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# SESAR Solution PJ.02-01-06 SPR-INTEROP/OSED for V3 Final Version - Part I


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# PJ.02-W2 AART

AIRPORT, AIRSIDE AND RUNWAY THROUGHPUT

This Operational Service and Environment Definition 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 Part I of the SPR-INTEROP/OSED presents the concepts that contribute to WTS (for Departures) developed in PJ02-01 SESAR 2020 Wave 1:

- AO-0323 – Static Pairwise Separations (S-PWS) for Departures (PJ.02-01-06);
- AO-0304 – Weather -Dependent Reductions of Wake Turbulence Separations for Departures (WDS-D) (PJ.02-01-05);
- AO-0329 – Optimised Separation Delivery for Departure (OSD) (PJ.02-01-02).

The PJ.02-01-06 Solution is an extension of the PJ.02-01 departures solutions that were developed in SESAR Wave 1 to V3 maturity. PJ.02-01 aimed to optimise wake turbulence separation minima for departures to enhance airport runway throughput. It focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions
- Separation delivery support tools for ATCOs

The purpose of this PJ.02-01-06 OSED as a separate Wave 2 document is to describe the further development of the static pairwise wake separation minima for departures, specifically development of the time-based minima, based on an expanded aircraft type matrix. These updates are principally represented through the introductions of:

- The revised S-PWS-D time-based aircraft type matrix to section 3.2.4.2.2;
- The methodology and results description for the distance-based Wave 2 developments as Annex A. This document presents the results of the study to update the RECAT Pairwise Wake turbulence Separation matrix for arrivals and departures (RECAT-PWS);
- The methodology and results description for the conversion of this work to a time-based scheme as Annex B. This document presents the methodology and results of the study for Time Based Static Pairwise Wake Separations for Departures.

However, for completeness all three PJ02-01 departure solutions are covered in the document.

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# 1 Executive Summary

This Part I of the SPR-INTEROP/OSED presents the concepts that contribute to WTS (for Departures) developed in SESAR 2020 Wave 1 PJ.02-01:

- AO-0329 – Optimised Separation Delivery for Departure (PJ.02-01-02);
- AO-0323 – Static Pairwise Separations (S-PWS) for Departures (PJ.02-01-06);
- AO-0304 – Weather -Dependent Reductions of Wake Turbulence Separations for Departures (PJ.02-01-05).

The PJ.02-01-06 Solution is an extension of the PJ.02-01 departures solutions that were developed in SESAR Wave 1 to V3 maturity. The purpose of this PJ.02-01-06 OSED as a separate Wave 2 document is to describe the further development of the static pairwise wake separation minima for departures.

PJ.02-01 aimed to optimise wake turbulence separation minima for departures to enhance airport runway throughput. It focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions
- Separation delivery support tools for ATCOs

OSD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between departure pairs on the initial departure path.

S-PWS-D is the efficient aircraft type pairwise wake separation rules for departure operations currently consist of the time-based seven wake category (7-CAT) based wake separation minima, or the time- and distance-based 103x103 (updated from the 96x96 matrix developed in Wave 1) aircraft type based pairwise wake separation minima in conjunction with the twenty wake category (20-CAT) time and distance-based wake separation minima for departure pairs involving other aircraft types.

In SESAR 2020 Wave 1 draft aircraft type pairwise time-based wake separation minima and refined wake category time-based wake separation minima were established and employed in the validation exercises in order to support assessment of the Human Performance, Safety and Performance validation objectives.

WDS-D is the conditional reduction or suspension of the wake separation minima for departure operations, applicable under pre-defined wind conditions so as to enable a runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either crosswind transported out of the path of the follower aircraft on the initial departure path, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft on the initial departure path.

The wake separation minima on the initial departure path are defined as both distance-based minima and time-based minima, and so may be applied as either distance-based minima or time-based minima.

OSD, PWS-D and WDS-D increase departure runway capacity, and improve the efficiency, predictability and resilience of departure operations, while maintaining safety.

OSD, PWS-D and WDS-D are all V3 mature. OSD has ended in Wave 1. For PWS-D, this PJ.02-01-06 OSED represents an activity to develop the aircraft type pairwise time-based wake separation minima for departures and the refined wake category time-based wake separation minima.

# 2 Introduction

## 2.1 Purpose of the document

This document[1] provides the requirements specification, covering functional, non-functional and interface requirements related to all three SESAR 2020 Wave 1 PJ.02-01 departures solutions and focusses on providing updates to the S-PWS-D solution.

The purpose of this PJ.02-01-06 OSED as a separate Wave 2 document is to describe the further development of the static pairwise wake separation minima based on an expanded aircraft type matrix. These updates are principally represented through the introductions of:

- The revised S-PWS time-based aircraft type matrix to section 3.2.4.2.2;
- The methodology and results description for the distance-based Wave 2 developments as Annex A. This document presents the results of the study to update the RECAT Pairwise Wake turbulence Separation matrix for arrivals and departures (RECAT-PWS);
- The methodology and results description for the conversion of this work to a time-based scheme as Annex B. This document presents the methodology and results of the study for Time Based Static Pairwise wake Separations for Departures.

**The SESAR Solution Development Life Cycle** aims to structure and perform the work at project level and progressively increase SESAR Solution maturity, with the final objective of delivering a SESAR Solution data-pack for industrialisation and deployment. The Part I of the SPR-INTEROP/OSED represents one of the key parts of this SESAR Solution data-pack.

## 2.2 Scope

This is the Part I of the SPR-INTEROP/OSED for SESAR Solution PJ.02-01-06 for the V3 pre-industrial development & integration maturity phase.

This SPR/INTEROP/OSED covers safety, performance, operational aspects as well as the interoperability aspects related to a specific technology to support all three SESAR 2020 Wave 1 PJ.02-01 departures solutions and focusses on providing updates to the SESAR Solution PJ.02-01-06 WTS (for Departures) based on Static Aircraft Characteristics. Thus covering the following concepts solutions:

- AO-0329 – Optimised Separation Delivery for Departure;
- AO-0323 – Static Pairwise Separations (S-PWS) for Departures;
- AO-0304 – Weather -Dependent Reductions of Wake Turbulence Separations for Departures.

[1] The opinions expressed herein reflect the authors view only. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

## 2.3 Intended readership

The intended readership is the SESAR Solution PJ.02-01-06 project members, the other solutions in SESAR Project PJ.02 Airport, Airside and Runway Throughput, the related solutions in SESAR Project PJ.01 Enhanced Arrivals and Departures, the related solutions in SESAR Project PJ.04 Total Airport Management, the related solutions in SESAR Project PJ.09 Advanced Demand & Capacity Balancing, the related transversal SESAR Projects PJ.19 and PJ.22, and all impacted and interested stakeholders.

## 2.4 Background

The Wake Turbulence Separations for Departures based on Static Aircraft Characteristics is to utilise the more efficient wake separations developed by the RECAT-EU-PWS activities under the re-categorisation programme and in SESAR 1 Project P06.08.01 and under approval by EASA [35]. RECAT-EU for departures is currently deployed at one European airport (London Heathrow).

The Weather Dependent Reductions of Wake Turbulence Separations for Departures is based on the Crosswind Reduced Separation for Departures concept developed by the CREDOS Project in the European Commission 6$^{th}$ Framework Programme (EC 6$^{th}$ FP) from 2006 to 2010 [56], and was further developed and validated in SESAR 1 Project P06.08.01 and which included the wind speed related “Total Wind” criteria concept [51].

The Optimised Separation Delivery for Departures and the associated controller tool support is based on the controller tool support developed in the CREDOS Project [58], taking into account the operational practitioner feedback at the end of the CREDOS project [60].

As part of SESAR 2020 Wave 2, the PJ.02-01-06 solution has been created to support the planned refinements to the 96x96 matrix proposed in Wave 1. This has since been expanded to a 103x103 matric to include additional and new aircraft types. For completeness, this OSED still contains all three of the Wave 1 PJ.02-01 departures solutions (OSD, PWS-D and WDS-D).

## 2.5 Structure of the document

The SPR-INTEROP/OSED consists of five parts:

- Part I, this part, providing the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP) related to SESAR Solution PJ.02-01-06 WTS (for Departures) based on Static Aircraft Characteristics, that have been developed and validated during the validation activities of SESAR 2020 Solution PJ.02-01-06 to a V3 maturity level. They are presented in the context of the Operational Service and Environment Definition (OSED) which describes the environment, assumptions and other issues that are applicable to the SPR and INTEROP requirements.
- Part II: The Safety Assessment Report which describes the results of the safety assessment work for the SESAR Solution PJ.02-01-06 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I.
- Part III: The Security Assessment Report which describes the results of the security assessment work for the SESAR Solution PJ.02-01-06 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I.

- Part IV: The Human Performance Assessment Report which describes the results of the Human Performance Assessment Report which describes the results of the Human Performance assessment work for the SESAR Solution PJ.02-01-06 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I.
- Part V: The Performance Assessment Report (PAR) that consolidates the performance results obtained across the different validation activities at the SESAR Solution PJ.02-01-06 concepts solutions level.

This part of the SESAR Solution PJ.02-01-06 SPR-INTEROP/OSED (Part I) consists of five main sections , an appendix and two annexes. Each section and the appendix addresses each of the Wave 1 departures solutions based on Static Aircraft Characteristics concepts solutions while the Annexes focus on Wave 2 S-PWS-D research:

- Section 1: Executive Summary of the brief description of the concepts solutions and the associated research needs gaps and issues;
- Section 2: Introduction covering the purpose of the document, the scope, the intended readership, the background to the V2 feasibility maturity level of the concepts at the end of SESAR 1, the glossary of terms and the list of acronyms;
- Section 3: The Operational Service and Environment Definition detailing the concepts solutions and the improvements, expected benefits, allocated validation targets, key features and capabilities, any dependencies on other SESAR 2020 solutions, operational characteristics, roles and responsibilities, technical characteristics, applicable standards and regulations, previous operating method, new operating method, use cases, and differences between the new and previous operating methods;
- Section 4: The Safety, Performance and Interoperability Requirements (SPR-INTEROP) established in the V3 maturity validation activities of SESAR 2020 Solution PJ.02-01-06.
- Section 5: References and Applicable Documents;
- Appendix A: Costs and Benefits Mechanisms including stakeholders identification and expectations, benefits mechanisms and costs mechanisms;
- Annex A: PWS-A/D Methodology, detailing the process used to produce the proposed 103 x 103 DB-PWS-A/D matrix.
- Annex B: TB S-PWS-D Methodology & Results, detailing the process used to convert the distance-based matrix proposed in Annex A into a time-based matrix.

## 2.6 Glossary of terms

| Term | Definition | Source of the definition |
|---|---|---|
| DBS | Refers to applying wake separations on final approach which are based on distances. This is how wake separations are applied in the majority of current operations. | OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [51] |
| In-trail aircraft pair | Refers to consecutive aircraft pairs that are landing on the same runway. | OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [51] |

| | | |
|---|---|---|
| Not-in-trail aircraft pair | Refers to consecutive aircraft pairs that are landing on different parallel runways. | OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [51] |
| ORD | Refers to the Optimised Runway Delivery concept which intends to provide additional tool support to show the Controller the required spacing on the approach to take into account the effect of compression primarily caused by aircraft decelerating to land. | OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [51] |
| S-PWS | A wake separation concept where wake separations are optimised by defining them between aircraft type pairs rather than between wake categories. | OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [51] |
| TBS | Refers to the generic TBS concept that was developed in SESAR 1 Project P06.08.01 which included tool support to show the Controller the required separation. | OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [51] |
| WDS (departures) | A concept that allows the reduction of wake separations between departures when the wind is above a certain threshold based on the argument that WT is more rapidly decayed as the wind magnitude increases.<br>*Note that within SESAR 2020 there are two main versions: WDS (total wind) and WDS (crosswind).*<br>*WDS (total wind) aims to allow reduced Wake Turbulence (WT) separations based on the argument that WT is more rapidly decayed as the wind magnitude increases.*<br>*WDS (crosswind) aims to allow the reduction of WT separations based on the argument that WT is transported out of the path of follower aircraft.*<br>*Also note that a third version of differentiated rotation positions and climb profiles is under consideration in SESAR 2020.* | OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [51] |

**Table 1: Glossary of terms**

## 2.7 List of Acronyms

| Acronym | Definition |
|---|---|
| **3-CAT** | Three Wake Category |

| | |
|---|---|
| **6-CAT** | Six Wake Category |
| **7-CAT** | Seven Wake Category |
| **14-CAT** | Fourteen Wake Category |
| **20-CAT** | Twenty Wake Category (Fourteen Wake Category with Six Wake Category) |
| **A-CDM** | Airport Collaborative Decision Making |
| **A-SMGCS** | Advanced Surface Movement Guidance and Control System |
| **ACC** | Area Control Centre |
| **ADI** | Average Departure Interval |
| **ADS-B** | Automatic Dependent Surveillance Broadcast |
| **AFTN** | Aeronautical Fixed Telecommunication Network |
| **AIP** | Aeronautical Information Publication |
| **AO** | Aircraft Operations |
| **AOCC** | Aircraft Operations Control Centre |
| **AoR** | Area of Responsibility |
| **AMAN** | Arrival Manager (System) |
| **APOC** | Airport Operations Centre |
| **AROT or aROT** | Arrival Runway Occupancy Time |
| **ATC** | Air Traffic Control |
| **ATCo** | Air Traffic Controller |
| **ATCO** | Air Traffic Control Officer |
| **ATFCM** | Air Traffic Flow and Capacity Management |
| **ATIS** | Automatic Terminal Information Service |
| **ATM** | Air Traffic Management |
| **ATS** | Air Traffic Service |
| **ATSA** | Air Traffic Services Assistant |
| **CAP** | Capacity |
| **CAT** | Category (for aircraft classification for wake) |
| **CAT <n>** | Category of ILS System (CAT I, CAT II, CAT III) |
| **CBA** | Cost Benefit Assessment |
| **CDM** | Collaborative Decision Making |
| **CNS** | Communication Navigation and Surveillance |
| **CONOPS** | Concept of Operations |
| **CR** | Change Request |

| | |
|---|---|
| **CREDOS** | Crosswind-Reduced Separation for Departure Operations |
| **CTOT** | Calculated Take Off Time |
| **CWP** | Controller Working Position |
| **D-ATIS** | Digital Automatic Terminal Information Service |
| **DBS** | Distance Based Separation |
| **DC** | Data Collection |
| **DDI-D** | Dynamic Departure Indicator - Distance |
| **DDI-T** | Dynamic Departure Indicator - Time |
| **DER** | Departure End of the Runway |
| **DF** | Deceleration Fix (for landing stabilisation) |
| **DLR** | Deutsches Zentrum für Luft- und Raumfahrt |
| **DMAN** | Departure Manager (System) |
| **DME** | Distance Measuring Equipment |
| **EASA** | European Aviation Safety Agency |
| **EATMA** | European ATM Architecture |
| **E-ATMS** | European Air Traffic Management System |
| **EC 6FP** | European Commission 6$^{th}$ Framework Programme |
| **EFPS** | Electronic Flight Progress Strip |
| **EU** | European Union |
| **EXE** | Exercise |
| **FAF** | Final Approach Fix |
| **FAP** | Final Approach Point |
| **FOC** | Flight Operations Centre |
| **FPL** | Flight Plan |
| **ft** | feet |
| **FTD** | Final Target Distance |
| **FTS** | Fast Time Simulation |
| **GH** | Ground Handlers |
| **GMC** | Ground Movement Controller |
| **GMP** | Ground Movement Planner |
| **GNSS** | Global Navigation Satellite System |
| **GPS** | Global Positioning System |
| **GWCS** | Glideslope Wind Conditions Service |

| | |
|---|---|
| **HEAVY** | ICAO Heavy Wake Category |
| **HMI** | Human Machine Interface |
| **HPAR** | Human Performance Assessment Report |
| **Hz** | Hertz |
| **IAF** | Initial Approach Fix |
| **ICAO** | International Civil Aviation Organisation |
| **IAS** | Indicated Air Speed |
| **ILS** | Instrument Landing System |
| **INTEROP** | Interoperability Requirements |
| **ITD** | Initial Target Distance |
| **kg** | kilograms |
| **KIAS** | Knots Indicated Air Speed |
| **KPA** | Key Performance Area |
| **kt or kts** | knots |
| **KTAS** | Knots True Air Speed |
| **LiDAR** | Light Detection and Ranging |
| **LIGHT** | ICAO Light Wake Category |
| **LT** | Live Trial |
| **m** | metres |
| **m/s** | metres per second |
| **MDI** | Minimum Departure Interval |
| **MEDIUM** | IACO Medium Wake Category |
| **MET** | Meteorological |
| **MHz** | Megahertz (1,000,000 Hz) |
| **MLS** | Microwave Landing System |
| **MRS** | Minimum Radar Separation |
| **MTOM** | Maximum Take Off Mass |
| **MTOW** | Maximum Take Off Weight |
| **N/A** | Not applicable |
| **NDB** | Non Directional Beacon |
| **NM** | Nautical Mile (1852m) |
| **NMF** | Network Management Function |
| **NPR** | Noise Preferential Route |



