approach increases if the pilot is required to maintain a speed greater than the required landing speed down to a too low height.

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				when using an ISGS procedure.		
REQ-14.3-SPRINTEROP-ACFT.2103	Flight Deck shall be able to execute flare during ISGS operations without increasing the risk of hard landing or long landing	If needed, test aircraft will be equipped with flare management assistant.	All Pilots reported that their actions in approach allowed to successfully stabilize the aircraft before landing (manage energy,) with the Standard Operational Procedures. Pilots succeeded to accomplish 3.2 deg ISGS landings without any hard landing reported. All landings were within the normal distribution range	Energy management during the flare for both the solutions 3.9° ISGS and 4.4° ISGS was acceptable looking at the results of the PEQ completed by the 3 ENAV and 2 Honeywell pilots (it was considered not relevant for DASSAULT pilots).	n/a	Energy management during the flare for both the solutions 3.9° ISGS and 4.4° ISGS was acceptable looking at the results of the Ciampino trial.
REQ-14.3-SPRINTEROP-ACFT.2104	Upon initiating the approach briefing, in case the aircraft is eligible for the ISGS approach (possible from ATC point of view and	Trial conditions are known before the start of the approach.	The briefing was conducted, and it was possible to successfully execute the trials	The briefing was conducted and it was possible to successfully execute the trials	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	taking into account aircraft capabilities) and the ATIS informs that the ISGS approach is active, the Flight Deck shall assess the feasibility of the ISGS operation under the expected flight and weather conditions.		involving 28 test subjects.	involving nine test subjects	each test subject prior to the trial.	provided to each test subject prior to the trial.
REQ-14.3-SPRINTEROP-ACFT.2105	Upon cleared for ISGS Approach, Flight Deck shall confirm the feasibility of the instructed ISGS operation under the actual flight and weather conditions	Trial conditions are known before the start of the approach.	The briefing was conducted, and it was possible to successfully execute the trials involving 28 test subjects.	The briefing was conducted and it was possible to successfully execute the trials involving nine test subjects	The Trial was successfully executed with eight test subjects and simulated ATC services. Briefing was provided to each test subject prior to the trial.	The Trial was successfully executed with 45 test subjects in total and simulated ATC services. Briefing was provided to each test subject prior to the trial.
REQ-14.3-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly an ISGS operation in both		n/a	For the airborne part, considering the collective subjective feedback it can be concluded	For the airborne part, considering the collective subjective feedback it can be concluded	The experimented ISGS operations can be treated as standard operation without introducing

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
	manual and AP/FD modes			that in the specific case of Ciampino trials executed by ENAV, DASSAULT and Honeywell flight crew the experimented ISGS operations can be treated as standard operation without introducing any HP and safety issue respect to the day to day operations.	that in the Twente trials executed by Lufthansa and TUI flight crew the experimented ISGS operations can be treated as standard operation without introducing any HP and safety issue respect to the day to day operations.	any HP and safety issue respect to the day to day operations.
REQ-14.3-SPRINTEROP-ACFT.2107	Flight Deck shall be able to fly an ISGS operation in a similar way (IHM, SOP, etc) as when an approach with standard slope is flown		The flight tests were successfully conducted with commercial flights. Pilots have not experienced any difficulties in applying the existing SOPs for ISGS operation.	For the airborne part, considering the collective subjective feedback it can be concluded that in the specific case of Ciampino trials executed by ENAV, DASSAULT and Honeywell flight crew the experimented ISGS	For the airborne part, considering the collective subjective feedback it can be concluded that in the Twente trials executed by Lufthansa and TUI flight crew the experimented ISGS operations can be treated as standard	in the specific case of Ciampino trials executed by ENAV, DASSAULT and Honeywell flight crew the experimented ISGS operations can be treated as standard operation without introducing any HP and safety issue

ID	Requirement text	Workaround	Safety conclusion Frankfurt	Safety conclusion Ciampino	Safety conclusion Twente	Overall Safety conclusion
				operations can be treated as standard operation without introducing any HP and safety issue respect to the day to day operations.	operation without introducing any HP and safety issue respect to the day to day operations.	respect to the day to day operations.

