Contextual note – PJ.02-01-04 "Wake Turbulence Separations (for Arrivals) based on Static Aircraft Characteristics" (V3) Description Form for Deployment Planning

1. Purpose

This contextual note describes SESAR solution PJ.02-01-04 "Wake Turbulence Separations (for Arrivals) based on Static Aircraft Characteristics" with a summary of the results stemming from R&D activities contributing to deliver it. It provides (to both those external and internal to the SESAR programme) an overview of PJ.02-01-04 in terms of scope, main operational and performance benefits, relevant system impacts and recommends additional activities that should be conducted during the industrialisation phase or as part of deployment.

This contextual note complements the solution Data Pack comprising the SESAR deliverables required for industrialisation and deployment.

2. Improvements in Air Traffic Management (ATM)

Static PairWise Separation for arrivals (S-PWS-A) is the efficient aircraft type pairwise wake separation rules for final approach consisting of both the 96 x 96 aircraft type based wake separation minima (for the most common aircraft in ECAC area) and the twenty wake category (20-CAT) based wake separation minima for arrival pairs involving all the remaining aircraft types.

The S-PWS are applied using a separation delivery tool; the pairwise separations will be used as input into the separation delivery tool. It is important to note that the application of the S-PWS-A concept will not have any negative impact on safety. By bringing the aircraft closer together, the frequency of wake turbulence encounters at lower severity level may increase. However, the pairwise wake turbulence risk will be aligned to what is considered as acceptable today on the basis of proven current operations experience at ICAO minima for reference aircraft pairs. In addition the use of the ORD tool improves the accuracy of separation delivery and reduces the number of unmanaged under-separations.

The solution targets capacity constrained runways during high intensity runway operations and applies to very large, large and possibly medium airports.

Relevant Operational Environments

OEs	Sub Operating Environments	Definition
Airport (capacity constrained)	Very Large Airport	Airports with more than 250k movements per year
	Large Airport	Airports with more or equal than 150k and less or equal than 250k movements per year
	Medium Airport	Airports with more or equal than 40k and less than 150k movements per year

Note: The investment on the ORD tool may be only justified only in large and very large airports.

3. Operational Improvement Steps (OIs) & Enablers

Applicable OI Step:

  AO-0306 — Wake Turbulence Separations (for Arrivals) based on Static Aircraft Characteristics .

Required Enablers:

  AERODROME-ATC-42a - Airport ATC tool to support static pair-wise wake separation (S-PWS) in final approach;

APP ATC 118 – ATC System to support static pair-wise wake separation (S-PWS) on approach;

REG-0523 – Regulatory provisions (AMC) for static pair-wise wake separation minima (S-PWS).

Optional Enablers:

AERODROME-ATC-60 – Airport ATC system to monitor wake turbulence risk using ground-based LIDAR/Radar;

Dependent OI Step (predecessor):

AO-0328 — Optimised Runway Delivery on Final Approach. This OI step is covered by solution PJ.02-01-01.

Applicable Integrated Roadmap Dataset is DS20.

4. Background and Validation Process

Significant work was performed by EUROCONTROL and ANSPs (NATS, DSNA, and AUSTROCONTROL) on Pairwise separation and TBS throughout SESAR 1.

SESAR1 Validation:

- **SESAR1 P06.08.01:** Flexible and Dynamic Use of Wake Turbulence Separations.

Solution PJ.02-01-04 builds on this work to further optimise wake turbulence separation rules. The Distance based pairwise wake separation scheme (96x96 pairwise and 20-CAT matrices) developed in the RECAT-PWS-EU Safety Case Ed. 1.4 submitted to EASA was used to derive TBS variant, which has been employed in five validation exercises to assess benefits and operational feasibility when used in combination with the ORD tool.

Within PJ.02-01-04, both real-time and fast-time simulation activities were carried out:

SESAR2020 Wave 1 Validation:

- **RTS2:** Validation to assess Static Pairwise Separations on the arrival approach (S-PWS-A) with Optimised Runway Delivery (ORD) tool under segregated runway operations**;**
- **RTS3a:** Validation to assess Static Pairwise Separations on the arrival approach (S-PWS-A) with Optimised Runway Delivery (ORD) tool plus Static Pairwise Separations for departures (S-PWS-D) with Optimised Separation Delivery (OSD) tool under mixed runway operations;
- **RTS4a:** Validation to assess Static Pairwise Separations on the arrival approach (S-PWS-A) with Optimised Runway Delivery (ORD) tool plus Static Pairwise Separations for departures (S-PWS-D) with Optimised Separation Delivery (OSD) tool under mixed mode runway operations;
- **RTS4b:** Validation to assess Static Pairwise Separations on the arrival approach (S-PWS-A) with Optimised Separation Delivery (OSD) tool plus Static Pairwise Separations for departures (S-PWS-D) with Optimised Separation Delivery (OSD) tool in a dual approach environment with CSPR under segregated and partially segregated runway operations;
- **FTS9:** Fast time simulations of ORD, S-PWS and WDS concepts for different airports to support the CBA.