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| **OFA** | Operational Focus Area |
| **OI** | Operational Improvement |
| **OM** | Outer Marker (final approach) |
| **OPAR** | Operational Performance Assessment Report |
| **OSD** | Optimised Separation Delivery (departures) |
| **OSED** | Operational Service and Environment Definition |
| **PANS** | Procedures for Air Navigation Services |
| **PAR** | Performance Assessment Report |
| **PCP** | Pilot Common Project |
| **PFS** | Paper Flight Strip |
| **PIRM** | Programme Information Reference Model |
| **PJ** | Project |
| **PSR** | Primary Surveillance Radar |
| **PWS** | Pairwise Wake Separation |
| **PWS-D** | Pairwise Wake Separation for Departures |
| **QoS** | Quality of Service |
| **R&D** | Research & Development |
| **R/C** | Radio Communications |
| **RBT** | Reference Business Trajectory |
| **RECAT** | Re-categorisation (wake scheme) |
| **RECAT-EU** | RECAT Europe |
| **RECAT-EU-PWS** | RECAT Europe Pair Wise Separation |
| **REQ** | Requirement |
| **RMT** | Reference Mission Trajectory |
| **ROT** | Runway Occupancy Time |
| **RSVA** | Reduced Separation in the Vicinity of the Aerodrome |
| **RT (or R/T)** | Radio Telephone or Radiotelephony |
| **RTS** | Real-Time Simulation |
| **s** | seconds |
| **S-PWS** | Static Pair Wise Separation |
| **SAC** | Safety Criteria |
| **SAR** | Safety Assessment Report |
| **SBT** | Shared Business Trajectory |

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| **SecAR** | Security Assessment Report |
| **SESAR** | Single European Sky ATM Research Programme |
| **SESAR 1** | SESAR from 2010 to 2016 |
| **SESAR 2020** | SESAR from 2016 (to 2020) |
| **SID** | Standard Instrument Departure |
| **SJU** | SESAR Joint Undertaking |
| **SME** | Subject Matter Expertise |
| **SMT** | Shared Mission Trajectory |
| **SPR** | Safety and Performance Requirements |
| **SSR** | Secondary Surveillance Radar |
| **STAR** | Standard Terminal Arrival Route |
| **SWIM** | System Wide Information Model |
| **TAS** | True Air Speed |
| **TB** | Time Based |
| **TBA** | To be added |
| **TBD** | To be determined |
| **TBS** | Time Based Separation |
| **TDI** | Target Distance Indicator |
| **TIS-B** | Traffic Information Services - Broadcast |
| **TOBT** | Target Off Blocks Time |
| **TMA** | Terminal Manoeuvring Area |
| **TS** | Technical Specification |
| **TSAT** | Target Start-up Approval Time |
| **TT** | Target Time |
| **TTOT** | Target Take-Off Time |
| **UTC** | Universal Coordinated Time |
| **V APP** | Approach Speed |
| **VCR** | Visual Control Room |
| **VOR** | VHF Omnidirectional Range |
| **$V_R$** | Rotation Speed (for Take Off) |
| **WDS** | Weather Dependent Separation |
| **WDS-D** | Weather Dependent Separation for Departures |
| **WT** | Wake Turbulence |

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| **WTC** | Wake Turbulence Category |
| **WTE** | Wake Turbulence Encounter |
| **WVE** | Wake Vortex Encounter |

**Table 2: List of acronyms**

# 3 Operational Service and Environment Definition

## 3.1 SESAR Solution PJ.02-01-06: a summary

### 3.1.1 Introduction

SESAR Wave 1 Solution PJ.02-01 encompasses the following departure concepts:

- AO-0323 – Static Pairwise Separations (S-PWS) for Departures (PJ.02-01-06);
- AO-0304 – Weather -Dependent Reductions of Wake Turbulence Separations for Departures (WDS-D) (PJ.02-01-05);
- AO-0329 – Optimised Separation Delivery for Departure (OSD) (PJ.02-01-02).

SESAR Solution PJ.02-01 focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions
- Separation delivery support tools for ATCOs

In Wave 2 work continued on PJ.02-01-06 to further optimise wake turbulence separation minima for departures to enhance airport runway throughput (A0-0323). PJ02-01-06 is the focus of this OSED due to the additional development conducted in SESAR 2020 Wave 2 on this solution.

SESAR Solution PJ.02-01-06 is part of the High Performing Airport Operations Project PJ02.

As airports remain one of the most significant bottlenecks in the ATM, the WTS (for Departures) based on Static Aircraft Characteristics solutions represent great potential for system-wide improvements.

### 3.1.2 Summary of Departures Solutions

OSD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between departure pairs on the initial departure path.

S-PWS-D is the set of efficient aircraft type pairwise wake separation rules for departure operations, which currently consists of the time-based seven wake category (7-CAT) based wake separation minima, or the time and distance-based aircraft type-based pairwise wake separation minima in conjunction with the twenty wake category (20-CAT) time- and distance-based wake separation minima for departure pairs involving other aircraft types. Note the PWS-D solution was developed across Wave 1 and Wave 2; most of this document includes the overview of Wave 1 work focussed on the development of distance-based PWS and 20-CAT matrices. Wave 2 work on development of the time-based PWS matrix and a refined list of aircraft is referenced in the appropriate sections, with the methodology and discussion included in Annex A and Annex B.

WDS-D is the conditional reduction or suspension of wake separation minima for departure operations, applicable under pre-defined wind conditions, so as to enable a runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either crosswind transported out of the path of the follower aircraft on the initial departure path, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft on the initial departure path. Two pre-defined wind conditions were proposed for consideration, a 10 knots wind speed in any direction (Total Wind concept), and a 6 to 10 knots crosswind to the initial departure track (Crosswind concept), of which the Crosswind concept has been the primary focus of development and validation in PJ.02-01-06.

A third WDS-D concept was also under consideration, this is the wake avoidance of the wake generated by the lead aircraft through the follower aircraft employing an earlier differentiated rotation position and a steeper climb profile than the lead aircraft. However initial analysis of recorded operational data has indicated that the current operations differentiated rotation positions and climb profiles at London Heathrow are not sufficiently consistent to ensure wake avoidance.

The wake separation minima on the initial departure path are defined as both distance-based minima and time-based minima, and so may be applied as either distance-based minima or time-based minima.

OSD, PWS-D and WDS-D increase departure runway capacity, and improve the efficiency, predictability and resilience of departure operations, while maintaining safety:

- **Runway Capacity:** The reduction of wake separation minima through the application of the more efficient PWS-D, and the application of the conditional reduction or suspension of WDS-D, facilitated by the OSD ATC support tool, has a direct impact on runway throughput and therefore capacity.
- **Efficiency:** The OSD ATC support tool enhances operational efficiency by enabling the ATCOs to safely, efficiently and consistently deliver to the PWS-D and WDS-D wake separation minima.
- **Predictability:** The OSD ATC support tool, by facilitating delivery to the optimised departure wake separation minima (PWS-D, WDS-D), will help to maintain runway throughput in adverse departure operations conditions. Additionally, where the reduction of separation (PWS-D) is not translated 100% into an increase in the declared capacity, the additional spare capacity allows for the more efficient delivery of any peak over-demand, thus reducing delay.
- **Flexibility:** PWS-D can be used to refine delivered separations to either increase capacity or to provide additional resilience in the runway throughput schedule. WDS-D as a conditional separation reduction can be used tactically when conditions allow providing additional resilience to the departures throughput.
- **Resilience:** The OSD ATC support tool and the use of PWS-D and WDS-D under different modes of operation (segregated, mixed mode) supports ATC to be able to more flexibly manage the runway mode of operation, and so provide added resilience to disruption events such as a temporary unserviceable runway.
- **Environment/Fuel Efficiency:** Through reducing delay and disruption there is a positive impact on fuel efficiency and the associated emissions impact on the environment.
- **Human Performance:** The OSD ATC support tool helps to manage the complexity of employing the efficient PWS-D and WDS-D wake separation minima, facilitating safe, efficient and consistent delivery to the wake separation minima, and mitigating the associated impact on ATC workload.

- **Safety:** The OSD ATC support tool enables the efficient and consistent separation delivery to the PWS-D and WDS-D rules, thus enabling a safe reduction in the overall amount of wake separation that is required to be delivered.
- **Cost Efficiency:** The expected increase of capacity will largely compensate for the associated cost of deploying the OSD ATC support tool to enable the employment of the efficient PWS-D and WDS-D wake separation minima.

More details on the benefits results from the validation exercises are detailed in the VALR and PAR documents.

For the departures concepts solutions there are no major dependencies to other SESAR Solutions.

### 3.1.3 Validation Targets Allocated to SESAR Solution PJ.02-01-06

From the PJ19 Validation Targets (2018) the following validation targets were allocated to SESAR Solution PJ.02-01-06:

- Airport Capacity

| SOL CODE | Solution Validation Target | APT CAP Target per Sub-OE | | |
|---|---|---|---|---|
| | | APT Very Large | APT Large | APT Medium |
| Solution PJ.02-01-06 | 2,160% | 2,160% | 2,160% | 2,160% |

- Predictability

| SOL CODE | Solution Validation Target | PRD1 Target per Sub-OE | | | |
|---|---|---|---|---|---|
| | | Terminal Very High Complexity | Terminal High Complexity | Terminal Medium Complexity | Terminal Low Complexity |
| Solution PJ.02-01-06 | 0,800% | 0,494% | 0,104% | 0,098% | 0,104% |

- Environment/Fuel Efficiency (saving kg/flight)

| SOL CODE | Solution Validation Target | FEFF Target per Sub-OE | | | | | |
|---|---|---|---|---|---|---|---|
| | | Terminal Very High Complexity | Terminal High Complexity | Terminal Medium Complexity | APT Very Large | APT Large | APT Medium |
| Solution PJ.02-01-06 | 20,643 | 7,035 | 1,481 | 1,389 | 4,443 | 3,703 | 2,592 |

- Safety

| SOL CODE | Solution Validation Target | Safety | | |
|---|---|---|---|---|
| | | APT Very Large | APT Large | APT Medium |
| Solution PJ.02-01-06 | -0.86% | -3.68% | -3.68% | -3.68% |

### 3.1.4 Scope and Related OI Steps and Link to CONOPS

| SESAR Solution ID | SESAR Solution Title | OI Steps ID | OI Steps Title | OI Step/Enabler Coverage |
|---|---|---|---|---|
| PJ.02-01-06 | WTS (for Departures) based on Static Aircraft Characteristics | AO-0329 | Optimised Separation Delivery for Departure | **Fully (V3)** |
| | | AO-0323 | Wake Turbulence Separations (for Departures) based on Static Aircraft Characteristics | **Fully (V3)**<br>(Planned for Wave 2 is an activity to develop the safety case for the aircraft type pairwise time-based wake separation minima and the refined wake category time-based wake separation minima for departures for regulatory approval) |
| | | AO-0304 | Weather-Dependent Reductions of Wake Turbulence Separations for Departures | **Fully (V3)**<br>(Procedures that could increase the benefits such as early lateral displacement procedures and differentiated rotation position and climb profile procedures identified as an activity for Wave 2) |

**Table 3: SESAR Solution PJ.02-01-06 Scope and related OI steps/enablers**

| High Level Concept of Operations Requirement ID | High Level Concept of Operations Requirement | Reference to relevant Concept of Operations Sections e.g. Operational Scenario applicable to the SESAR Solution |
|---|---|---|
| S02-01-HLOR-01 | The Optimisation of Wake Turbulence Separation shall:<br>• increase runway throughput | Airport Operational Scenario Execution Phase: Arrival (Scope: Approach, Final Approach, and Landing) |

| | | |
|---|---|---|
| | • ensure more refined and efficient wake separation than current ICAO rules<br>• ensure consistent and efficient management of spacing compression on final approach and the initial departure phase of flight<br>by automatically managing the complexity of applying the required wake separation between each aircraft pair through:<br>• the implementation of S-PWS and WDS<br>• the use of the associated ATC support tools<br>while:<br>• supporting passive wake vortex decay devices | Airport Operational Scenario Execution Phase: Departure (Scope: Take-Off)<br>Airport Operational Scenario Post Execution phase: Arrival (Scope: Approach, Final Approach, and Landing)<br>• Airport Operational Scenario Post Execution phase: Departure (Scope: Take-Off) |

**Table 4: Link to Concept of Operations**

### 3.1.5 Deviations with respect to the SESAR Solution(s) definition

No deviations.

## 3.2 Detailed Operational Environment

### 3.2.1 Operational Characteristics PJ.02-01-06 WTS (for Departures) based on Static Aircraft Characteristics

SESAR Solution PJ.02-01-06 aims to optimise wake turbulence separation minima for departures in Very Large Airports and Large Airports, and Terminal Very High Complexity, Terminal High Complexity and Terminal Medium Complexity sub operational environments. These operational environments are defined in PJ19 Validation Targets (2018) and extracted into Table 5 below.

| OEs | Sub Operating Environments | Definition |
|---|---|---|
| Terminal | Terminal Very High Complexity | Very High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of equal or more than 10 |
| | Terminal High Complexity | High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of between 6 and 10 |
| | Terminal Medium Complexity | High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of between 2 and 6 |
| | Terminal Low Complexity | Low complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of less than 2 |
| En-route | En-route Very High Complexity | Very High complexity ACCs have a complexity score of equal to or greater than 10 |
| | En-route High Complexity | High complexity ACCs have a complexity score of between 6 and 10 |
| | En-route Medium Complexity | Medium complexity ACCs have a complexity score of between 2 and 6 |
| | En-route Low Complexity | Low complexity ACCs have a complexity score of less than 2 |
| 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 |
| | Medium Airport | Airports with more or equal than 40k and less than 150k |
| | Small Airport | Airports with more or equal than 15k and less than 40k |
| | Other | Airports with less than 15k movements per year |

**Table 5: Overview of Operating Environments (OEs) and Sub-OEs**

The runway configurations and modes of operations employed at Very Large Airport and Large Airports include:

- Single runway operating in mixed mode operations;
- Independent parallel runways operating in segregated mode operations;
- Dependent parallel runways operating in segregated mode operations with the option of some arrival aircraft landing on the designated departure runway;
- Closely spaced parallel runways operating in segregated mode operations;
- Closely spaced parallel runways operating in mixed mode operations.

The departures concepts solutions PWS-D and WDS-D wake separations are applicable immediately after take-off, on a predetermined extent during climb-out on the initial straight-out common departure path of the standard instrument departures (SIDs).

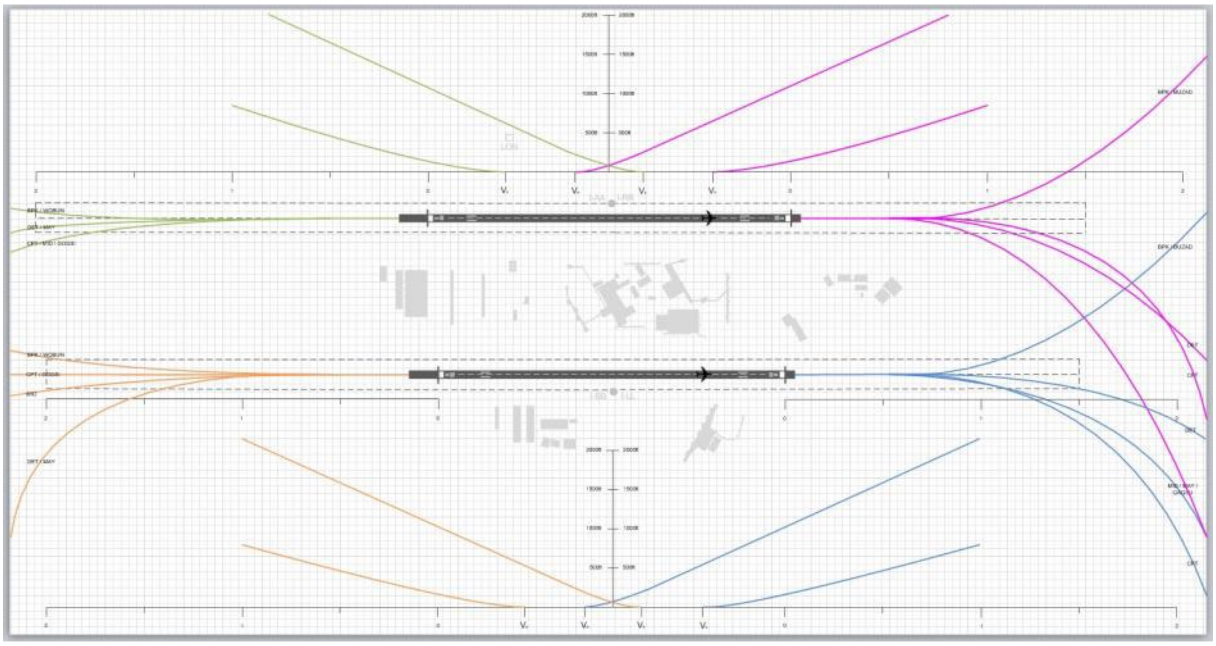

**Figure 1: Illustrated Initial Departure Paths and Climb Profiles for Parallel Runway Operations**

The rotation and initial airborne positions, the vertical climb profiles, and the airspeed profiles of the departing aircraft vary depending on the wake category and aircraft type of the departing aircraft and the performance / economy mode in which the departing aircraft are being flown. The A380 and Heavy wake category aircraft types tend to become airborne later and climb slower than the Medium and Light wake category aircraft types.
A SID is a departure procedure normally developed to accommodate as many aircraft categories as possible. There are two basic types of SID including straight departures and turning departures. SIDs are based on the track guidance acquired:

- Within 20.0 km (10.8 NM) from the departure end of the runway (DER) on straight departures; and
- Within 10.0 km (5.4 NM) after completion of turns on departures requiring turns.

A straight departure is one in which the initial departure track is within 15° of the alignment of the runway centre line. When a departure route requires a turn of more than 15° it is called a turning departure. Straight flight is assumed until reaching an altitude / height of at least 120m (394ft). Procedures normally cater for turns at a point 600m from the beginning of the runway.

The SIDs route structure is locally dependent for each runway and reflects the noise preferential routes. Where the common path of a lead and follower aircraft extends beyond the initial departure track there may be a need to apply SID separation requirements of 1 minute, 2 minutes and sometimes 3 minutes, with in some SID route combinations the need to add 1 minute additional separation when the lead aircraft type is in a slower speed group than the follower aircraft type with either none, one or two intervening speed groups depending on the SID route combination. In addition, for a complex TMA with several aerodromes, there may be a need to impose a minimum departure interval (MDI) or an average departure interval (ADI) to reduce the number of aircraft following a particular SID route. SID route separations and MDI and ADI are defined as distance-based constraints at aerodromes that apply distance-based separation and spacing constraints for departures.