### 4.1.3 IGS-to-SRAP

#### 4.1.3.1 The demonstration objectives

##### 4.1.3.1.1 OBJ-14.5-V3-VALP 0203 IGS-to-SRAP impact on safety crew perspective

- The impact on additional runway markings under VMC on IGS-to-SRAP safety from crew perspective (EX3-OBJ-VLD-01-0203-001)
  - the safety criteria were aimed at collecting evidences that the additional runway markings are sufficient to not negatively impact IGS-to-SRAP procedures compared to the reference scenario, from the perspective of the crew
- The impact on IGS-to-SRAP additional PAPI under VMC on IGS-to-SRAP safety from crew perspective (EX3-OBJ-VLD-01-0203-002)
  - the safety criteria were aimed at collecting evidences that the additional IGS-to-SRAP PAPI is sufficient to not negatively impact IGS-to-SRAP procedures compared to the reference scenario, from the perspective of the crew
- The impact on IGS-to-SRAP safety from crew perspective (EX3-OBJ-VLD-01-0203-003)
  - the safety criteria were aimed at collecting evidences that the nominal runway markings and nominal PAPI are sufficiently distinguishable from SRAP markings and PAPI in order not to result in unacceptable safety from the perspective of the crew

The Objectives and Criteria were addressed in Twente demonstration through subjective feedback of the pilots involved in the demonstration (see DEMOR for more details) collected through post run questionnaires and post exercise questionnaires. The criteria were all successfully met as the most of the pilots agreed that the:

- the IGS-to-SRAP PAPI indications were acceptable
- the runway markings were acceptable
- the level of safety of a landing would have been acceptable
- there was never confusion regarding which runway threshold and aiming point to use
- the simultaneous use of two PAPIs (one for each threshold) is acceptable
- the runway markings and PAPI for the IGS-to-SRAP approaches to RWY06 are clearly distinguishable from the markings and PAPI for the conventional approaches to RWY05
- landing and roll out on the conventional RWY05 are not, or would not have been, unacceptably influenced by the additional SRAP runway markings
- landing and roll out on the conventional RWY05 are not, or would not have been, unacceptably influenced by the additional IGS-to-SRAP PAPI indications



- the impact of the PAPI on IGS-to-SRAP approaches is comparable to normal approaches to the conventional threshold/PAPI
- the impact of the SRAP runway markings on IGS-to-SRAP approaches is comparable to normal approaches to the conventional threshold/runway markings
- The RWY designation (“05” for the full length, “06” for the SRAP in the exercise) was acceptable

Despite the vast majority of responses were positive as above reported, some issues were mentioned by participating pilots in relation with the visibility of the PAPI. Similar recommendations as noted in section 4.1.1.1.1 about SRAP, are also applicable to IGS-to-SRAP.

Although the collected subjective feedback was that SRAP operations can be managed by applying existing SOP, it was noted that one sentence or a small paragraph may be required in company SOPs to highlight the importance of identifying the correct threshold (e.g. requirement to read back full landing clearance including “to second threshold”).and that last minute changes between thresholds would not be acceptable.

Finally, pilots were not confident flying IGS-to-SRAP operations in tailwind conditions as IGS operations are very difficult to manage in such cases, even to a conventional threshold. The combination of the tailwind and the IGS left the crew subjectively feeling that the ground speed was too high for the aircraft weight. Confidence was OK in headwind conditions.

#### 4.1.3.2 Safety Requirements

ID	Requirement text	Workaround	Safety conclusion
REQ-14.5-SPRINTEROP-CTL.1001	Approach Supervision shall decide when a published IGS-to-SRAP becomes active/inactive for operations, considering the conditions for application are and remain met: 1. No operational ATC & weather limitations 2. Necessary navigation guidance means are serviceable	No ATC service at Twente (EHTW). MIL ATC service for Twente initial approach.  Trial conditions and awareness of participating aircraft known before the start of the approach.	The Trial was successfully executed with six test subjects but without ATC services. Awareness campaign was provided prior to the trial.
REQ-14.5-SPRINTEROP-CTL.1213	When designing the IGS-to-SRAP local procedure, the location of the second runway aiming point shall provide sufficient landing distance available for all eligible aircraft at that specific airport	For all participating aircraft during the tests at Twente, the required runway length was always within the available landing distance, even in cases where only go arounds were planned.	
REQ-14.5-SPRINTEROP-CTL.1101	Information about a published IGS-to-SRAP being active to a given runway QFU shall be available to Flight deck in order to prepare expected approach briefing (e.g. via ATIS)	Awareness of trial conditions and airport / runway environment by participating aircraft / Flight Crews known before the start of the approach	The awareness campaign was conducted and it was possible to successfully execute the trials involving six test subjects
REQ-14.5-SPRINTEROP-CTL.1201	The IGS-to-SRAP approach chart shall be specific to one final approach path (i.e. touchdown aiming point) and supporting	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (IGS-to-SRAP 4.49° / 4.0° / 3.5° / SRAP 3.0° ) will be issued and	Trial approach charts were designed prior the trial execution and made available for the participating aircraft. It was