5. Results and Performance Achievements

The findings also show that use of Pairwise Separation for Arrivals with the Optimised Runway Delivery tool in both segregated and mixed mode operations is operationally feasible and acceptable to controllers in a high complexity

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approach environment and a large airport environment. Note that if PWS-A with ORD is to be implemented in a CSPR airport environment then the concept needs to be validated for that local environment.

The application of PWS separation in TBS mode in all wind conditions leads to significant increase of throughput. For all separation scheme, the capacity benefits are limited if the traffic pressure is not sufficiently increased so as to force the aircraft flights to be separated close to minima. However, even without adaptation of the traffic pressure the investigated separation schemes lead to some benefits in terms of throughput.

Although resilience was not assessed per se, it should be noted that any increase in arrival throughput in the PWS-A scenario may be used to increase airport resilience rather than increase airport capacity. It would be up the local environment of where the solutions are implemented to decide whether to use the increase in runway throughput for additional capacity or resilience

No increase of potential human error was observed and no increase in the potential severity of existing human errors were observed or reported to be introduced by the TB PWS-A procedures under nominal conditions under either segregated or mixed mode runway operations. There was no increase in separation non-conformances before alignment or on the base leg. The controllers' feedback on the time based PairWise Separation concept with the ORD tool was very positive with controllers reporting that TB PWS-A with the ORD tool enabled them to manage the higher levels of traffic when implemented in segregated mode runway. The controllers have reported a lower level of workload with the application of TBS PWS-A and the ORD tool due to the possibility of closer spacing of the aircraft on the final approach.

6. Recommendations and Additional activities

The following recommendations should be taken into consideration during the industrialisation and deployment phases:

- The ORD tool needs to need to be further evolved to ensure it works reliably in all wind conditions, however challenging and complex;

- Training of TWR ATCO's shall emphasize the need for retaining current skills in aircraft WV category acknowledgement and the related spacing.

  An information campaign to airlines is required so that pilots are aware of the changes in separations that may be applied on the final approach and also to ensure that pilots conform to ATCO instructions in a timely manner. There is also a need to ensure pilots are convinced PWS-A is safe and pilots adhere to the instructions given by ATC to ensure PWS separations as applied as if pilots do not conform then the runway throughput benefits will be reduced;

- Further investigation is recommended on applicability of the PWS-A with ORD in CSPR/DT.

- Refine guidance, safety case and material supporting regulation of the Static pairwise separation matrix for arrivals. Develop (i.e. regulation and associated safety cases) a refined methodology for separation minima based on more categories or different categories for more adequacy to local airport environment depending on the traffic mix and the inclusion of new aircraft types in pairwise matrixes. Support the safety evidences for the regulatory approval, the refinement for further benefits increase and the consolidation allowing to facilitate deployment that correspond to optional regulatory enablers

7.   Actors Impacted by the SESAR Solution

The following actors are impacted by AO-0306:

- Air Traffic Controllers;
- Flight Crew;
- ANSPs;
- Airlines /airspace Users;
- Airport Operators;
- Regulatory Authorities.

8.   Impact on Aircraft System

No impact on aircraft system.

9.   Impact on Ground Systems

PWS-A requires the ORD tool to be integrated in CWP and current TBS system (if present).

The solution is based on existing MET capabilities and information to measure or forecast the wind on the final approach path.

The TS/IRS and the SPR-INTEROP/OSED refer to a new MET service (METForWTS service) that has been developed by solution PJ.18-04b. This service has achieved TRL2 in Wave 1 and it may be an option for this solution if further developed and validated in future R&D activities.

10.   Regulatory Framework Considerations

For distance-based pairwise separation for arrivals, a regulatory change as per the RECAT-PWS-EU Safety Case Ed. 1.4 has been submitted to EASA and is under review. Pairwise separation is expected to become an EASA AMC to Req. ATS.TR.220 Application of wake turbulence separation from Reg. EC 2017/373 Annex IV Part-ATS.

For Time based pairwise separations for arrivals, a regulatory change as per the TBS Minima Safety Case Ed. 1.0 has been submitted to EASA and is under review. TBS is expected to also become an EASA AMC to Req. ATS.TR.220 Application of wake turbulence separation from Reg. EC. 2017/373 Annex IV Part-ATS

11.   Standardisation Framework Considerations

N/A

12.   Solution Data pack

Solution PJ.02-01-04 is covered by PJ.02-01 Data Pack that includes the following documents:

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- D1.1.01 – PJ02-01 OSED-SPR-INTEROP (Final) Parts I 00.01.02, II, IV and V – 01.02.01 (31/01/2020);
- D1.1.02 – PJ02-01 TS/IRS (Final) – 00.03.04 (06/03/2020)[1];
- D1.1.04 – PJ02-01 VALR (Final) – 00.01.01 (31/01/2020);
- D1.1.05 – PJ02-01 CBA – 00.01.01 (31/01/2020).

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[1] The final version of the TS/IRS MS Word document still contains many requirements that are "in progress" status while they have been actually validated. The status of these requirements is properly updated and documented in the SE-DMF that represents the reference for the list of validated requirements.

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