An ATC slot time is generated for some departing flights by the Network Manager Operations Centre (NMOC) in Brussels. These slot times are generated for some flights to avoid any particular sector becoming overly congested. The ATC slots are 15 minutes windows, where the flight must depart (time of becoming airborne) between 5 minutes before the slot time and 10 minutes after the slot time, as shown on the flight progress strip. If a flight misses the window defined by the slot time a call is made to Brussels and a new slot time is requested. The slot time is the Calculated Take-Off Time (CTOT) for the associated flight.

When formulating and optimising the departure sequence there is a need to take into consideration:

- Wake turbulence separations
- Route (SID) separations
- Slot times
- Minimum departure intervals (or sometimes average departure intervals)

Airport Collaborative Decision Making (A-CDM) brings together information from Aircraft Operations (AO), Ground Handlers (GH) and Air Traffic Control (ATC) to facilitate more accurate decision making with regard to aircraft start and taxi times, as well as better adherence to the Calculated Take-Off Time (CTOT). A-CDM information includes landing time and on-stand time as well as expected turn-around time, all of which are used to calculate a Target Off-Blocks Time (TOBT).

The A-CDM TOBT are provided as an input to the DMAN system, which are then used alongside a number of other inputs (see Figure 2 ) to derive both a Sequence Order and to issue Target Start-up Approval Times (TSAT). If the TOBT is updated this is likely to result in a new TSAT being issued; however the TSAT time is fixed at TSAT minus <n> minutes (e.g. 10 minutes) to provide an element of stability. A change to departure separations or other parameters (e.g. weather minima criteria) can be entered in DMAN by the Tower Supervisor; such a change will trigger an update in DMAN and a possible change to both the departure sequence order and TSAT times.

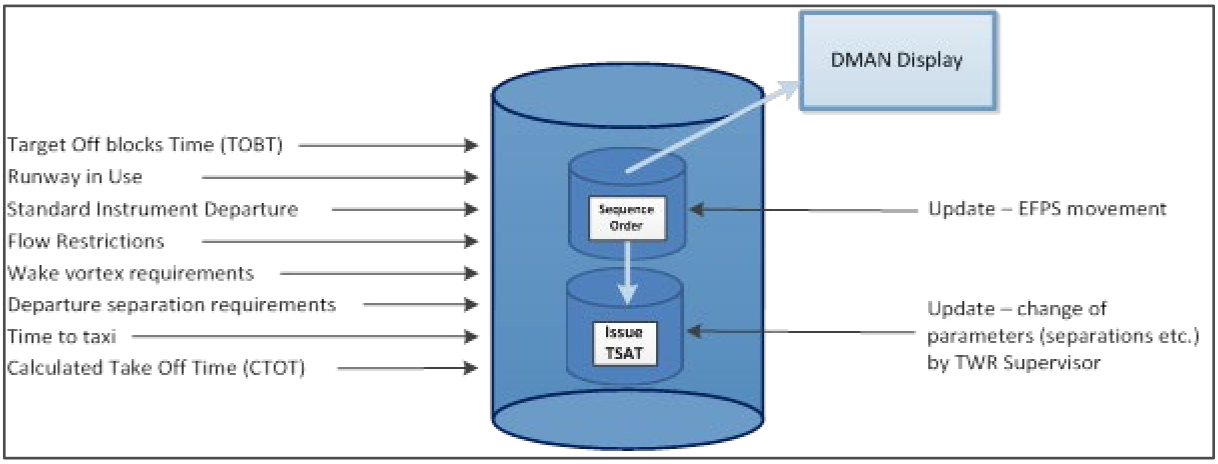


**Figure 2: Example DMAN - Inputs, Outputs and Updates**

Although some of the data used to derive the DMAN sequence order uses simple parameters (e.g. fixed taxi times) the order may be updated at various stages during the aircraft's transit from stand to runway holding point to ensure better accuracy. Updates may be triggered by the movement of an aircraft's Electronic Flight Progress Strip (EFPS) from one controller to the next or within the bays on a controller's EFPS display. The update points may be when the Ground Movement Planner (GMP) hands an aircraft to a Ground Movement Controller (GMC) position; when the GMC controller moves an EFPS from the 'Started' to 'Pushback' bay; when the GMC controller moves the EFPS from the 'Pushback' to 'Taxi' bay; and when the GMC hands the aircraft to the Air Departures controller. This is illustrated in Figure 3, where each movement, shown by a red arrow, indicates a possible DMAN update point.

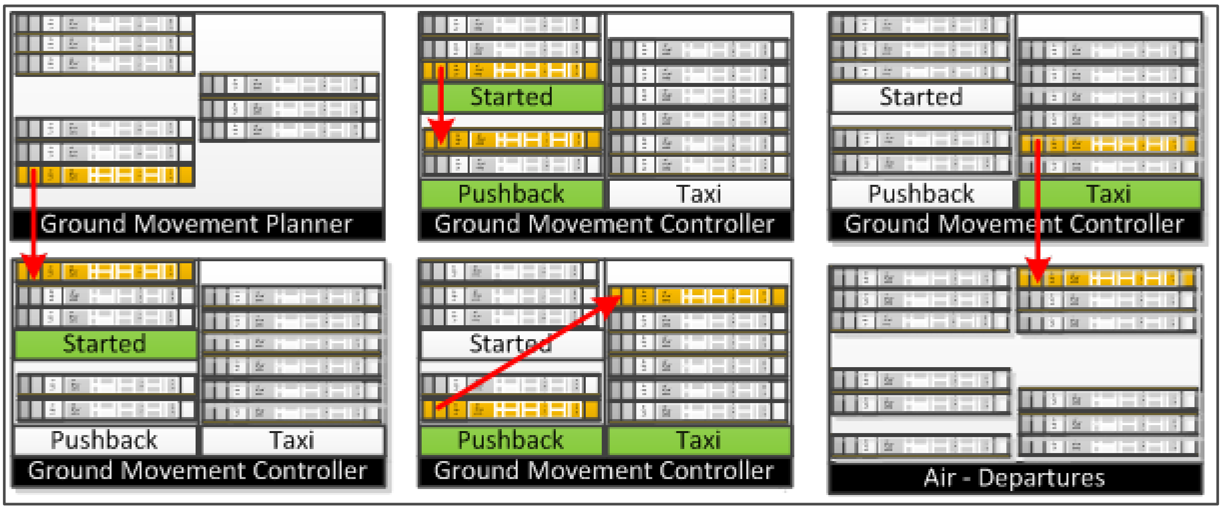


**Figure 3: Representative Electronic Flight Progress Strip Bays**

'Radar Gate' data may also be used as input into DMAN. Various radar gates may be positioned around the airfield and when taxiing departure aircraft pass through each gate the aircraft's remaining taxi time can be updated in DMAN. Receipt of the gate data may provoke a sequence order update in DMAN and a corresponding update (if applicable) in the DMAN sequence order.

Visibility of the DMAN sequence order may be limited to the GMP controller position. Provision may also be made for the GMC positions and also the Tower Runway Controller position to being provided with the DMAN sequence order and/or the Target Take-Off Time (TTOT) on the EFPS of each flight.

When the Tower Runway Controller is provided with the optimised DMAN sequence order, this is the order usually followed for the departure aircraft to line-up and take-off. However, it should be noted that some departure aircraft at the holding point may still be awaiting pre-flight information from their airline operations centre, or may have not completed all of the pre-flight activities such as for example passenger safety briefing, and so are unready to line-up. When this happens the Tower Runway Controller may need to tactically determine an alternative departure sequence order for the departure aircraft to line-up and take-off.

When the Tower Runway Controller is not provided with the optimised DMAN sequence order they take into account the departure aircraft positioning at the runway holding point, and the readiness of the departure aircraft to line-up and take-off, to tactically determine the order for the departure aircraft to line-up and take-off. This includes consideration of SID route separations when tactically optimising the order.

The departure separation minima may be applied as either time-based or distance-based.

When applying time-based separation minima, the time separation criteria are applied by measuring the successive airborne times of the departure aircraft ("airborne time" to "airborne time"). To deliver the airborne time separation criteria local procedural approaches are employed. These local procedural approaches include determining the take-off clearance time for the follower aircraft from the recorded “start of take-off roll time” of the lead aircraft, or determining the take-off clearance time of the follower aircraft from the recorded “airborne time” of the lead aircraft.

To achieve the time-based separation minima in practice when applying the recorded “start of take-off roll time” of the lead aircraft, take-off clearance may be issued to the follower aircraft once the required time separation has elapsed after the lead aircraft recorded “start of take-off roll time”. The recorded “start of take-off roll-time” is the time the aircraft is recorded as commenced rolling beyond the line-up and wait position.

To achieve the time-based separation minima in practice when applying airborne times, take-off clearance may be issued to the follower aircraft, with an allowance for the anticipated follower aircraft take-off roll time on the runway. Take-off clearance may be issued once the required time separation minus the anticipated follower aircraft take-off roll time has elapsed after the lead aircraft recorded “airborne time”.

When applying distance-based separation minima, once airborne, departure aircraft are subject to the wake turbulence radar separations, therefore the Tower Runway Controller may apply a distance based clearance such that the required distance-based wake turbulence radar separation is set up when the follower aircraft becomes airborne. A distance based clearance can be issued as long as the Tower is equipped with radar surveillance.

On handover of separation responsibilities to the TMA Departure Radar Controller there is a need to have achieved the associated radar separation minima employed in the TMA, where the minimum radar separation is 3 NM horizontal or 1,000ft vertical, and where distance-based wake separation minima apply.

There is a requirement to take into account terrain features and obstacles that may impact the wind field when developing and validating the WDS-D concepts. The local topography such as hanger buildings, terminal buildings and high ground in the vicinity of the aerodrome may impact both surface winds and winds aloft.

Aircraft ATM capabilities such as the rotation position on the runway, climb profile performance during climb-out, lateral navigational performance during climb-out, and airspeed performance during climb-out, all need to be taken into consideration in the development and validation of the departures concepts solutions.

There is a need to take into consideration the impact of the departures concepts solutions on the departure planning processes and procedures on the ground and on the systemised airspace processes and procedures in the TMA.

### 3.2.2 Roles and Responsibilities

The EATMA Node and Node Instances impacted by the departures concepts solutions are:

- Aerodrome ATS
    - Tower Runway Supervisor
    - Tower Runway Control
- Flight Deck

- Flight Deck

The applicable roles and responsibilities for the departures concepts solutions include:

- Tower ATC Roles
  - Tower ATC Supervisor
  - Tower Runway Controller
  - Tower Ground Controller
  - Tower Clearance Delivery Manager

  [Note that Air Traffic Services Assistants (ATSAs) may assist the above roles, with respect to checking and amending the departure aircraft SID route and aircraft type information, so as to assist in ensuring the required integrity of this information]

- TMA ATC Roles
  - TMA Supervisor
  - TMA Planning Controller
  - TMA Executive Controller (Departure Radar Controller)

- Flight Operations Centre & Flight Crew Roles
  - Flight Crew
  - FOC ATC Flow Manager

- Airport Roles
  - Airport CDM Project Manager
  - Apron Manager

- System Roles
  - Operation Technicians / System Engineers

These roles and the specific/additional role responsibilities are detailed below. There may also be an indirect impact on some Network Roles such as the Network Manager, Flow Manager and Local Traffic Manager.

| Role | Current Responsibility | Specific/additional role |
|---|---|---|
| Tower ATC Supervisor | The Tower Supervisor is responsible for the safe and efficient provision of air traffic services by Tower ATC. Has overall responsibility for the planning of the Tower operation. Monitors operations. Decides on departure rates. Decides on staffing and manning of CWPs in accordance with expected traffic demand. Proposes runway configuration. Gives permission for maintenance, etc. Represents Tower ATC when | Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the Separation Delivery ATC tool support for Tower ATC (e.g. A-CDM System & DMAN System). |

| | | |
|---|---|---|
| | coordinating with the Airport Operator on operational issues. | Responsible for ensuring runway conditions, and planned and forecast changes to the runway conditions, are reflected in the separation policy information.<br><br>Is aware of the wind conditions, and for determining and deciding on the application (if required) of the departures separations solutions concepts (PWS-D, WDS-D) in consultation with the TMA Supervisor or TMA Planner Controller, and the TMA Departure Radar Controller.<br><br>Responsible for ensuring that flight crew are informed of the application of WDS (departures), for example, through D-ATIS. |
| Tower Runway Controller | The Tower Runway Controller is responsible for the provision of air traffic services to aircraft within the control zone, or otherwise operating in the vicinity of controlled aerodromes (unless transferred to Approach Control/ACC, or to the Tower Ground Controller), by issuing clearances, instructions and permission to aircraft, vehicles and persons as required for the safe and efficient flow of traffic. The Tower Runway Controller will be assisted by departure and surface management systems, where available. | Responsible for employing the efficient departure wake separations for enabling the safe and efficient flow of departure traffic.<br><br>Uses the Separation Delivery ATC tool support to determine and provide for the safe and efficient flow of departure traffic.<br><br>Informs departure aircraft when the WDS (departure) concept is being employed.<br><br>Monitors safe separations and the efficient spacing and sequence for departures when using the reduction of WT separations.<br><br>Receives, from different sources, and disseminates to the flight deck, critical WT and |

| | | |
|---|---|---|
| | | weather information, when needed. |
| Tower Ground Controller | The Tower Ground Controller is part of the controller team responsible for providing an Air Traffic Service (ATS) at controlled aerodromes. Their main task is the provision of ATS to aircraft and vehicles on the manoeuvring area. They must also ensure that airport maintenance vehicles carrying out necessary improvements on an active manoeuvring area do not interfere with the movement of aircraft. They will be assisted by an Advanced Surface Movement Guidance and Control System (A-SMGCS) | Responsible for adjusting to the additional capacity and sequencing opportunities and for employing efficient sequencing for departures.<br><br>Uses DMAN (or similar) information based on the WDS (departure) concept or adjusts manually to the capacity and sequencing opportunities.<br><br>Informs departure aircraft when the WDS (departure) concept is being employed. |
| Tower Clearance Delivery Controller | The Clearance Delivery Controller is part of the controller team responsible for providing an Air Traffic Service at controlled aerodromes. Their main task is the verification of Flight data (e.g. FPL, Stand, TSAT etc.) and the delivery of ATC Clearance (Departure Clearance) and Start-Up Approval. They are assisted by a departure management system (DMAN).<br><br>It is important to note that, according to the aerodrome environment (e.g. airport complexity, traffic density, etc.) and the local regulations at a specific airport, the tower positions may share tasks and responsibilities. To this respect, control areas and responsibilities are clearly defined in local documents and agreements at each airport. | Responsible for adjusting to the additional capacity and sequencing opportunities and for employing efficient sequencing for departures.<br><br>Informs departure aircraft when the WDS (departure) concept is being employed. |
| TMA Supervisor | The TMA Supervisor is responsible for the general management of all activities in their respective Operations Room. They decide on staffing and manning of CWPs in accordance with expected traffic demand. Supported by simulations of traffic load and of traffic complexity, | Is aware of the additional departure capacity resulting from employing the more efficient departure wake separation minima and the weather dependent reduced wake separation minima. |

| | | |
|---|---|---|
| | and assisted by the NMF, they take decisions concerning the dynamic adaptation of sector configurations to balance capacity to forecast demand. | Is aware of the wind conditions, and for deciding and agreeing to the application (if required) of the WDS (departures) concept, in consultation with the Tower ATC Supervisor.<br><br>Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the Separation Delivery tool support (departure) for TMA Controllers. |
| TMA Planning Controller | Mainly responsible for planning and coordination of the traffic entering, exiting or existing within the ATC Sector. | Responsible for planning and coordination of the traffic entering, exiting or existing within the ATC Sector, taking into account the increase in the departure traffic rate as a result of using the more efficient departure wake separation minima (PWS-D) and the weather dependent reduced wake separation minima (WDS-D) |
| TMA Executive Controller<br><br>TMA Departure Radar Controller | Responsibility for traffic management within the sector/AoR and for the tactical tasks.<br><br>They are responsible for the safe and expeditious flow of all flights operating within their area of responsibility. Their principal tasks are, compliance with the ICAO Rules of the Air, other relevant ICAO (e.g. Doc. 4444) and European/National provisions to separate known flights operating within their area of responsibility and to issue instructions to pilots for conflict resolution and segregated airspace circumnavigation. | Monitors the transition from the efficient wake separation minima (PWS-D) and the weather dependent reduced separation minima (WDS-D) employed on the initial departure path by Tower ATC, to the radar separation minima (minimum radar separation & wake separation minima) applied in the TMA.<br><br>Monitors WDS (departure) availability and application per flight. |