	navigation guidance mean. The position and colour of the associated PAPI shall be indicated on the chart.	available to participating aircraft / Flight Crews	possible to successfully execute the trials involving six test subjects. Positive responses were collected on the designed approach procedures:  the approach charts provided all required information and were acceptable
REQ-14.5-SPRINTEROP-CTL.1208	When designing the IGS-to-SRAP local procedure and the location of the second threshold and aiming point, the current and future taxiway layout of the aerodrome shall be taken into consideration for facilitating runway vacation	Not possible at EHTW due to the limited taxiway system. There is no RWY occupancy pressure for those test a/c which will landing (e.g. test a/c are free to back-track if needed).	
REQ-14.5-SPRINTEROP-CTL.1211	The IGS-to-SRAP approach chart shall include altitude/distance information for the applicable runway aiming point to facilitate Flight Deck procedure check during the approach	Trial (not published) approach charts for GBAS W/X/Y/Z RWY06 (IGS-to-SRAP 4.49° / 4.0° / 3.5°) will be issued and available to participating aircraft / Flight Crews	Trial approach charts were designed prior the trial execution and made available for the participating aircraft. It was possible to successfully execute the trials involving six test subjects. Positive responses were collected on the designed approach procedures:  the approach charts provided all required information and were acceptable

REQ-14.5-SPRINTEROP-APT.1301	Flight Deck shall be supported by appropriate approach and landing visual aids to acquire the references for determining if approach and landing can be continued below CAT I decision height.	SRAP is supported by runway markings and dedicated PAPI and threshold number. No Approach Lighting System (ALS) will be available, however the approaches will be conducted in VMC conditions and not down to CAT I minima	<p>The trial was successfully executed in VMC involving six test subjects that were supported by runway markings and dedicated PAPI. Positive subjective responses were collected about the acceptability of the runway markings and PAPI. Specifically:</p> <ul style="list-style-type: none"> <li>• the PAPI indications were acceptable</li> <li>• the runway markings were acceptable</li> <li>• the level of safety of a landing would have been acceptable</li> <li>• there was never confusion regarding which runway threshold and aiming point to use</li> <li>• the simultaneous use of two PAPIs (one for each threshold) was acceptable</li> <li>• not having approach lighting/cross bars for RWY06 is acceptable under the conditions as</li> </ul>
------------------------------	--	--	---

			<p>present during the approaches</p> <p>Despite the main conclusion based on the collected questionnaires, further assessment might be needed: some issues were mentioned by participating pilots in relation with the brightness of the portable PAPI affecting its visibility in the bright sunlight.</p> <p>Finally it was suggested to make visible only the PAPI relevant for the approach. However, this may be not feasible for the CONOPS developed for IGS-to-SRAP operations as two aircraft may be on different approaches simultaneously.</p>
REQ-14.5-SPRINTEROP-APT.1302	<p>In case of IGS-to-SRAP, Flight Deck shall be able to clearly distinguish between each threshold and aiming point and be supported by appropriate landing visual aid references (e.g. location and identification of the second runway threshold and aiming point, a second PAPI).</p>	<p>IGS-to-SRAP is supported by runway markings and dedicated PAPI and threshold number.</p>	<p>The trial was successfully executed in VMC involving six test subjects that were supported by runway markings and dedicated PAPI. Despite the positive subjective responses collected with the provided questionnaire, there cannot be a final conclusion on safety considering some pilots</p>

