Contextual note – PJ.02-01-07 "Wake Vortex Decay Enhancing Devices" (TRL6) Description Form for Deployment Planning

1. Purpose

This contextual note describes the solution PJ.02-01-07 "Wake Vortex Decay Enhancing Devices" 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.02-01-07 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)

PJ.02-01-07 is a technological solution reducing the Wake Turbulence Risk via positioning of decay enhancing devices that accelerate the Wake Vortex Decay in Ground Proximity.

Wake Vortex Decay Enhancing Devices, so-called plate lines, can be installed at any major European airport in order to increase safety by reducing the risk of low-altitude wake encounters. In addition, further capacity gains may be possible through further optimisation of the wake turbulence separations on final approach (not addressed by this solution).

Plate lines reduce the lifetime of long-lived wake vortices in ground proximity by about 30%, making wake encounters less likely. Each plate line consists of several upright plates that are installed beyond the ends of runways underneath the approach glide path where the individual plates are oriented in parallel to the runway centreline. While descending, wake vortices interact with the plates generating disturbances that propagate in and against flight direction. These disturbances reduce the lifetime of the long-lived and potentially most hazardous wake vortices.

Relevant Operational Environments

OEs	Sub Operating Environments	Definition
Airport	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

3. Operational Improvement Steps (OIs) & Enablers

Applicable OI Step:

POI-0037-AO— Reduction of Wake Turbulence Risk considering Acceleration of Wake Vortex Decay in Ground Proximity.

Required Enablers:

AIRPORT-08 – Decay Enhancing Devices.

Applicable Integrated Roadmap Dataset is DS20.

4. Background and Validation Process

Previous work on Wake Vortex Decay Enhancing Devices indicates a reduction of the maximum wake vortex life time by at least 20%, leading to a positive impact on wake encounter rates close to ground and hence creating an associated safety benefit. Wake Vortex Decay Enhancing Devices can be installed at any major European airport in order to increase safety by reducing the number of encounters.

Within this solution, a live trial activity in Wave 1 was used to validate the Wake Decay Enhancing Devices:

- **LT10:** Two plate lines were installed at runway 16 of Vienna airport. A measurement campaign was conducted with the objective to quantify the accelerated vortex decay and the related safety gains. An average reduction of wake vortex lifetime of over 30% was found.

5. Results and Performance Achievements

The established plate line design and positioning successfully passed the safety assessment conducted by the EASA Safety- & Compliance Management of Vienna Int. Airport. It was also approved by the respective authorities (Bundesministerium für Verkehr, Innovation und Technologie, Austria). The plate lines were installed at Vienna Int. Airport and were operational during approach and landing on that runway.

The wake decay enhancing method is passive, low-cost, robust, and safe. The installation of the plates increases flight safety and reduces the number of go-arounds. The live trial has demonstrated the technical feasibility employing a temporary plate line design. Alternative designs for permanent installation have been developed.

The measurements with the temporal plate line design have demonstrated that the concept works well physically. Given the approval of the permanent plate design by authorities the concept can be installed with relatively little effort at other airports. The performance of the plate lines is measured in terms of reduced lifetime of the long-lived vortices. The lifetime of the long-lived wake vortices in the flight corridor under calm wind conditions can be reduced by the installation of plate lines by about 30%.

Furthermore, the solution may enable capacity gains via synergies with other measures for the optimization of aircraft separations (e.g. RECAT, S-PWS or WDS), but this capacity benefits have not been validated in Wave 1.

6. Recommendations and Additional activities

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

1. Elaborate a technical plate line design for permanent installation at an airport;
2. Receive approval from the authorities for the installation of plate lines at the runway ends;
3. Installation of the plate prototype in a suitable environment considering legal, and stakeholders requirements;
4. Thorough quantification of the acceleration of wake vortex decay by plate lines considering the effects of individual aircraft types, flight altitudes, and environmental conditions. This analysis shall also provide guidance on the number of required plate lines and their location.

Very large scale demonstrations could support the transition of this solution towards deployment.

Future R&D activities may assess the potential reductions of separation minima that the solution may bring for other arrival concepts e.g. RECAT-EU, S-PWS, etc. after carefully considering their respective safety cases.

7. Actors Impacted by the SESAR Solution

The following actors are impacted by AO-0325:

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

8. Impact on Aircraft System

Plate-Lines have no influence on existing aircraft systems.

9. Impact on Ground Systems

Plate lines are installed beyond the runway ends and are electromagnetically compatible with the instrument landing system. Due to the plate line placement, guidance lighting visibility is maintained.

10. Regulatory Framework Considerations

Plate Lines were classified as air traffic control system. They comply with the requirements set forth by ICAO regarding obstacle clearance, stability, and frangibility. A safety assessment was conducted by the EASA Safety- & Compliance Management of Vienna Int. Airport assuring that the plate lines comply with the relevant standards and regulations.

11. Standardisation Framework Considerations

N/A

12. Solution Data pack

Solution PJ.02-01-07 is covered by PJ.02-01 Data Pack that includes the following documents:

- D1.1.01 – PJ02-01 OSED-SPR-INTEROP (Final) Parts I 00.01.02, II, IV and V – 01.02.01 (31/01/2020)[1];

[1] Note that the SPR-INTEROP/OSED does not explicitly explain that PJ.02-01-07 is actually a technological solution and not an ATM solution as initially intended. PJ.02-01-07 is a technological solution aiming at reducing the Wake Turbulence Risk via positioning of decay enhancing devices that accelerate the Wake Vortex Decay in Ground Proximity. The potential reduce of separation based on this solution (ATM solution) was not validated in Wave 1.

- D1.1.02 – PJ02-01 TS/IRS (Final) – 00.03.04 (06/03/2020)[2];
- 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).

[2] 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.