| | | |
|---|---|---|
| | To separate aircraft on radar after departure. | Receives and disseminates critical WT and weather information. |
| Flight Crew | During the planning phase: the Flight Crew receives the planning restrictions from the FOC and specific instructions for the flight ("fly as filed" or try to adhere to planning TTs, in function of business model for the specific flight). The Flight Crew also receive their planned Take Off time, if leaving from an airport inside the horizon from destination AMAN – or as in planning.<br><br>The Flight Crew is informed when the SBT/SMT becomes RBT/RMT.<br><br>The Flight Crew is involved in different CDM processes (just with controlling ATCO or with several actors).<br><br>The Flight Crew may perform new types of manoeuvres/procedures.<br><br>The Flight Crew will integrate in their decision process new information resulting from increased situational awareness on the ground.<br><br>The Flight Crew will integrate in their decision process new information resulting from increased situational awareness during the flight.<br><br>The Flight Crew remains ultimately responsible for the safe and orderly operation of the flight. | Is aware of the applicable concept (PWS-D, WDS-D) in operation and the impact on the time separation and/or distance separation minima set up on climb out on the initial departure path.<br><br>Is informed of when the applicable concept (PWS-D, WDS-D) is being employed on climb-out on the initial departure path, for example, through D-ATIS.<br><br>Reports critical weather and WT information to ATC. |
| FOC ATC Flow Manager | In charge of tactical coordination (e.g. from H-3 to H). It covers Network Manager Regulation monitoring / Runways in use / slot swapping etc. | Takes into account the increased departures rate as a result of the employment of the PWS-D and WDS-D concepts.<br><br>Is informed of when the WDS-D concept is being employed. |
| Airport CDM Project Manager | The Airport CDM Project Manager is responsible for ensuring and improving communication between | Takes into account the increased departures rate as a |

| | | |
|---|---|---|
| | all stakeholders, including data-management of CDM relevant data. This includes the dissemination of airport information like landing time, constraints, turn-round time, "Departure Planning Information" and received "Flight Update Messages", etc.<br><br>Airport Collaborative Decision Making (A-CDM) is a concept which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources. Implementation of Airport CDM allows each Airport CDM Partner to optimise their decisions in collaboration with other Airport CDM Partners, knowing their preferences and constraints and the actual and predicted situation.<br><br>The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and timely information and by adapted procedures, mechanisms and tools. | result of the employment of the PWS-D and WDS-D concepts.<br><br>Is informed of when the WDS-D concept is being employed. |
| Airport Apron Manager | The Apron Manager is responsible for guidance of aircraft to and from the stands (e.g. providing push-back approval), ensuring the safe and efficient movement of aircraft and vehicles within his/her area of responsibility according to local procedures. The Apron Manager also maintains close coordination with Tower Ground Controller, AOCC and APOC on planned aircraft movements.<br><br>Normally, control of the activities and the movement of aircraft and vehicles rest with ATC with respect to the manoeuvring area. In the case of aprons, such responsibility sometimes rests with the apron management. Apron Manager's main responsibilities are the guidance of aircraft to and | Takes into account the increased departures rate as a result of the employment of the PWS-D and WDS-D concepts.<br><br>Is informed of when the WDS-D concept is being employed. |

| | | |
|---|---|---|
| | from the stands, ensuring the safe and efficient movement of aircraft and vehicles within his/her area of responsibility according to local procedures, and maintaining close coordination with other actors on planned aircraft movements using CDM. Airlines may hire third party services for apron management service under the supervision of the airport authority, in compliance with its regulations or through airlines own regulations (ICAO, EASA). | |
| Operation Technicians / System Engineers | Monitors the health of the systems used to provide air traffic control services and restore them in case of failure. | Monitors the health and when necessary, restores the Separation Delivery Tool support, and associated support tools and system services, such as the departures runway surface and initial departure path wind conditions services. |

**Table 6: Applicable Roles and Responsibilities**

### 3.2.3 Technical characteristics

This section describes the technical characteristics and constraints that define the context in which the technical requirements are applicable, for the Departures Concepts Solutions.

#### 3.2.3.1 Departures Technical Environment

The Departures Concepts Solutions require:

- ATCO Delivery Tool support for departures
- Local environment weather information and wind forecasting and monitoring capabilities
- Coordination between Approach and Tower Supervisor for using the wind information to activate/deactivate the WDS-D and for authorising/ending the use of the weather-dependent reduction of the wake turbulence separations. If the wind were to drop below the required threshold unexpectedly then the Supervisors and Controllers shall need to be alerted to allow for a transition to a different separation mode.

The technical characteristics of the Departures Concepts Solutions encompass:

- ATC Delivery Tool support
- Departure Manager (DMAN) System
- Airport Collaborative Decision Making (A-CDM) System
- Advanced Meteorological Information Provision
- Flight Data Processing System

- Surveillance System for Surface Movement (e.g. Advanced Surface Movement Guidance and Control System (A-SMGCS)) including some coverage of the straight-out initial common departure path
- Primary & Secondary Radar Surveillance System for the TMA and SIDs including the straight-out initial common departure path
    - Elementary Mode-S Surveillance (ELS) or Mode A/C
    - Enhanced Mode S Surveillance (EHS) (for UK Airports)
- Tower CWPs (Airport Tower Supervisor, Tower Runway Controller, Tower Ground Controller, Tower Clearance Delivery Controller or Apron Manager)
    - Electronic Flight Progress Strips
    - Traffic Situation View Display
    - Meteorological Information Display
    - A-CDM and DMAN HMI & Information Display
    - ATC Voice Communications
- TMA CWPs (TMA Supervisor, TMA Planning Controller, TMA Executive Controller (TMA Departure Radar Controller)
    - Flight Progress Strips (Either electronic or paper)
    - Radar Situation View Display
    - ATC Voice Communications

#### 3.2.3.2 Departures Concepts Solutions OI

Individually for each Departures Concepts Solutions OI the following technical characteristics have been identified.

**AO-0329 – OSD Optimized Separation Delivery for Departure PWS-D**

The OSD concept is intended to assist Controllers in efficiently deliver airborne separation in time or distance after departure using:

- ATCO Separation Delivery tool support (OSD tool support) for departures
- Departure aircraft trajectory event time information in support of OSD concept
- Aircraft performance information in support of OSD concept
- Local environment weather information and wind forecasting and monitoring capabilities
- HMI support

**AO-0323 – Wake Turbulence Separations (for departures) based on Static Aircraft Characteristics**

The S-PWS concept is intended to optimise wake separations between departures on the initial departure path by moving from schemes defined by a small number of wake categories (4 to 7 wake categories) to a scheme defined between the aircraft type pairs most frequently serviced at European major airports, together with a scheme defined by a larger number of wake categories (20-CAT (6-CAT + 14-CAT)) for other aircraft type combinations. It uses the ATCO delivery support tool of AO-0329.



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**AO-0304 – Weather-dependent reductions of Wake Turbulence separations for departure (WDS-D)**

The WDS (departures) concept is conditionally applied as a function of the weather forecasting and of the local wind conditions. These two factors will impact the concept implementation. Consequently, the safe application of the concept requires the wind conditions to be monitored in the area surrounding the aircraft departure path.

The concept needs:

- ATCO Separation Delivery Tool support (OSD tool support enhanced to support WDS-D)
- Local environment weather information and wind forecasting and monitoring capabilities
- Supervisor Wind Conditions Monitoring Tool support (WDS-D tool support)
- Coordination between Tower Supervisor and the Tower ATCOs for using the wind information to activate/deactivate the WDS-D and for authorising/ending the use of the weather-dependent reduction of the wake turbulence separations. If the wind were to drop below the required threshold unexpectedly then the Supervisors and Controllers shall need to be alerted to allow for a transition to a different separation mode.
- Coordination between Tower Supervisor, Airport Ops Support (Airport CDM Project Manager, Airport Apron Management) and Flight Ops Support (FOC ATC Flow Manager) with respect to changes in the departure rate as a result of authorising/ending the use of the wake turbulence separation reductions is taken into account in the A-CDM and DMAN related processes.



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### 3.2.3.3 Wind Forecasting and Monitoring

The OSD, S-PWS and WDS concepts rely on wind forecasting and monitoring at the runway surface and along the initial departure path. The reliability, accuracy and stability of the wind forecasting solutions available to a local implementation determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For S-PWS with OSD for departures, there is a need to consider the departures path wind profile requirements for adequately managing the transition to the TMA Departure Radar Controller separations (radar and wake), and for adequately managing airspeed profile differences between the lead and follower aircraft. There is potentially a requirement for a full wind profile over the initial departure path until aircraft turn onto their respective SIDs, and potentially extended to common paths beyond the first SID turn. This will be required with a forecast horizon from take-off clearance to the departing aircraft turning on to their respective SIDs, which is potentially around 60s (to becoming airborne) to 120s (to SID turn) forecast horizon over the initial departure path (15s to react to take-off clearance, 30s to 60s aircraft type related take-off roll to becoming airborne, around 45s for the 2 NM flying time from rotation to SID turn), and may be for a longer time horizon, if needing to be extended to common paths beyond the first SID turn. If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 60s (to becoming airborne) to 120s (to SID turn) forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For WDS for departures, both for the total wind concept and the crosswind concept there is a need to establish the wind forecasting and monitoring requirements which may include both departure runway 10m anemometer wind speed measurements at the initial airborne positions of the departure aircraft (and not the departure line-up end or stop end of the runway), and a full initial departure path wind profile. One aspect to consider is sufficient forecast notification of when the wind conditions will drop below the minimum criteria. There is a need to stop the wake separation reduction in good time before the wind conditions change below the minimum criteria. This should be at least the roll time plus flying time of the follower aircraft over the common initial departure path so as to provide assurance that the minimum criteria will be prevalent until the follower aircraft is either on a wake independent SID route to the lead aircraft SID route, or the standard TMA wake separation has been set up. If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 60s (to becoming airborne) to 120s (to SID turn) forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required. There may be a need for a longer forecast horizon to support avoiding switching in and out of employing WDS for departures in variable or unstable wind conditions and also to support the departure flow management decisions with respect to committing to a higher departure flow rate on taxi-out to the runway holding points.

For WDS for departures, based on differentiated rotation positions and climb profiles, either alone or combined with the crosswind concept, similar requirements to the crosswind component also apply to the headwind component of the wind profile over the initial departure path due to the risk of the wake vortices being transported towards the initial airborne positions and climb profile of the follower aircraft. This potentially just applies to the rotation and initial climb portion of the initial departure path and so a shorter time horizon of around 60s (to becoming airborne) to 90s (initial climb).



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If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 60s to 90s forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

### 3.2.4 Applicable standards and regulations

#### 3.2.4.1 Reference Scenario WTC Schemes for the Departures Concepts Solutions

For departures the WT separations are defined in both distance and time to be applied at take-off. Most aerodromes in Europe apply the time-based separation minima.

The departure WT separations apply as soon as the follower aircraft becomes airborne (back wheels lift off the ground).

Such WT separation schemes (including ICAO, RECAT-EU 6 category and UK 5 category) are based on Wake Turbulence Categories (WTC) and are applied independent of the wind conditions.

##### 3.2.4.1.1 ICAO-4 DB and TB Schemes for Departures

The ICAO-4 radar separation standards for departures include MRS which prevents aircraft collision and WT separation which is intended to protect aircraft from adverse WTEs. Historically WT separations have been based on aircraft grouped into categories based on their MTOW and have a resolution of 1 minute (60s) for time separation application and 1 NM for distance separation application. This has been needed in the past to ensure Controllers can memorise the wake separations and apply them without tool support. Additional separation has been prescribed whenever a less heavy category is following behind an aircraft from a heavier category. This implies that when the traffic at a certain airport contains aircraft from mainly one of the categories, a low penalising effect of WT separations will appear. On the other hand, whenever the aircraft categories are mixed, there will be efficiency and capacity losses due to the extra separation that has to be applied.

ICAO Doc 4444 [38] defines the following WT separation categorisation and separation minima for application on the approach and departure phase of flight. ICAO-4 WT separation minima are based on a grouping of aircraft types into three categories according to the maximum certificated take-off mass as follows:

- **HEAVY ("H")**: all aircraft types of 136,000 kg or more;
- **MEDIUM ("M")**: aircraft types less than 136,000 kg but more than 7,000 kg;
- **LIGHT ("L")**: aircraft types of 7,000 kg or less.

Typical aircraft types in the Heavy WT category are: B747 family, B767 family, B777 family, A330/A340 family, A300/A310 family, MD11.

Typical aircraft types in the Medium WT category are: B757 family, B737 family, A320 family, CRJs family (CRJ100/200/700/900/1000), E-Jets family (E135/140/145/170/175/190/195) and ATRs.

A list of more than 9000 aircraft types is categorized on that basis in ICAO Doc 8643.

The Airbus A380-800 (A388), with a MTOW in the order of 560,000 kg, is the largest passenger aircraft ever entered into revenue service. The aircraft is in the Heavy WTC, which has no upper limit defined.



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However, for the A380-800, an ICAO State guidance released in 2008 recommends an increase in relation to the WT separation minima published in the PANS-ATM.

Currently the ICAO-4 scheme for time-based wake turbulence longitudinal separation minima applies for departure at the majority of European airports. Some apply the ICAO-4 scheme for distance-based longitudinal separation minima. Additional separation has then been prescribed behind Heavy category lead aircraft and for Light category follower behind Medium category leader.

The ICAO-4 time separation and distance separation rules applied on departure are presented in Table 7 below.

| Departures Distance Based and Time Based Wake Turbulence Separation Minima | | Follower Aircraft ICAO-4 Wake Category or Aircraft Type | | | |
|---|---|---|---|---|---|
| | | A388 | Heavy | Medium | Light |
| Lead Aircraft ICAO-4 Wake Category or Aircraft Type | A388 | (*) | 6 NM<br>120 s (1) | 7 NM<br>180 s (2) | 8 NM<br>180 s (2) |
| | Heavy | (*) | 4 NM<br>(*) | 5 NM<br>120 s (1) | 6NM<br>120 s (1) |
| | Medium | (*) | (*) | (*) | 5 NM<br>120 s (1) |
| | Light | (*) | (*) | (*) | (*) |

**Table 7: ICAO-4 Wake Category Based Separations for Departures**

(*) When a wake turbulence restriction is not required, then separation reverts to radar separation minimum set for collision risk mitigation. Either reduced separation in the vicinity of the aerodrome (RSVA) is applied or the 3 NM MRS is applied as prescribed by the appropriate ATS authority.

(1): 3 minutes if taking off from an intermediate position

(2): 4 minutes if taking off from an intermediate position

WT separation minima are to be applied in the following scenarios on approach:

- an aircraft is operating directly behind another aircraft at the same altitude or less than 300m (1,000ft) below, or;
- both aircraft are using the same runway, or parallel runways separated by less than 760m (2,500ft); or;
- an aircraft is crossing behind another aircraft, at the same altitude or less than 300m (1,000ft) below.

#### 3.2.4.1.2 RECAT-EU DB and TB Schemes for Departures

The RECAT-EU 6 category scheme aims to provide a more efficient WT scheme by re-grouping aircraft based upon MTOW and wing span and is the result of an optimization of the ICAO wake turbulence separation classes.

For departures the RECAT-EU WT separations are defined in both time and distance to be applied on departure from when the follower aircraft becomes airborne as per Table 8.

| Departures Distance Based and Time Based Wake Turbulence Separation Minima | | Follower Aircraft RECAT EU Wake Category | | | | | |
|---|---|---|---|---|---|---|---|
| | | "Super Heavy" "A" | "Upper Heavy" "B" | "Lower Heavy" "C" | "Upper Medium" "D" | "Lower Medium" "E" | "Light" "F" |
| Lead Aircraft RECAT EU Wake Category | "Super Heavy" "A" | 3 NM (**) | 4 NM 100 s (1) | 5 NM 120 s (1) | 5 NM 140 s (1) | 6 NM 160 s (1) | 8 NM 180 s (1) |
| | "Upper Heavy" "B" | | 3 NM (**) | 4 NM (**) | 4 NM 100 s (1) | 5 NM 120 s (1) | 7 NM 140 s (1) |
| | "Lower Heavy" "C" | | (*) (**) | 3 NM (**) | 3 NM 80 s (1) | 4 NM 100 s (1) | 6 NM 120 s (1) |
| | "Upper Medium" "D" | | | | | | 5 NM 120 s (1) |
| | "Lower Medium" "E" | | | | | | 4 NM 100 s (1) |
| | "Light" "F" | | | | | | 3 NM 80 s (1) |

**Table 8: RECAT-EU 6 Category Wake Category Based Separations for Departures**

(*): Minimum radar separation (MRS), set at 3 NM, is applicable as per the current ICAO Doc 4444 [38] provisions.

(**): Lower bound of 60s used in WT risk assessment

(1): Add 1 minute if taking off from an intermediate position

For aircraft category pairs with no defined WT separation then either reduced separation in the vicinity of the aerodrome (RSVA) is applied or the 3 NM MRS is applied.

For the deployment it remains optional to locally deploy only part of the RECAT-EU scheme, or apply larger separation minima than proposed ones, or opt for a progressive application.

When applying time-based separation minima, the time separation criteria are applied by measuring successive airborne times (the time the back wheels lift from the ground after rotation). To deliver the airborne time separation criteria, local procedural approaches are employed. These local procedural approaches include determining the take-off clearance time for the follower aircraft from the recorded "start of take-off roll time" of the lead aircraft, or determining the take-off clearance time of the follower aircraft from the recorded "airborne time" of the lead aircraft.

To achieve the time-based separation minima in practice, when applying the recorded "start of take-off roll time" of the lead aircraft, take-off clearance may be issued to the follower aircraft once the required time separation has elapsed after the lead aircraft recorded "start of take-off roll time". The recorded "start of take-off roll-time" is the time the aircraft is recorded as commenced rolling beyond the line-up and wait position.

To achieve the time-based separation minima in practice, when applying airborne times, take-off clearance may be issued to the follower aircraft, with an allowance for the anticipated follower aircraft take-off roll time on the runway, once the required time separation minus the anticipated follower aircraft take-off roll time has elapsed, after the lead aircraft recorded "airborne time".

When applying distance-based separation minima, once airborne, departure aircraft are subject to the wake turbulence radar separations, therefore the Tower Runway Controller may apply a distance based clearance such that the required distance-based wake turbulence radar separation is set up when the follower aircraft becomes airborne. A distance based clearance can be issued as long as the Tower is equipped with radar surveillance.

On handover of separation responsibilities to the TMA Departure Radar Controller there is a need to have achieved the associated radar separation minima employed in the TMA, where the minimum radar separation is 3 NM horizontal or 1,000ft vertical, and where distance-based wake separation minima apply.

