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SESAR Solution PJ.02-01-06 Contextual Note for V3

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00.01.00	01/02/2023	Final	EUROCONTROL	Final delivered to SJU

*silent approval

Copyright Statement

PJ.02-W2 AART

AIRPORT, AIRSIDE & RUNWAY THROUGHPUT

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

Abstract

This contextual note describes PJ.02-01-06 OI step AO-0323 (Wake Turbulence Separations for Departures 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 AO-0323 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.

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1 Purpose

This contextual note describes PJ.02-01-06 OI step AO-0323 (Wake Turbulence Separations for Departures 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 AO-0323 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.

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2 Improvements in Air Traffic Management (ATM)

Significant work was performed by EUROCONTROL and ANSPs (NATS, DSNA, and AUSTROCONTROL) on Pairwise separation and TBS throughout SESAR 1. In SESAR 2020 Wave 1 solution PJ.02-01-06 built on this work to further optimise wake turbulence separation rules. The TB pairwise wake separation scheme (7 -CAT matrix) developed in the RECAT-EU-PWS Safety Case Ed. 1.4 submitted to EASA has been employed in three validation exercises. Additionally, the proposed TB 96 x 96 pairwise & 20-CAT matrices have been employed in two validation exercises. Thus TB PWS-D was assessed in five validation exercises with the OSD tool. In Wave 1, real-time simulation activities were used to validate this concept.

In Wave 2, PJ.02-01-06 the methodology for determining time based static pairwise wake separations between successive departures was refined and validated. The assessment methodology for integrating additional / new aircraft types to increase the operational benefits of S-PWS-D was also refined. New aircraft types were included in the pairwise matrix and the wake separation scheme extended from 96 aircraft types to 103 aircraft types. Additional safety evidence for supporting regulatory approval process was gained from the activities conducted, including VALEXE 11, the flight simulation. Wave 2 developments mentioned in this paragraph were included in the RECAT-EU-PWS Safety Case Ed. 2.1 and submitted to EASA for review.

2.1 Relevant Operational Environments

SESAR Solution PJ.02-01-06 aims to optimise wake separations for arrivals in Very Large, Large and Medium Airports. These operating environments are defined in PJ.19-W2 Validation Targets (2021) and extracted below.

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
	Medium Airport	Airports with more or equal than 40k and less than 150k movements per year

2.2 Expected Benefits

The following KPAs were expected to be benefitted through PWS-D:

- **Resilience** (additional resilience to cases of perturbation);
- **Environment** (decrease in fuel burn from aircraft taxi-out time);
- **Predictability** (less variability between planned and actual departure time);
- **Flight efficiency** (decrease in departure aircraft wake separations);
- **Cost efficiency** (can be integrated with existing systems);

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- **Capacity** (increased runway throughput).

For **Safety** it should be noted that 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.

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3 Operational Improvement Steps (OIs) & Enablers

Applicable OI Step:

AO-0323 — Wake Turbulence Separations (for Departures) based on Static Aircraft Characteristics.

Required Enablers:

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

AERODROME-ATC-42b — Airport ATC tool to support static pair-wise wake separation (S-PWS) for departure operations.

Optional Enabler:

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

Applicable Integrated Roadmap Dataset is DS23.

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4 Background and validation process

SESAR1 Validation:

- **SESAR1 P06.08.01:** Flexible and Dynamic Use of Wake Turbulence Separations;
- **RECAT-EU-PWS** Safety Case development.

SESAR2020 Wave 1 Validation:

- **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 the ORD tool for arrivals plus Static Pairwise Separations on for departures (S-PWS-D) with Optimised Separation Delivery (OSD) tool under mixed 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;
- **RTS5:** Validation of Static Pairwise Separations on Departure (S-PWS-D) and Weather Dependent Separations on Departure (WDS-D) and their integration with a departure Optimised Separation Delivery (OSD) tool on a single runway in segregated mode (London Heathrow);
- **RTS6:** Validation of Wake Turbulence Separations based on Static Aircraft Characteristics on Departure (S-PWS-D) and their integration with a departure Optimised Separation Delivery (OSD) tool plus Weather Dependent Separations on the arrival approach (WDS-A) and their integration with an arrival separation delivery tool.

SESAR2020 Wave 2 Validation:

- **VALEXE 11**: Flight simulation to validate the methodology developed to define time based Static Pairwise Wake Separations for departures (by validating the underlying principle of the safety case that justifies the reduction in departure separations through “equivalence” to arrival separation minima) and assess the acceptability of the reduced S-PWS-D to pilots.

5 Results and performance achievements

Consolidated Wave 1 Results

The results show that Pairwise Separation for Departures (7-CAT and 96-CAT) with Optimised Separation Delivery is operationally feasible and acceptable in segregated and mixed runway operations.

Wave 2

In Wave 2 the methodology for determining time based static pairwise wake separations between successive departures was refined and validated.

The assessment methodology for integrating additional / new aircraft types to increase the operational benefits of S-PWS-D was also refined.

New aircraft types were included in the pairwise matrix and the wake separation scheme extended from 96 aircraft types to 103 aircraft types.

Additional safety evidence for supporting regulatory approval process was gained from the activities conducted in Wave 2, including VALEXE 11, the flight simulation.

6 Recommendations and Additional activities

No additional activities recommended to complete V3.

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7 Actors impacted by the SESAR Solution

The following actors are impacted by AO-0323:

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

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8 Impact on Aircraft System

No impact on aircraft systems is currently foreseen.

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9 Impact on Ground Systems

PWS-D requires OSD tool support to be integrated in CWP and current TBS system (if present). Meteo services are needed for measuring and forecast the wind on the initial departure path.

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10 Regulatory Framework Considerations

A regulatory change as per the Wake Turbulence Re-Categorisation and Pair-Wise Separation Minima on Approach and Departure 'RECAT-EU-PWS' Safety Case report Ed. 2.1 (10th October 2022) 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.

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11 Standardization Framework Considerations

No change to the standardisation framework is currently foreseen.

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12 Solution Data pack

The PJ.02-01 Data Pack includes the following documents:

- D1.1.01 – PJ02-01 OSED-SPR-INTEROP (Final) Parts I, II, IV and V – 01.00.00 (31/01/2020);
- D1.1.02 – PJ02-01 TS/IRS (Final) – 01.00.00 (31/01/2020);
- D1.1.04 – PJ02-01 VALR (Final) – 01.00.00 (31/01/2020);
- D1.1.05 – PJ02-01 CBA – 01.00.00 (31/01/2020).

The SESAR 2020 Wave 2 PJ.02-01-06 Data Pack (D4.11) includes the following documents:

- D4.16.02 – PJ02-01-06 OSED-SPR-INTEROP (Final) Parts I, II, IV and V – 00.02.01 (31/10/2022);
- D4.16.06 – PJ02-01-06 VALR (Final) – 01.00.00 (11/11/2022);
- D4.16.08 – PJ02-01-06 TS/IRS (Final) – 01.00.00 (23/01/2023).

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