				mentioned margin of confusion on the provided visual aids.
REQ-14.5-SPRINTEROP-ACFT.2104	Flight Deck shall recall during approach briefing the specific visual references (runway marking and lighting, VASI/PAPI, etc) that are expected in IGS-to-SRAP operation.	Part of the trial	Flight Deck operating procedure	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the procedures in the Twente conditions
REQ-14.5-SPRINTEROP-ACFT.2105	Flight Deck shall recall during approach briefing the reduced landing distance available from the second aiming point to the expected runway exit in IGS-to-SRAP operation	Part of the trial	Flight Deck operating procedure	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the procedures in the Twente conditions
REQ-14.5-SPRINTEROP-ACFT.2106	Flight Deck shall be able to fly a IGS-to-SRAP operation in both manual and AP/FD modes	Supported by flight control modes		The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the procedures in the Twente conditions
REQ-14.5-SPRINTEROP-ACFT.2107	Flight Deck shall be able to fly a IGS-to-SRAP operation in a similar way (HMI, SOP, etc.) as when an approach with single aiming point is flown	Trial flights will be flown based on SOPs		The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the procedures in the Twente conditions. It was noted that one sentence or a small paragraph may be required in company SOPs to

			highlight the importance of identifying the correct threshold (e.g. requirement to read back full landing clearance including “to second threshold”). Furthermore, last minute changes between thresholds would not be acceptable, limitation to be traced in SOPs
REQ-14.5-SPRINTEROP-ACFT.2108	Before contacting APP Control, Flight Deck shall assess the feasibility of the probable IGS-to-SRAP operation under the expected flight and weather conditions	Trial conditions and awareness of participating aircraft known before the start of the approach.	The trial was successfully executed in VMC involving six test subjects and positive responses were collected on the acceptability of the procedures in the Twente conditions

## 4.2 Safety impact of the VLD on current operations

### 4.2.1 SRAP

The VLD live trials had no impact on current operations at Twente airport considering the characteristic of the airport (size, small airport, and traffic, limited traffic load)

### 4.2.2 ISGS

#### FRANKFURT

Safety was not impacted by the 3.2 deg approach as tested in the Frankfurt trial.

#### CIAMPINO

The VLD live trials had no impact on current operations at Ciampino airport

- No changes were on the visual aids provided to current operations: It was not possible to use a second PAPI in Ciampino due to safety risks impact on the operational environment and the impossibility to command 2 different PAPIs by an Air Traffic Controller.
- The flight trials have been managed applying current standard spacing required on RWY33 of Ciampino airport that is 10/15 NM (depending on local coordination): due to final ISGS approach segment length and the standard spacing of RWY33 the testing aircraft have never been on the final approach segment at the same time of other daily traffic, that anyway has been managed at the same time of the testing aircraft, being the Ciampino airport an operational airport hosting commercial flights.
- The ISGS approach charts at the time of the flights have not been published, the approach procedures have been flown by the live trials cleared at pilot discretion.

#### TWENTE

The VLD live trials had no impact on current operations at Twente airport considering the characteristic of the airport (size, small airport, and traffic, limited traffic load)

### 4.2.3 IGS-to-SRAP

The VLD live trials had no impact on current operations at Twente airport considering the characteristic of the airport (size, small airport, and traffic, limited traffic load)



## 5 References

---

### Safety

---

- [1] SESAR D1.3 DEMO Plan Part I-II v 00.01.00
- [2] SESAR PJ02-02 D2.1.01 PJ02-02 OSED-SPR-Interop Part I, II Edition 00.01.00
- [3] SESAR Safety Reference Material - latest edition accessible in STELLAR Program Library
- [4] Guidance to Apply SESAR Safety Reference Material - latest edition accessible in STELLAR Program Library
- [5] STELLAR Slideboard, Safety part (complementary guidance)
- [6] (EU) No 2017/373 laying down common requirements for service providers and the oversight in air traffic management/air navigation services and other air traffic management network functions, repealing Regulation (EC) No 482/2008, Implementing Regulations (EU) No 1034/2011 and (EU) No 1035/2011 and amending Regulation (EU) No 677/2011 (and associated AMC and GM)
- [7] SESAR P16.01.04, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

-END OF DOCUMENT-

**AIRBUS**



**indra**

**Honeywell**