### 3.2.4.2 Solution Scenario WT Separation Schemes for the Departures Concepts Solutions

The Solution Scenario WT Separation Schemes are RECAT-PWS-EU (S-PWS-D) Scheme and the Weather Dependent Separation Scheme (WDS-D).

#### 3.2.4.2.1 RECAT-PWS-EU DB Scheme for Departures (DB-PWS-D) (AO-0323)

The S-PWS-D concept is a wake turbulence scheme which is based upon individual aircraft types rather than grouping aircraft into wake categories. In a wake category scheme the separations need to be designed to protect the lightest follower aircraft type in a wake category from the heaviest leader aircraft type in a wake category. This leads to inefficient separations between other aircraft type pairs which do not need the same amount of protection. The S-PWS-D WT scheme provides more efficient separations as they can be optimised for each aircraft type pair based upon the static characteristics of each aircraft type.

RECAT-PWS-EU has developed an aircraft type pairwise table and a 20 x 20 wake category table for distance-based separation that can be applied for departures.

#### 3.2.4.2.2 RECAT-PWS-EU TB Scheme for Departures (TB-PWS-D) (AO-0323)

The S-PWS-D concept is a wake turbulence scheme which is based upon individual aircraft types rather than grouping aircraft into wake categories. In a wake category scheme the separations need to be designed to protect the lightest follower aircraft type in a wake category from the heaviest leader aircraft type in a wake category. This leads to inefficient separations between other aircraft type pairs which do not need the same amount of protection. The S-PWS WT scheme provides more efficient separations as they can be optimised for each aircraft type pair based upon the static characteristics of each aircraft type.

Prior to Wave 2 research for the departures, due to not having the profiles to characterise the "time-to-fly" on departure and necessary information on take-off speeds and departure speed profiles, the RECAT / Pair-Wise minima determination for departures consisted of the RECAT-EU time-based separation minima for departures in which some of the separation minima for CAT-F1, CAT-F2 and CAT-F3 aircraft times were decreased. The obtained separation table kept the 20-category structure but effectively consisted of 7-categories (or 9 different groupings when considering F & F1 & F2 and F3 were separately grouped as the lead aircraft wake category and F1 & F2 and F & F3 were separately grouped as the follower aircraft wake category).

| | | | A380-800 | ICAO HEAVY | | ICAO MEDIUM | | | ICAO LIGHT |
|---|---|---|---|---|---|---|---|---|---|
| | | | RECAT-EU A | RECAT-EU B | RECAT-EU C | RECAT-EU D | RECAT-EU E | RECAT-EU F | |
| | | | A1, A | B1, B2, B | C1, C2, C3, C, C4 | D1, D | E1, E2, E3, E | F1, F2 | F, F3 |
| A380-800 | RECAT-EU A | A, A1 | (*) | 100 | 120 | 140 | 160 | 180 | 180 |
| ICAO HEAVY | RECAT-EU B | B, B1, B2 | (*) | (*) | (*) | 100 | 120 | 140 | 140 |
| ICAO HEAVY | RECAT-EU C | C, C1, C2, C3, C4 | (*) | (*) | (*) | 80 | 100 | 120 | 120 |
| ICAO MEDIUM | RECAT-EU D | D, D1 | | | | | | 100 | 120 |
| ICAO MEDIUM | RECAT-EU E | E, E1, E2, E3 | | | | | | | 100 |
| ICAO MEDIUM | RECAT-EU F | F, F1, F2 | | | | | | | 80 |
| ICAO LIGHT | RECAT-EU F | F3 | | | | | | | |

**Table 9: RECAT 7-CAT WT Time-Based Separation Minima on Departure**

In Wave 1, prior to the development of the time-based pair-wise matrix, a method has been proposed by NATS and agreed by EUROCONTROL for deriving draft 20 x20 and aircraft type pairwise matrices for use in the PJ02.01 validation exercises in order to enable assessment of the Human Performance validation objectives of employing the full TB-PWS-D concept. The description of these assessments is included throughout this document.

This method was based on adjusting the time-based RECAT-EU for departures as per Table 8 when there is a difference of 0.5 NM or more between the distance-based RECAT-EU wake separation and the distance based RECAT-PWS-EU for that aircraft type pair, with adjusting the time-based RECAT-EU for departures wake separation by 10s for each 0.5 NM difference to formulate the time-based RECAT-PWS-EU wake separations for the aircraft type pairwise matrix and the 20 x 20 wake category matrix.

The departure separation matrix was revisited in Wave 2; through the collection and analysis of more comprehensive operational and wake data for departures. A more optimised pairwise solution was developed, which included addition of further aircraft types, as well as a time-based matrix. A time-based 20x20 matrix was also produced.

The final RECAT 20-CAT time-based separation matrix for departure is provided in Table 10.

| | A1 | A | B1 | B2 | B | C1 | C2 | C3 | C4 | C | D1 | D | E1 | E2 | E3 | E | F1 | F2 | F3 | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | | | 100.0 | 100.0 | 100.0 | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 | 140.0 | 140.0 | 160.0 | 160.0 | 160.0 | 160.0 | 180.0 | 180.0 | 180.0 | 180.0 |
| A1 | | | 100.0 | 100.0 | 100.0 | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 | 140.0 | 140.0 | 160.0 | 160.0 | 160.0 | 160.0 | 180.0 | 180.0 | 180.0 | 180.0 |
| B | | | | | | | | | 60.0 | 60.0 | 100.0 | 100.0 | 120.0 | 120.0 | 120.0 | 120.0 | 140.0 | 140.0 | 140.0 | 140.0 |
| B1 | | | | | | | | | 60.0 | 60.0 | 100.0 | 100.0 | 110.0 | 120.0 | 120.0 | 120.0 | 140.0 | 140.0 | 140.0 | 140.0 |
| B2 | | | | | | | | | 60.0 | 60.0 | 90.0 | 100.0 | 110.0 | 120.0 | 120.0 | 120.0 | 130.0 | 140.0 | 140.0 | 140.0 |
| C | | | | | | | | | 60.0 | 60.0 | 80.0 | 80.0 | 100.0 | 100.0 | 100.0 | 100.0 | 120.0 | 120.0 | 120.0 | 120.0 |
| C1 | | | | | | | | | 60.0 | 60.0 | 80.0 | 80.0 | 100.0 | 100.0 | 100.0 | 100.0 | 120.0 | 120.0 | 120.0 | 120.0 |
| C3 | | | | | | | | | 60.0 | 60.0 | 60.0 | 70.0 | 90.0 | 100.0 | 100.0 | 100.0 | 110.0 | 120.0 | 120.0 | 120.0 |
| C2 | | | | | | | | | 60.0 | 60.0 | 60.0 | 70.0 | 90.0 | 90.0 | 100.0 | 100.0 | 100.0 | 110.0 | 120.0 | 120.0 |
| C4 | | | | | | | | | 60.0 | 60.0 | 60.0 | 60.0 | 60.0 | 70.0 | 90.0 | 90.0 | 90.0 | 100.0 | 120.0 | 120.0 |
| D | | | | | | | | | | | | | | | | | 90.0 | 100.0 | 120.0 | 120.0 |
| D1 | | | | | | | | | | | | | | | | | 70.0 | 90.0 | 120.0 | 120.0 |
| E | | | | | | | | | | | | | | | | | | | 100.0 | 100.0 |
| E1 | | | | | | | | | | | | | | | | | | | 100.0 | 100.0 |
| E2 | | | | | | | | | | | | | | | | | | | 100.0 | 100.0 |
| E3 | | | | | | | | | | | | | | | | | | | 100.0 | 100.0 |
| F | | | | | | | | | | | | | | | | | | | 80.0 | 80.0 |
| F1 | | | | | | | | | | | | | | | | | | | 80.0 | 80.0 |
| F2 | | | | | | | | | | | | | | | | | | | 80.0 | 80.0 |
| F3 | | | | | | | | | | | | | | | | | | | | |

**Table 10: RECAT 20CAT time-based separation scheme for departure [s]**

The methodology and discussion of results of this work is presented in Annexes A and B.

The resulting time-based matrix is embedded below:

PWS_D_AppendixA_
RECATPWS_departu

The full TB-PWS-D concept aims to improve overall runway throughput through using the more efficient WT separations. However, it could also be used to improve runway throughput resilience to delay (assuming no change in declared capacity).

With the advent of 20 x 20 and aircraft type pairwise matrices, it is believed that a Separation Delivery tool will be required as it is unlikely that controllers will be able to retain the information regarding the required separation. This is the Optimised Separation Delivery tool.

#### 3.2.4.2.3 Weather Dependent TB Schemes for Departures (TB-WDS-D) (AO-0304)

WDS-D is the conditional reduction or suspension of wake separation minima for departure operations, applicable under pre-defined wind conditions, so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on the initial departure path, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft. Two pre-defined wind conditions are under consideration, a 10 knots wind speed in any direction (Total Wind concept) and a 6 knots to 10 knots crosswind to the initial departure track (Crosswind concept). Note that for the Crosswind concept, from the CREDOS Project results, a 6 knots to 10 knots crosswind facilitates a conditional reduction to 90s due to the time required for transport of the wake vortices out of the path of the follower aircraft.

With respect to the Crosswind concept the reduced wake separation may be dependent on the strength of the crosswind with pre-define criteria, for example with pre-defined crosswind criteria for a reduction to 90s, for a reduction to 80s, for a reduction to 70s, and for a reduction to 60s.

A third WDS-D concept is also under consideration, this is the wake avoidance of the wake generated by the lead aircraft through the follower aircraft employing an earlier differentiated rotation position and a steeper climb profile than the lead aircraft. This naturally occurs between A380 and Heavy wake category lead aircraft and Medium and Light wake category follower aircraft. This may be limited by headwind criteria due to the wind transport risks. This may need to be combined with the Crosswind concept to ensure the wake is transported out of the path of the follower aircraft at low level in case the follower aircraft has a late rotation position or shallower climb profile as a result of being under-powered due to engine problems. However initial analysis of recorded operational data has indicated that the current operations differentiated rotation positions and climb profiles are not sufficiently consistent to ensure wake avoidance.

The WDS-D concepts rely on wind forecasting and monitoring at the runway surface and along the initial departure path. The reliability, accuracy and stability of the wind forecasting solutions available to a local implementation determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

There is requirement to take into account terrain features and obstacles that may impact the wind field when developing and validating the WDS-D concepts. The local topography such as hanger buildings, terminal buildings and high ground in the vicinity of the aerodrome may impact both surface winds and winds aloft.

Aircraft ATM capabilities such as the initial airborne position on the runway, climb profile performance during climb-out, lateral navigational performance during climb-out, and airspeed performance during climb-out, all need to be taken into consideration in the development and validation of the WDS-S concepts solutions.

The wake separation minima on the initial departure path are to be defined as both distance-based minima and time-based minima, so as to be able to be applied as either distance-based minima or time-based minima.



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On handover of separation responsibilities to the TMA Departure Radar Controller there is a need to have achieved the associated radar separation minima employed in the TMA, where the minimum radar separation is 3 NM horizontal and 1,000ft vertical, and where distance-based wake separation minima apply.

## 3.3 Detailed Operating Method

### 3.3.1 Previous Operating Method

The operating method covers from aircraft awaiting departure at the runway holding point until they have climbed up to the Terminal Manoeuvring Area (TMA).

The ATC procedures for an aircraft departing an aerodrome will be specific to each airport. This section summarises the standard procedures used for departing aircraft.

#### 3.3.1.1 Applying Separation Standards

Two methods are widely used by the Tower Runway Controller when applying wake turbulence separation criteria to departing aircraft, one method based on time separation and one method based on distance separation.

Wake turbulence separation minima are the spacing between aircraft, determined by either time or distance, to be applied so that aircraft do not fly through the wake of a preceding aircraft within the area of maximum vortices.

Wake turbulence separation is applied between preceding and following aircraft which are departing from:

- the same runway;
- closely spaced parallel runways (<760 m);
- parallel runways (>760 m) where the project path of the following aircraft crosses within 1000ft of the preceding aircraft;
- crossing runways if the project path of the following aircraft crosses within 1000ft of the preceding aircraft.

The most common method is a procedural time based separation using metric minutes and with a granularity of 1 minute. The time separation criteria are applied by measuring airborne times (“airborne time” to “airborne time”) between successive aircraft. The goal of the Tower Runway Controller, when applying wake turbulence separation to departing aircraft, is to achieve a minimum airborne interval time at the point at which the follower aircraft becomes airborne

To deliver the airborne time separation local procedural approaches are employed. These local procedural approaches include determining the take-off clearance time for the follower aircraft from the recorded “start of take-off roll time” of the lead aircraft, or determining the take-off clearance time of the follower aircraft from the recorded “airborne time” of the lead aircraft.



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To achieve the time-based separation minima in practice when applying the recorded “start of take-off roll time” of the lead aircraft, take-off clearance may be issued to the follower aircraft once the required time separation has elapsed after the lead aircraft recorded “start of take-off roll time”. For example to achieve a 2 minute separation, 2 minutes from the recorded “start of take-off roll time” of the lead aircraft, the transmission of the take-off clearance can be issued to the follower aircraft. The recorded “start of take-off roll-time” is the time the aircraft is recorded as commenced rolling beyond the line-up and wait position with a ground speed of 10 knots or more so as to provide for time contingency for the follower aircraft having a shorter roll-time than the lead aircraft.

To achieve the time-based separation minima in practice when applying airborne times (“airborne times”), take-off clearance may be issued to the follower aircraft; with an allowance for the anticipated follower aircraft take-off roll time on the runway; once the required time separation minus the anticipated follower aircraft take-off roll time has elapsed after the lead aircraft recorded “airborne time”. For example to achieve a 2 minute separation, 1 minute 30 seconds from the recorded “airborne time” of the lead aircraft, the transmission of take-off clearance can be issued to the follower aircraft. In this case the controller estimates that there will be a delay of approximately 30 seconds comprised of 1) the reaction time of the Flight Crew prior to commencing the take-off roll and 2) the time taken for the following aircraft to reach rotation speed ($V_R$) and to become airborne.

Note that where Flight Crews are aware of the weight category of the preceding aircraft they may also measure the required 2 minutes. Whilst not mandatory this is a common practice.

An alternative to the application of time based separation procedures for departing aircraft is the use of distance based procedures. Once airborne, aircraft are subject to wake turbulence radar separations therefore the Tower Runway Controller may apply (disregarding the minute rules) a distance based clearance to ensure the required wake separation criteria. A distance based clearance can be issued as long as the Tower is equipped with radar surveillance. The nature of speed profiles for departing aircraft means that the leading aircraft tends to accelerate away from the following aircraft which has the effect of increasing the separation distance between lead/follower pairs. Erosion of separation can occur longitudinally, although this is rare. A more likely scenario involves erosion of vertical separation between departing aircraft; where there is a risk that aircraft will fly within 1000ft vertically, action is taken by the TMA Departure Radar Controller.

Other factors can influence the required minimum spacing for departing aircraft. In high density, high complexity terminal airspace, constraints may arise from within the TMA which can affect the applied minimum spacing for departing aircraft at a given airport. For example, the requested minimum spacing for consecutive aircraft may be 5 NM even if the required/minimum radar separation is a lower value, such as 3 NM. In this case it is the duty of the Tower Runway Controller to adhere to the requirements of the TMA.

Current ICAO wake turbulence separations can be described as static and are applied in all weather conditions, however certain conditions are known to have an effect on both the transport and decay of the wake vortices. These effects are not currently taken into account in the determination of required wake turbulence separation criteria, which can make existing criteria appear overly conservative. This is especially true in strong wind conditions which can result in the wind component transporting the wake of the preceding aircraft out of the path of the following aircraft.

The rate of decay of the wake vortices can also be influenced by weather conditions which result, in some cases (unstable air mass) in a faster dissipation of the vortex, and in other cases (very stable air mass) in a more prolonged, longer lasting vortex.



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#### 3.3.1.2 Planning

At capacity constrained airports, queue management processes attempt to produce a departure sequence to optimise the departure queue. The departure sequence is iteratively updated at certain planning milestones and made available to a number of affected actors, including the Tower Runway Controller(s). Some airports have a Departure Manager (DMAN) tool to perform this function, whilst at other airports the departure sequence is the result of a manual process to determine the most efficient departure queue. The DMAN uses a number of criteria are such as aircraft type, weight category, expected push-back time, expected taxi time, Calculated Take-Off Time (CTOT), runway entry point (intersection departures) and SID. The use of static, fixed wake turbulence separations provides a degree of simplicity in the calculation of an optimised departure sequence.

#### 3.3.1.3 Runway Layout Configuration

Runway direction is chosen, based on many criteria, but the main one is the wind direction. Headwind conditions at the runway surface are the preferred wind for departures, compared to crosswind conditions or tailwind conditions.

#### 3.3.1.4 Runway Modes of Operation

In a large airport, you can distinguish between two main runway operations. One is the segregated mode, where one duty runway-in-use is used for departures, and another duty runway-in-use is used for the arrivals. The other configuration is mixed mode, where the arrival and departure streams are interlaced on to a duty runway-in-use.

If operating in mixed mode, the penalty of having to apply distance based separation for arrivals is less, since Controllers are typically able to reduce the 'Gap' size required to depart one aircraft between two arrivals, as the headwind increases, without becoming constrained by the wake turbulence separation minimum.

The two modes can also be combined, so that a few arrivals will land on the departure runway, or vice versa.

When planning a runway change the look ahead needed is a bit shorter for departures than for arrivals. The most important constraint when changing the departure runway is the time the Flight Crew need in preparation for another runway and departure SID.

In current operations the Tower Runway Controller is also responsible for providing landing clearance to arriving aircraft. In order to do this the arrival traffic is transferred to the Tower Runway Controller a few nautical miles from the threshold. They monitor the speed and position of the next approaching arrival and check the runway occupancy of preceding aircraft is progressing as expected.

#### 3.3.1.5 Runway Departure Control

The Tower Runway Controller is responsible for the airborne phase of flight immediately after departure, they also have to deliver line-up and take-off clearances to departing aircraft and time.

Both visual out of the window and surveillance equipment is used.

When applying time based separation the separation minima are applied by measuring airborne times ("airborne time' to "airborne time") between successive aircraft. At least two methods are employed for achieving the time separations for successive departing aircraft:

- Use of the system clock - The time when the lead aircraft commences their take-off roll ("start of take-off roll time") or becomes airborne ("airborne time") is populated onto the flight progress strip. This may be through either ATCO action with or without automation support, or automatically through surveillance monitoring dependent on local procedures and the associated local automation support.
  - The ATCO then adds the required time separation for the follower aircraft to the "start of take-off roll time" of the lead aircraft to determine the earliest time to issue clearance to take-off to the follower aircraft using the system clock. This may be with or without the support of a count-down timer, dependent on local procedures and the associated count-down timer support.
  - The ATCO adds the required time separation for the follower aircraft to the recorded "airborne time" of the lead aircraft, and subtracts the expected time between issuing the take-off clearance and the follower aircraft to become airborne, to determine the earliest time to issue the clearance to take-off to the follower aircraft using the system clock.
- Use of the radar display - This method is based on the ATCO using one or more reference points on the radar display to ensure a sufficient lateral separation has been achieved between the 'lead' and 'follower' aircraft.

ATCOs may vary the method used depending on the conditions. For instance, in low headwind conditions some ATCOs prefer the method of using the system clock whereas in higher headwind conditions the use of the radar display may be preferred.

### 3.3.2 New SESAR Operating Method

This section presents the new operating method for the PWS-D, WDS-D and OSD concepts that are applicable on the initial departure path for departures.

The philosophy adopted is to evolve the current operating method focusing on:

- Enabling the Tower Runway Controller to apply the more efficient PWS-D wake separation rules consistently, efficiently and safely between departure pairs.
- Enabling the safe employment of the WDS-D conditional reduction or suspension of the wake separation rules, applicable under pre-defined wind conditions.
- Supporting the coordination required such that the appropriate pressure of departure traffic is provided to the Tower Runway Controller at the runway holding positions.
- Supporting the coordination required with TMA operations.

#### 3.3.2.1 Enabling the Tower Runway Controller to Apply the PWS-D Wake Separation Rules (AO-0323)

##### 3.3.2.1.1 Optimised Separation Delivery for Departure (AO-0329)

With the PWS-D wake separation rules employing the pairwise aircraft type matrix, with the 20 x 20 wake category matrix for the other aircraft type pairs, it is no longer possible for the Tower Runway Controller to mentally derive the required wake separation between a departure pair.





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It is proposed that the OSD system support is provided for a follower departure aircraft from when the follower departure aircraft is given the clearance to line-up instruction. It is not until this occurs that the runway departure sequence order for the follower aircraft is established in relation to the lead aircraft ahead, and thus the PWS-D wake separation rules and SID route separation and other separation and spacing constraints can be applied by the OSD system support.

For time-based separation, it is proposed that the OSD system support calculates the earliest take-off clearance time or the earliest airborne time for the follower aircraft. This is the “Not Before Take-Off Time” or the “Not Before Airborne Time” for separation and spacing constraints supported by the OSD system support for displaying to the Tower Runway Controller. It is a “Not Before Take-Off Time” or “Not Before Airborne Time” as there may be other more constraining separation or spacing constraints unknown by the OSD system support that still need to be manually applied by the Tower Runway Controller.

It is proposed that the “Not Before Take-Off Time” or “Not Before Airborne Time” is displayed in a time field of the follower departure aircraft information in the electronic environment (e.g. a time field of the electronic flight progress strip of the departure aircraft in the Heathrow EFPS environment). This may or may not be supported by a count-down timer depending on local procedural preferences and the associated automated system support.

***Procedural Option of Applying the Recorded “Start of Take-Off Roll Time”***

In the local procedural option of applying the recorded “start of take-off roll time” of the lead aircraft, the earliest the take-off clearance may be issued to the follower aircraft is the time once the required time separation has elapsed after the lead aircraft recorded “start of take-off roll time”.

- For this local procedural option, the “Not Before Take-Off Time” for the separation constraints between the lead and follower aircraft, is the recorded “start of take-off roll time” for the lead aircraft, plus the required time separation for the largest separation constraint to the follower aircraft.
- This is in the case of when no larger constraint, such as a SID route separation to a proceeding aircraft in front of the lead aircraft is required to be applied, and is being supported by the OSD system support; in which the case the associated “Not Before Take-Off Time” for this larger separation constraint, is the recorded “start of take-off roll time” of the associated proceeding aircraft, plus the required time separation of the larger separation constraint.
- For this local procedural option, the Tower Runway Controller uses the “Not Before Take-Off Time” directly as the earliest time the take-off clearance may be issued.

*Procedural Option of Applying the Recorded "Airborne Time"*

In the local procedural option of applying the recorded "airborne time" of the lead aircraft, the earliest the take-off the clearance may be issued to the follower aircraft; with an allowance of the anticipated follower aircraft take-off roll time on the runway; is the time once the required time separation, minus the anticipated follower aircraft roll time on the runway has elapsed, after the lead aircraft recorded "airborne time".

- For the local procedural option, the "Not Before Airborne Time" being the earliest time for the "airborne time" for the follower aircraft, the "Not Before Airborne Time" for the separation constraints between the lead and follower aircraft, is the recorded "airborne time" of the lead aircraft, plus the required time separation for the largest separation or spacing constraint to the follower aircraft.
- This is in the case of when no larger constraint, such as a SID route separation to a proceeding aircraft in front of the lead aircraft, is required to be applied and is being supported by the OSD system support; in which the case the associated "Not Before Airborne Time" for this larger separation constraint, is the recorded "airborne time" of the associated proceeding aircraft, plus the required time separation of the larger separation constraint.
- For this local procedural option, the Tower Runway Controller uses the "Not Before Airborne Time" as the earliest time for the "airborne time" of the follower aircraft, and mentally subtracts the anticipated roll time for the follower aircraft, to mentally establish the earliest time the take-off clearance may be issued.
    - Note that in cases where the lead aircraft recorded airborne time is known to be late, due to a late manual indication action on the EFPS, the Tower Runway Controller may take this into account when mentally establishing the earliest clearance to take-off time.
    - The Tower Runway Controller may prefer that the displayed "Not Before Airborne Time" is rounded up to the nearest 5 seconds, in order to simplify the mental calculation of subtracting the anticipated roll time.
- In the case when there is no wake separation constraint, and no other time separation constraints are either supported by the OSD support tool, or apply to the follower aircraft, the Tower Runway Controller prefers that the indication that no "Not Before Airborne Time" applies to the follower aircraft is displayed well before the lead aircraft becomes airborne, soon after the lead aircraft starts rolling, in order to prepare for giving clearance to take-off to the next aircraft, potentially immediately or soon after the lead aircraft becomes airborne.



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*Optional OSD Support for Other Departure Separation or Spacing Criteria*

The “Not Before Take-Off Time” or the “Not Before Airborne Time” may just be based on the required wake separation to the lead departure aircraft ahead, or may take into account other departure separation or spacing criteria depending on local preferences:

- It is envisaged that there may be a local preference for the “Not Before Take-Off Time” or “Not Before Airborne Time” to at least be based on the required wake separation time to the lead departure aircraft ahead, and also the required SID route separation, or an indication of a possible SID route separation; with the responsibility for providing for the CTOT slot time, and the minimum departure intervals and average departure intervals, remaining with the Tower Runway Controller, without incorporating into the OSD system support.
    - Note that it is perceived as potentially significantly misleading for the “Not Before Take-Off Time” or the “Not Before Airborne Time” to be based just on the required wake separation time, due to the potential for the Tower Runway Controller being drawn into giving a clearance to take-off without consideration of the required SID route separation.
    - However the local application of the SID route separations may be too complex to be fully supported by the OSD system support, with the OSD system support just being able to provide an indication of a possible SID route separation. When this is the case the responsibility for providing for the required SID route separation remains with the Tower Runway Controller, without the SID route separation being incorporated into the “Not Before Take-Off Time” or “Not Before Airborne Time”.
- It is envisaged that there may be a local preference for the “Not Before Take-Off Time” or “Not Before Airborne Time” to also include consideration of SID route related Minimum Departure Intervals (MDIs) and Average Departure Intervals (ADIs).
- It is not envisaged that the CTOT slot times need to be included when calculating the “Not Before Take-Off Time” or “Not Before Airborne Time”, as the issues associated with conformance to a CTOT slot time are usually resolved before the departure aircraft is given the clearance to line-up. Coordination may have taken place for the departure aircraft to take-off outside of the CTOT slot time, without the CTOT slot time being updated, and so the CTOT slot time constraints may no longer apply.

Note that with SID route separations, there may be a need to take into account the “start of take-off roll time” or “airborne time” of not just the lead departure aircraft ahead, but also the previous departure aircraft ahead (for a 2 minute SID route separation), and also the previous to the previous departure aircraft ahead (for a 3 minute SID route separation). This is also a consideration for supporting MDIs and ADIs on particular SID routes; there is a need to retain a sufficient horizon of the previous departure aircraft that have taken-off, with associated “start of take-off roll time” or “airborne time” and SID route information. MDIs are specified in minutes, typically from 3 minutes up to 10 minutes.

With respect to applying the SID route separations, it is proposed that the OSD system support be able to support the local SID routes from each of the departure runways, with the associated SID route separations, including the application of the additional separation when the lead aircraft type is in a slower speed group than the follower aircraft type, with either none, one or two intervening speed groups, depending on the SID route combination. Within the enabling context of the OSD system support, there may be a possibility of the refinement of the application of the SID route separations, directly taking into account aircraft type speed characteristics rather than just speed group speed characteristics.

### *Departure Pairs Not Constrained by a Wake Separation*

When a departure pair is not constrained by a wake separation, or a SID route separation, then either a reduced separation in the vicinity of the aerodrome (RSVA) is applied, or the 3 NM MRS is applied. There is not a requirement to apply a 60s time separation minimum. Because of this there is no time separation to be applied for the OSD system support to calculate a “Not Before Take-Off Time” or a “Not Before Airborne Time” for the follower aircraft. For these departure pairs the OSD system support will need to indicate that no “Not Before Take-Off Time” or “Not Before Airborne Time” applies to the follower aircraft, for example by displaying ”NONE” or “----" in the MM:SS fields of the “Not Before Take-Off Time” or “Not Before Airborne Time”.

### *High Integrity Data Requirements*

To calculate the required wake separation, the OSD system support is required to be provided with high integrity aircraft type and wake category information. This may be provided from flight data processing, or from the Tower Runway Controller electronic environment. In order to ensure the integrity of the aircraft type information, there will need to be associated controller procedures with respect to checking and amending the aircraft type and wake category information, preferably prior to the departure aircraft reaching the departure holding points, while at the latest prior to the departure aircraft being given clearance to line-up.

To correctly calculate the required wake separation for a departure aircraft taking-off from an intermediate position, the OSD system support needs to be notified of when a departure aircraft is taking-off from an intermediate position.

To correctly apply the required SID route separations and for supporting MDIs and ADIs on particular SID routes, the OSD system support is required to be provided with the high integrity SID route information for each departure aircraft.  This may be provided from flight data processing, or from the Tower Runway Controller electronic environment. In order to ensure the integrity of the SID route information, there will need to be associated controller procedures with respect to checking and amending the SID route information, preferably prior to the departure aircraft reaching the departure holding points, while at the latest prior to the departure aircraft being given clearance to line-up.

### *Flight Crew Requests for the Application of RECAT-EU or ICAO Wake Separations*

There may be situations where a flight crew requests the application of RECAT-EU or ICAO departure wake separations. For the ORD system support to be able to provide support for this, the OSD system support will need to be notified of the request, in order for the OSD system support to correctly calculate the required RECAT-EU or ICAO wake separation.

### *Clear Indication of a Wake Separation*

It is envisaged that there may be a local preference for a clear indication to be provided when the "Not Before Take-Off Time" or "Not Before Airborne Time" is for a wake separation, rather than a SID route separation, or MDI or ADI. To support this, the OSD system support will need to indicate when the "Not Before Take-Off Time" or "Not Before Airborne Time" is for a wake separation.

On being provided with a "Not Before Take-Off Time" or a "Not Before Airborne Time" the Tower Runway Controller may wish to review which separations have been taken into consideration to derive the "Not Before Take-Off Time" or "Not Before Airborne Time"; the wake separation, the SID route separation, the MDI or ADI, and so on. To support this, the OSD system support will need to provide all the constituent separation information associated with a "Not Before Take-Off Time" or "Not Before Airborne Time".

### *Provision of a Countdown Timer*

If Countdown Timer support is provided the zero of the countdown should be that of the "Not Before Take-Off Time" or "Not Before Airborne Time". The countdown timer may be analogue or digital, and the display window it is displayed in may also include information to facilitate the situation awareness of the Tower Runway Controller such as the required wake separation time and associated context such as the entry taxiways and wake categories of the associated preceding and following aircraft, depending on local preferences. Figure 4 provides an illustration of a display window with a digital countdown timer.

### *OSD Support for Distance Separations*

For distance-based separation, there is a need to develop the OSD system support. A possible approach is for the OSD system support to calculate the required minimum distance spacing from the line-up position of the follower aircraft (or the line-up end of the runway) that the lead aircraft ahead is required to achieve, before issuing the clearance to take-off to the follower aircraft.

- This is so that when the follower aircraft rotates and becomes airborne the required distance-based separation to the lead aircraft ahead is achieved.
- It is proposed that the required minimum distance is displayed as an arc or line across the planned SID route of lead aircraft ahead on the Tower Runway Controller radar display. This is the "Dynamic Departure Indicator -Distance" (DDI -D) and is illustrated in Figure 4.
- It is possible that the DDI-D may be displayed once the lead aircraft ahead is rolling. This is based on the assumption that the displayed DDI-D for the required minimum distance spacing in front of the lead aircraft ahead is no longer required once the clearance to take-off has been issued and the lead aircraft is rolling.

An algorithm for calculating the required minimum distance spacing from the line-up position of the follower aircraft (or the line-up end of the runway) has been developed and validated. There is a need for the algorithm to take into account the impact of the prevailing wind conditions on the ground speed of the lead aircraft on the initial departure path as this is impacts the amount of increase in the separation to the follower aircraft over the take-off roll time of the follower aircraft.

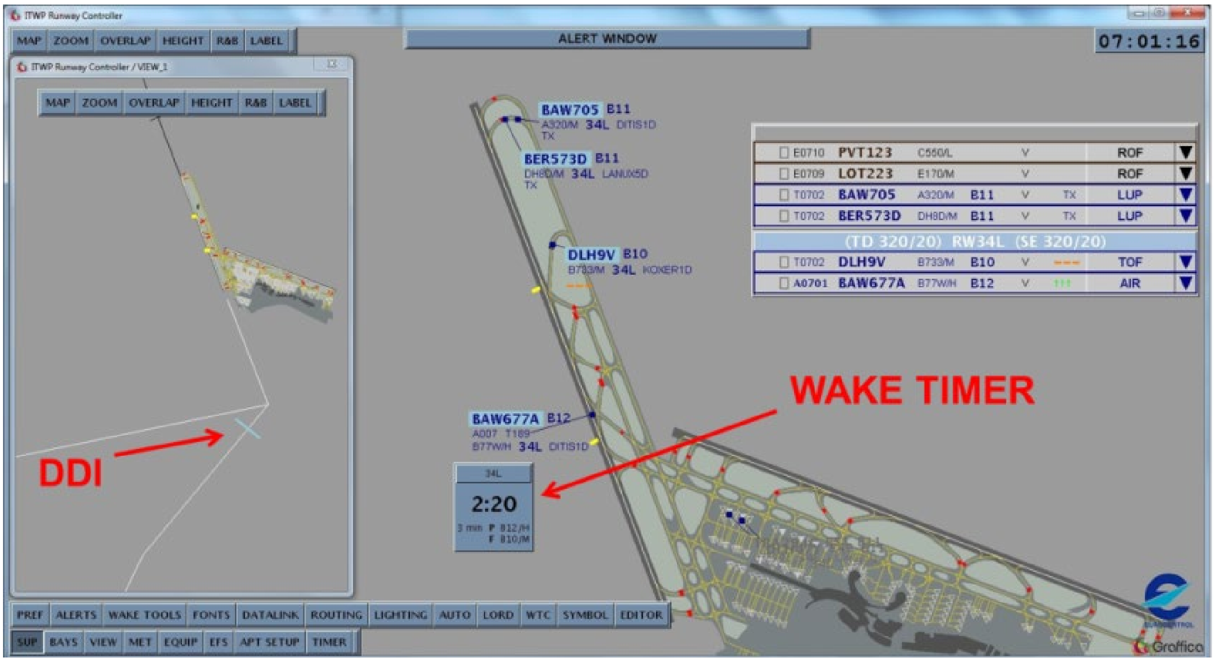


**Figure 4: Illustration of a Departure Distance Indicator (DDI) and a Digital Count Down Timer (WAKE TIMER) on an Integrated Tower Workstation Position (ITWP)**

Note that the Departure Distance Indicator (DDI) has been renamed the Dynamic Departure Indicator – Distance (DDI-D) and the Digital Countdown Timer (WAKE TIMER) has been renamed Dynamic Departure Indicator – Time (DDI-T).

Aircraft separation is calculated depending on the separation scheme, whether is time-based (TBS) or distance-based (DBS), and the type of separation constraint: Wake Turbulence, Minimum Radar Separation (MRS) and/or Weather Dependent.

For departure operations, the EUROCONTROL OSD tool supports the following separation rules:

- Wake Turbulence Separation: TBS or DBS, with delivery point at the follower's take off position
- Minimum Radar Separation (MRS): DBS, with delivery point at the follower's take off position
- Other DBS spacing constraint, potentially satisfied at delivery altitude

***OSD Support for Mixed Mode Operations***

It is anticipated that a Coupled AMAN/DMAN as developed in SESAR Solution PJ02-08 will be employed to coordinate the arrival and departure flow rates and the associated departure gap provision between the arrival aircraft.

In ECTL RTS3a where a Coupled AMAN/DMAN was not employed it was found that additional support was required to tactically coordinate the departure gap provision between arrival aircraft on intermediate and final approach.

#### 3.3.2.1.2 Proposed Provision of Departure Sequence Order to the OSD System Support

The DMAN System departure sequence order is used to support the push-back and ground movement decisions to the departure holding points. It is not necessarily updated to reflect that some aircraft may not be ready to line-up when at the holding points and that the Tower Runway Controller is required to make late tactical decisions as to the actual order that aircraft are lined-up and take-off. Because of this the DMAN System departure sequence order may not be a suitable order for use by the OSD system support.

It is proposed that the departure sequence information is provided from the Tower Runway Controller electronic environment.

- When a departure aircraft is provided with the instruction for clearance to line up, or for the combined clearance to line-up and take-off, and the departure aircraft is moved to the line-up area or the take-off area of the associated runway bay it is proposed the departure sequence ordering in the runway bay is provided, across both the line-up area and take-off area.
- When a departure aircraft takes-off and is moved from the runway bay to the airborne departure bay it is proposed that the updated departure sequence ordering in the airborne departure bay is provided together with the associated “airborne time” or “start of take-off roll time” of each departure aircraft.

An alternative approach to providing for the departure sequence information, particularly in paper flight progress strip environments, is to employ ground movement surveillance monitoring of when departure aircraft enter the runway and line-up, including the line-up order when multiple departure aircraft are lined-up, and also ground movement and/or air movement surveillance monitoring of the departure aircraft ahead either rolling down the runway or airborne on the initial departure path.

Note that for applying SID route separations there may be a need to retain at last three previous departure aircraft with their associated “Start of take-off roll time” or “airborne time” and SID route information.

Note that for applying SID route MDIs and ADIs there may be a need to retain up to ten minutes of previous departure aircraft with their associated “airborne time” or “start of take-off roll time” and SID route information.

#### 3.3.2.1.3 Proposed Provision of the Departure “Start of Take-Off Roll Time” to the OSD System Support

It is proposed that the “start of take-off roll time” is provided through ground movement surveillance of the line-up and initial roll of the aircraft, from each of the line-up positions on each departure runway. The “start of take-off roll time” is the time the aircraft is observed as commenced rolling beyond the line-up and wait position with a minimum ground speed such as 15 knots.

An alternative approach is for the “start of take-off roll time” to be provided from the Tower Runway Controller electronic environment when the departure aircraft is seen as commenced rolling beyond the line-up and wait position.

#### 3.3.2.1.4 Proposed Provision of the Departure “Airborne Time” to the OSD System Support

It is proposed that the “airborne time” of a departure aircraft is provided from the Tower Runway Controller electronic environment when the departure aircraft is seen as initially airborne by the Tower Runway Controller and the associated flight data entry (FDE) or flight progress strip (FPS) is moved to the airborne departure bay.

An alternative approach, particularly in a paper flight progress strip environment, is to employ ground movement and air movement surveillance, including the related downlinked airborne parameter (although this can be inconsistent for some aircraft types), to determine when each aircraft rotates and initially becomes airborne. This may also be considered in conjunction with a Tower Runway Controller electronic environment, in order to improve the consistency of the airborne time information, particularly if there is the possibility of any inconsistency in the time the departure aircraft may be moved to the airborne departure bay, especially if this could be early, and also if this could be significantly late.

#### 3.3.2.1.5 Proposed Provision of Departure Sequence Order Optimisation Support

Optimisation of the Departure Sequence Order starts from establishing the Target Off Blocks Time to being delivered to the departure holding positions for the departure runway-in-use. This is supported by the DMAN System in conjunction with the A-CDM System.

It is proposed for PWS-D that this is continued to be supported in the same way, with the DMAN System taking into account the more efficient PWS-D wake separation rules.

A potential issue with PWS-D and WDS-D, is the possible need to support tactical departure sequence order optimisation, when a departure aircraft at the departure holding position is unready to line-up, approaching the time for the line-up clearance for the optimised departure sequence order, and reports that they may be unready for some time, and thus an alternative departure aircraft will need to be given a line-up clearance, in order to maintain an efficient departure flow from the runway. In this situation the Tower Runway Controller may decide on a revised order sequence order, by applying similar criteria as per today, mentally deciding on the revised departure sequence order without sequence order optimisation system support, or possibly more preferentially, to be provided with a revises optimised departure sequence order by extending the DMAN system support.

### 3.3.2.2 Enabling the Employment of the WDS-D Conditional Reduction or Suspension of the Wake Separation Rules (AO-0304)

#### 3.3.2.2.1 WDS-D System Support

It is proposed that WDS-D system support is provided to inform Tower ATC of when WDS-D can be applied, and for supporting the decisions and coordination required, for the transition to employing the WDS-D conditional reduction or suspension of the wake separation rules, and also the timely transition to employing standard PWS-D wake separation rules.

It is proposed that sufficient conservatism is applied with respect to wind conditions criteria for employing WDS-D, such that there is assurance of sufficient persistence of the conditions when the follower aircraft is given clearance to line up.

It is proposed that the GO/NO GO Indication of the wind conditions criteria is presented on the wind conditions display of the Tower Supervisor, together with the prevailing/forecast wind criteria basis for the GO /NO GO Indication.

With respect to a transition from NO GO to GO, the Tower Supervisor may then make a decision to authorise the application of the WDS-D reduced wake separations, which then enables the GO Indication, together with the prevailing/forecast wind criteria basis, to be displayed on the wind conditions display at all the Tower ATC working positions. The Tower Supervisor may in some circumstances wish to pre-authorise the application of the WDS-D reduced wake separations when there is queued departure traffic and it forecast that the wind criteria will be satisfied in the near future.

With respect to the controlled transition from GO to NO GO by the Tower Supervisor, in advance of the prevailing/forecast wind conditions not meeting the wind conditions criteria, the Tower Supervisor may make a decision to withdraw the authorisation for the application of the WDS-D reduced wake separations, which then changes the GO Indication to a NO GO Indication on the Tower ATC working positions.

With respect to the uncontrolled transition from GO to NO GO, when the wind conditions change such that the wind conditions criteria are no longer prevalent, the Tower Supervisor is informed of the NO GO Indication on their wind conditions display, so that they can action withdrawing the authorisation to employ the reduced wake separation. Optionally, the WDS-S system support may automatically action the withdrawing of the authorisation to employ the reduced wake separation. The withdrawing of the authorisation changes the GO Indication to a NO GO Indication on the Tower ATC working positions.

There may be situations where the Tower Runway Controller decides that it is inappropriate to apply the reduced wake separations while there is a GO Indication. In these situations the Tower Runway Controller can either apply standard wake category based wake separation manually, probably RECAT EU wake separations, or co-ordinate with the Tower Supervisor to request withdrawing the authorisation to employ the reduced wake separation, to change the GO Indication to a NO GO Indication.

#### 3.3.2.2.2 Enhanced OSD System Support (AO-0329)

It is proposed that in the case of a conditional reduction of the wake separation rules, the OSD system support is enhanced to include these conditional reductions when calculating the required wake separation, and is notified of when to apply the WDS-D reduced wake separations, and when to apply the PWS-D standard wake separations.

For WDS-D based on crosswind transport of the wake vortices generated by the departure aircraft ahead out of the path of the departure aircraft, these conditional reductions are dependent on the departure aircraft SID route being upwind of the departure aircraft ahead SID route beyond the initial departure path. This will need to be supported and taken into account by the Enhanced OSD system support when applying the WDS-D reduced wake separations. There will also need to be assurance of the integrity of the SID route information, with associated controller procedures with respect to checking and amending the SID route information, prior to the departure aircraft reaching the departure holding points.

At any time the Flight Crew may request the application of standard wake separation, rather than the reduced wake separation. In this situation the Tower Runway Controller can manually apply the standard wake category based wake separation, probably RECAT EU wake separations and/or possibly ICAO wake separations. An optional alternative is to provide the Tower Runway Controller with the means to indicate to the Enhanced OSD tool support when there has been a request for the standard wake separation to be applied, so that the Enhanced OSD tool support is directed to use the standard wake separation.

There may be situations where the Tower Runway Controller decides that it is inappropriate to apply the reduced wake separations when there is a GO Indication. In these situations the Tower Runway Controller can manually apply the standard wake category based wake separation, probably RECAT EU wake separations, in advance of the co-ordination with the Tower Supervisor to request withdrawing the authorisation to employ the reduced wake separation, so as to change the GO Indication to a NO GO Indication.

#### 3.3.2.2.3 Conformance Monitoring and Alerting Support

For WDS-D based on cross-wind transport there may be a need to provide for conformance monitoring of the trajectory of the departure aircraft ahead, with respect to lateral navigation performance against the centre-line of the initial departure path, and the turn on to the planned SID route, and to alert the Tower Runway Controller when the departure aircraft ahead deviates outside of the required lateral navigation performance, such that the risk of a WVE by the departure aircraft has been unacceptably increased. This is so as to alert the Tower Runway Controller to the potential need to take action, with respect to protecting the departure aircraft. Similarly there may also be the need to provide for conformance monitoring of the trajectory of the departure aircraft, with respect to lateral navigation performance against the centre-line of the initial departure path, and the turn on to the planned SID route.

For WDS-D based on differentiated rotation position and differentiated climb profile, there may be a need to provide for conformance monitoring of the rotation position and vertical climb profile of the departure aircraft ahead, with respect to the anticipated rotation position and anticipated vertical climb profile performance for the aircraft type or wake category, and to alert the Tower Runway Controller, when the departure aircraft ahead deviates outside of the required rotation position performance, or vertical climb profile performance, such that the risk of a WVE by the departure aircraft has been unacceptably increased. This is so as to alert the Tower Runway Controller to the potential need to take action, with respect to protecting the departure aircraft. Similarly there may also be the need to provide for conformance monitoring of the rotation position, and climb profile of the departure aircraft, with respect to the anticipated rotation position performance, and anticipated vertical climb profile performance, of the aircraft type or wake category.

### 3.3.2.3 Supporting the Coordination for Ensuring Appropriate Pressure of Departure Traffic

The queue management processes optimising the departure queue, will need to take into account the efficient PWS-D and WDS-D wake separation rules, in order to ensure the appropriate pressure of departure traffic is presented to the Tower Runway Controller, at the runway holding positions.

It is proposed that the DMAN and A-CDM system support is enhanced, to take into the more efficient wake separation rules, and that the coordination and supporting procedures, for the transitions to/from employing the WDS-D conditional reduction or suspension of the wake separation rules, includes ensuring that the DMAN System and A-CDM System support, are taking into account the impact on the associated required pressure of traffic.

#### 3.3.2.4 Supporting the Coordination with TMA Operations

In a complex TMA servicing several airports, it may be important that TMA Operations are informed of when WDS-D is to be employed, so that the increase in the resulting departure rate can be taken into account.

It is proposed that where this is the case, that TMA Operations is informed of when WDS-D is able to be employed, together with the anticipated impact on the departure rate, so that consideration can be given as to whether departure rate restrictions will be required to be applied.

#### 3.3.2.5 Use Cases

##### 3.3.2.5.1 [NOV-2] Operational Node View for WTS (for Departures) based on Static Aircraft Characteristics for Departures Concepts Solutions

The Operational Node View summarise the information exchanges for PJ.02-01-06 concepts for departures described in the following Use Cases:

| | |
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| Use case | [NOV-5][DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D) |
| Use case | [NOV-5][DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D) |

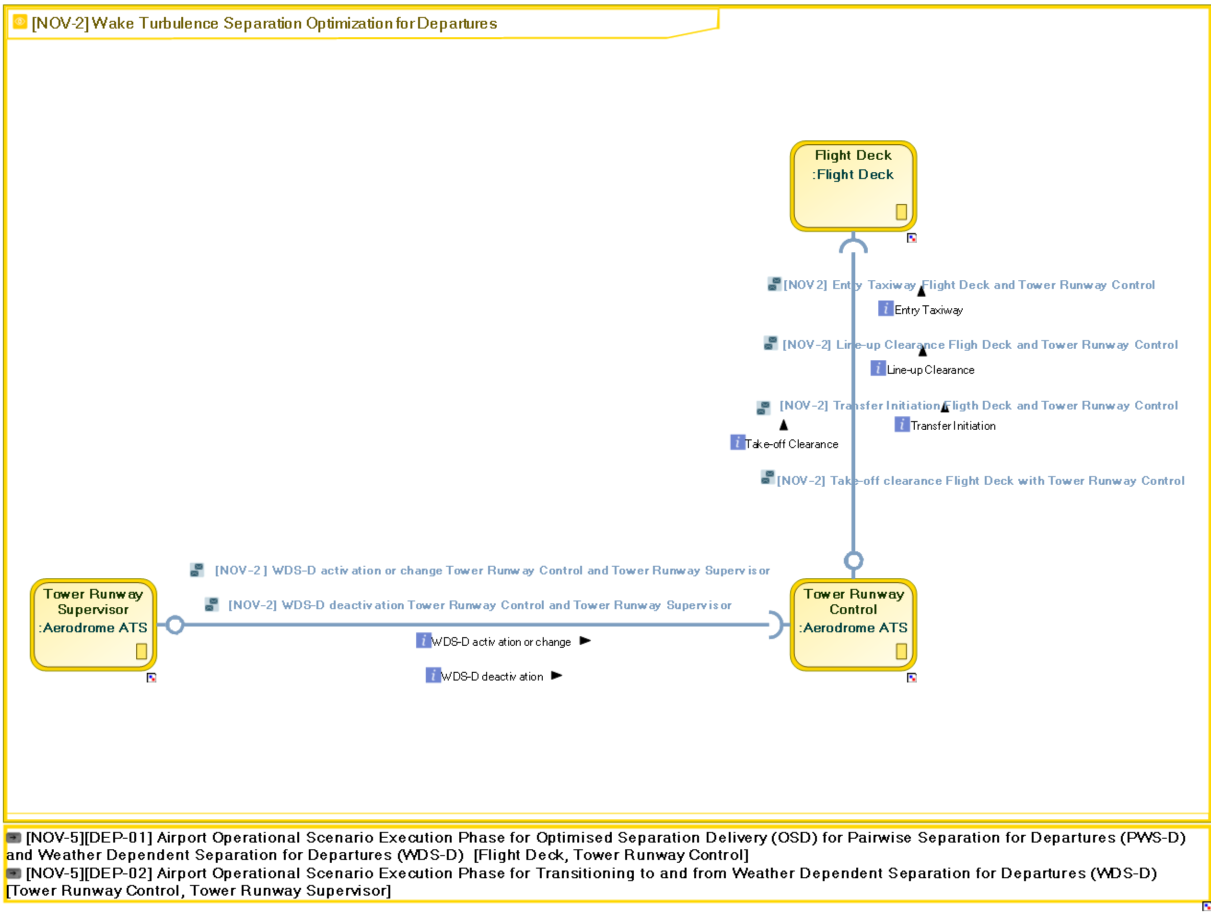


**Figure 5: [NOV-2] Operational Node View for WTS (for Departures) based on Static Aircraft Characteristics for Departures Concepts Solutions**

The [NOV-2] Operational Node View provided in Figure 5 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the operational node view diagram is provided below.

NOV-2-DEP.pdf

It is to be noted that the DEP UC for Airport Operational Scenario Long Term Planning is not identified as a relevant PJ.02-01-06 Operational Scenario in the SESAR 2020 Concept of Operations Edition 2017. This Use Case describes the steps involved with respect to the long term planning for employing PWS-D and WDS-D. This UC applies when a decision is being considered with respect to the options of employing PWS-D and of employing WDS-D at an aerodrome. The actors involved are the long term planning representatives of the aerodrome, such as the Airport Operator, the ATC Operator, the Airline Operators, and the Regulator Authority. This UC is invoked when there is capacity constrained aerodrome operations combined with the V3 maturity of the PWS-D and WDS-D concepts.

The following nominal flow steps have been identified:

- For the planned evolution of the aircraft type traffic mix at the aerodrome establish the forecast departure rate benefits of employing PWS-D compared to the current departure separation regime.
- Determine how the forecast departure rate benefits of PWS-D are to be employed with respect to both providing an increase in the scheduled departure rate and also in providing for additional headroom for resilience to adverse operating conditions.
- For the four seasons wind conditions experienced at the aerodrome establish the forecast departure rate benefits of employing WDS-D with PWS-D compared to just PWS-D and the benefits with respect to the rate at which queued departure traffic can be cleared.
- Determine how the forecast departure rate benefits of WDS-D can contribute to providing additional headroom for resilience to adverse operating conditions, and thus potentially negating the need to utilise some of the additional departure rate of PWS-D to provide for the additional headroom for resilience to adverse operating conditions.
- Determine the adjustments to be made to the A-CDM system support and the D-MAN system support with respect to the departure rate impact of employing PWS-D and WDS-D.
- Establish the Benefits Case for employing PWS-D and WDS-D.
- Instigate the Feasibility & Options, Project Definition and Implementation investment for developing and deploying PWS-D and WDS-D at the aerodrome.

#### 3.3.2.5.2 [NOV-5][DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)

***General Conditions (Scope and Summary)***

This Use Case describes in detail the steps involved for the Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)

***Pre Conditions***

The OSD or Enhanced OSD system support is deployed and available for supporting PWS-D and WDS-D respectively.

The OSD or Enhanced OSD system support is configured to support applying PWS-D and WDS-D respectively and optionally SID route separations and possibly MDI and ADI dependent on local requirements.

The OSD or Enhanced OSD system support is being provided with the high integrity departure sequence take-off order on the runway.

The OSD or Enhanced OSD system support is being provided with the “airborne time” or the “start of take-off roll time” for each departure aircraft dependent on local procedures.

The OSD or Enhanced OSD system support is being provided with high integrity aircraft type and wake category information for each departure aircraft.

The OSD or Enhanced OSD system support is being provided with high integrity SID route information for each departure aircraft.

The OSD or Enhanced OSD system support is being informed of departure aircraft taking off from an intermediate position.

The OSD or Enhanced OSD system support, dependent on local procedures, is being informed of departure aircraft requesting that the RECAT-EU or the ICAO wake separation be applied.

In the local case of supporting distance-based separation for departures, the required wind conditions service over each of the SID routes from the initial airborne positions to the maximum “Required Minimum Distance Spacing” is deployed and available for supporting the calculation of the position of the “Required Minimum Distance Spacing Arc” by the OSD or Enhanced OSD system support.

The A-CDM System and DMAN System have been configured to take into account the PWS-D and WDS-D wake separation rules that are being applied so that an appropriate pressure of departure aircraft with an appropriately optimised departure sequence order is delivered to the departure holding points for the departure runway-in-use.

The Flight Crew have been informed that the PWS-D and WDS-D wake separation rules are being applied and have been fully briefed and aware of the PWS-D and WDS-D wake separation rules.

***Post Conditions***

The departure aircraft has been delivered with optimised separation to the TMA Departure Radar Controller.

***Actors***

Tower Runway Controller, Flight Crew, TMA Departure Radar Controller.

***Trigger***

Departure aircraft at or approaching the runway holding points and have contacted the Tower Runway Controller.

***Nominal Flow Process Diagram***

The nominal flow is represented in the [NOV-5] [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D) in Figure 6.

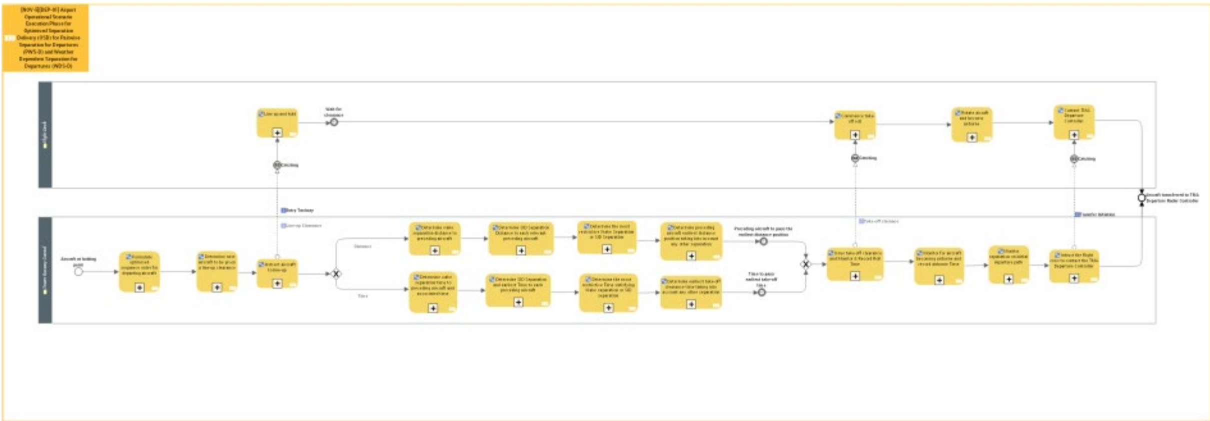

**Figure 6: [NOV-5] Process Diagram for [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)**

The Process Diagram for [DEP-01] in Figure 6 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-DEP-01.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 11 and Table 12 respectively.

| Activity | Description |
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| | **Tower Runway Control** |
| Formulate optimised sequence order for departing aircraft | <u>Nominal</u><br>For departure aircraft at or approaching the runway holding points the Tower Runway Controller formulates optimised sequence order for the next few departure aircraft, optimising the amount of wake separation and SID separation/spacing required while meeting any CTOT requirements.<br>This may be with the aid of an automatically optimised departure sequence order or may be self-determined without any automated system support. When self-determining the optimised sequence order the Tower Runway Controller may take into account the RECAT-EU (or ICAO) wake category based wake separations using an aide-memoire table rather than the aircraft type pairwise and 20-CAT matrices of the PWS-D wake separations. The Tower Runway Controller may reflect the formulated optimised sequence order in the electronic environment runway holding bay.<br>In mixed mode operations the optimisation of the departure sequence order also takes into account the coordination of the departure gaps in the arrival sequence. This includes optimising packed departures to where possible to being non-wake pairs without any SID separation/spacing constraints, and where a departure pair has wake separation or SID separation/spacing requirements interleaving an arrival aircraft between the two departing aircraft. This may be with the aid of automated system support as is being developed and validated in PJ02-08.<br><u>Non-Nominal</u> |

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| | The Flight Crew may inform the Tower Runway Controller that they are not ready to be given a line-up clearance due for example not having completed the authorisation steps with their airline operations centre. In such cases the Tower Runway Controller requests the reasons for not being ready for line-up, and the estimated time for when the aircraft will be ready for line-up. This may result in the need to change the optimised sequence order.<br>Once ready the Flight Crew inform the Tower Runway Controller that they are ready to be given a line-up clearance so that the departure aircraft can be re-considered for including in the optimised sequence order. |
| Determine next aircraft to be given a line-up clearance | <u>Nominal</u><br>When it is time to line-up the next departure aircraft the Tower Runway Controller uses the formulated optimised departure sequence order to determine the next departure aircraft to line-up.<br><u>Non-Nominal</u><br>For mixed mode operations if the departure gap spacing provided between the arrival aircraft on final approach is not as requested there may be a late change as to whether to line-up a departure aircraft or whether to switch to lining-up a different departure aircraft; in the case of a smaller departure gap than requested switching to lining-up a smaller departure aircraft type with a reduced take-off roll time; in the case of a larger departure gap than requested switching to lining-up a larger departure aircraft type requiring more take-off roll time. |
| Instruct aircraft to line-up | <u>Nominal</u><br>The Tower Runway Controller instructs the departure aircraft to line-up which may include informing the Flight Crew of the entry taxiway with the associated line-up position.<br>In an electronic environment the Flight Data Entry (FDE) or Flight Progress Strip (FPS) is moved from the holding bay to the runway bay and the entry taxiway with the associated line-up position entered on the FDE or FPS.<br>In mixed mode operations the departure aircraft may start lining-up after an arrival aircraft in front has crossed beyond the entry taxiway. The departure aircraft may be given a conditional clearance to line-up once the arrival aircraft has crossed beyond the entry taxiway.<br><u>Non-Nominal</u><br>In segregated mode operations more than one departure aircraft at a time may be instructed to line-up, and the line-up instructions and order the aircraft are moved from the holding bay to the runway bay may be out-of-order.<br>Departure aircraft may be instructed to line-up at an intermediate position with the associated line-up position entered on the FDE or FPS. |
| Determine Wake Separation Distance to preceding aircraft | <u>Nominal</u><br>When the departure aircraft is the next aircraft in the runway departure sequence to be given a take-off clearance, the Tower Runway Controller determines the Wake Separation Distance to apply.<br>When PWS-D is being applied, the Tower Runway Controller is unable to mentally apply the PWS-D pairwise aircraft type matrix, and the wake category 20-CAT matrix, and so is supported by the OSD tool, which determines and presents the Wake Separation Distance to apply. |

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| | When WDS-D is being applied in the context of PWS-D, the Tower Runway Controller is unable to mentally determine the Wake Separation Distance, and so is supported by the Enhanced OSD tool which determines and presents the Wake Separation Distance to apply, taking into account when the WDS-D reduced wake separation has been authorised to be applied, and in the case of the D-DB-WDS-Xw concept, that the follower departure aircraft planned SID path is upwind of the preceding departure aircraft planned SID path beyond the straight-out initial common departure path. When a D-DB-WDS-Xw reduced wake separation is being applied, the Enhanced OSD tool is to clearly inform the Tower Runway Controller this is the case.<br>When RECAT-EU or ICAO wake separations are being applied, the Tower Runway Controller is able to self-determine the required Wake Separation Distance without the aid of the OSD or Enhanced OSD tool, although may optionally be supported by the OSD or Enhanced OSD tool.<br><u>Non-Nominal</u><br>The Flight Crew may inform the Tower Runway Controller that they want the RECAT-EU or ICAO wake separation to be applied to the preceding departure aircraft rather than the PWS-D or WDS-D wake separation.<br>The Tower Runway Controller acknowledges the request and applies the requested wake separation distance with the optional support of the OSD or Enhanced OSD tool.<br><u>Failure</u><br>In the event of the OSD or Enhanced OSD tool becoming unavailable the Tower Runway Controller shall revert to manually applying ICAO or RECAT-EU DB wake separations with an optional aide memoire table of the ICAO or RECAT-EU wake separation rules. |
| Determine SID Separation Distance to each relevant preceding aircraft | <u>Nominal</u><br>The Tower Runway Controller determines the SID Separation Distance required to be applied to each relevant preceding aircraft. This may optionally be with the support of the OSD or Enhanced OSD tool. |
| Determine the most restrictive Wake Separation or SID Separation Distance | <u>Nominal</u><br>The Tower Runway Controller determines the most restrictive Wake Separation Distance or SID Separation Distance that is required to be applied. |
| Determine preceding aircraft earliest distance position taking into account any other separation | <u>Nominal</u><br>The Tower Runway Controller identifies the preceding aircraft and the associated earliest distance position that must be passed before issuing the take-off clearance in order to deliver the most restrictive separation distance required to be applied. This takes into account any other separation constraints, such as the MRS, and whether and to what extent reduced separation in the vicinity of the aerodrome can be applied. |

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| Wait for the proceeding aircraft to pass the earliest distance position | <u>Nominal</u><br>The Tower Runway Controller monitors the progress of the identified preceding aircraft, waiting for the preceding aircraft to pass the earliest distance position for issuing the take-off clearance.<br><u>Non-Nominal</u><br>The Flight Crew of the lined-up aircraft may inform the Tower Runway Controller that they are not ready to be given a take-off clearance due for example having a technical problem. The Tower Runway Controller requests the reasons for not being ready and in the case of being able to recover the situation, the estimated time for when the aircraft will be ready for take-off.<br>If recover action is possible with just a short delay, the Tower Runway Controller waits for the aircraft to be ready, and then proceeds to issue the take-off clearance, once the identified proceeding aircraft has passed the earliest distance position for issuing the take-off clearance.<br>If recover action is not possible with just a short delay, the Tower Runway Controller instructs the aircraft to vacate the runway, removing the aircraft from the runway bay. While the aircraft is vacating the runway, the Tower Runway Controller determines the next aircraft to be given a line-up clearance and instructs the aircraft to line-up. |
| Determine Wake Separation Time to preceding aircraft and associated Time | <u>Nominal</u><br>When the departure aircraft is the next aircraft in the runway departure sequence to be given a take-off clearance, the Tower Runway Controller determines the Wake Separation Time to apply.<br>When PWS-D is being applied, the Tower Runway Controller is unable to mentally apply the PWS-D pairwise aircraft type matrix, and the wake category 20-CAT matrix, and so is supported by the OSD tool, which determines and presents the Wake Separation Time to apply.<br>When WDS-D is being applied in the context of PWS-D, the Tower Runway Controller is unable to mentally determine the Wake Separation Time, and so is supported by the Enhanced OSD tool, which determines and presents the Wake Separation Time to apply, taking into account when the WDS-D reduced wake separation has been authorised to be applied, and in the case of the D-TB-WDS-Xw concept, that the follower departure aircraft planned SID path is upwind of the preceding departure aircraft planned SID path beyond the straight-out initial common departure path. When a D-TB-WDS-Xw reduced wake separation is being applied the Enhanced OSD tool is to clearly inform the Tower Runway Controller this is the case.<br>When RECAT-EU or ICAO wake separations are being applied, the Tower Runway Controller is able to self-determine the required Wake Separation Time without the aid of the OSD or Enhanced OSD tool, although may optionally be supported by the OSD or Enhanced OSD tool.<br>In the case of applying a “Not Before Take-Off Time”, once the “start of take-off roll time” is provided for the preceding aircraft, the “Not Before Take-Off Time” for the take-off clearance is determined, with the aid of the OSD or Enhanced OSD tool in the case of applying the PWS-D and WDS-D wake separations respectively, and optionally with the aid of the OSD or Enhanced OSD tool in the case of applying the RECAT-EU or ICAO wake separations.<br>In the case of applying a “Not Before Airborne Time”, once the “airborne time” is provided for the preceding aircraft, the “Not Before Airborne Time” is determined, with the aid of the OSD or Enhanced OSD tool in the case of applying the PWS-D and WDS-D |

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| | wake separations respectively, and optionally with the aid of the OSD or Enhanced OSD tool in the case of applying the RECAT-EU or ICAO wake separations.<br>Non-Nominal<br>When follower aircraft lines-up at an intermediate position in relation to the preceding aircraft line-up position, the Tower Runway Controller and the OSD or Enhanced OSD tool are required to apply the wake separation rules for taking-off from an intermediate position. These rules require that an additional 60s is to be added to the Wake Separation Time.<br>The Flight Crew may inform the Tower Runway Controller that they want the RECAT-EU or ICAO wake separation to be applied to the preceding departure aircraft, rather than the PWS-D or WDS-D wake separation. The Tower Runway Controller acknowledges the request, and applies the requested wake separation time, with the optional support of the OSD or Enhanced OSD tool.<br>Failure<br>In the event of the OSD or Enhanced OSD tool becoming unavailable the Tower Runway Controller shall revert to manually applying the ICAO or RECAT-EU TB wake separations, with an optional aide memoire table of the ICAO or RECAT-EU wake separation rules. |
| Determine SID Separation and earliest Time to each preceding aircraft | Nominal<br>The Tower Runway Controller determines the SID Separation time required to be applied to each relevant preceding aircraft. This may optionally be with the support of the OSD or Enhanced OSD tool.<br>In the case of applying a “Not Before Take-Off Time”, once the “start of take-off roll time” is provided for the preceding aircraft, the “Not Before Take-Off Time” for the take-off clearance is determined, optionally with the aid of the OSD or Enhanced OSD tool, for each relevant SID separation.<br>In the case of applying a “Not Before Airborne Time”, once the “airborne time” is provided for the preceding aircraft, the “Not Before Airborne Time” is determined, optionally with the aid of the OSD or Enhanced OSD tool for each relevant SID separation. |
| Determine the most restrictive Time satisfying Wake Separation or SID Separation | Nominal<br>The Tower Runway Controller determines the most restrictive Wake Separation Time or SID Separation Time that is required to be applied. This is the most restrictive “Not Before Take-Off Time” or “Not Before Airborne Time” |
| Determine earliest take-off clearance time taking into account any other separation | Nominal<br>The Tower Runway Controller determines the earliest take-off clearance time.<br>In the case of the applying a “Not Before Take-Off Time”, this is the most restrictive “Not Before Take-Off Time”.<br>In the case of applying a “Not Before Airborne Time”, this is the most restrictive “Not Before Airborne Time” minus the anticipated combined pilot reaction time and the take-off roll time of the follower aircraft. The Tower Runway Controller determines this by mentally subtracting the anticipated combined pilot reaction time and take-off roll time of the follower aircraft from the “Not Before Airborne Time”, taking onto account the |

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| | aircraft type, the anticipated airline operator take-off procedures in the prevailing operating conditions, and the anticipated pilot reaction time to the take-off clearance.<br>When no Wake Separation or SID Separation is required to be applied, the Tower Runway Controller takes into account any other separation constraints, such as the MRS, and whether and to what extent reduced separation in the vicinity of the aerodrome can be applied. |
| Wait for the time to pass the earliest take-off time | Nominal<br>The Tower Runway Controller monitors for when the time passes the earliest time to issue the take-off clearance.<br>This may be with the aid of a countdown timer.<br>In the case of applying a "Not Before Take-Off Time", the zero of the countdown timer should correspond to the "Not Before Take-Off Time", and so the take-off clearance can be issued once the countdown reaches zero.<br>In the case of applying a "Not Before Airborne Time", the zero of the countdown timer should correspond to the "Not Before Airborne Time", and so the take-off clearance can be issued once the countdown reaches the anticipated combined pilot reaction time and take-off roll time of the follower aircraft.<br>When no Wake Separation or SID Separation is required to be applied, the Tower Runway Controller takes into account any other separation constraints, such as the MRS, and whether and to what extent reduced separation in the vicinity of the aerodrome can be applied, often determining when to issue the take-off clearance based on the preceding aircraft passing a predetermined position on the straight-out initial departure path.<br>Non-Nominal<br>The Flight Crew of the lined-up aircraft may inform the Tower Runway Controller that they are not ready to be given a take-off clearance, due for example having a technical problem. The Tower Runway Controller requests the reasons for not being ready, and in the case of being able to recover the situation, the estimated time for when the aircraft will be ready for take-off.<br>If recover action is possible with just a short delay, the Tower Runway Controller waits for the aircraft to be ready, and then proceeds to issue the take-off clearance once the take-off clearance can be issued.<br>If recover action is not possible with just a short delay, the Tower Runway Controller instructs the aircraft to vacate the runway, removing the aircraft from the runway bay. While the aircraft is vacating the runway, the Tower Runway Controller determines the next aircraft to be given a line-up clearance and instructs the aircraft to line-up. |
| Issue Take-Off Clearance and Monitor & Record Roll Time | Nominal<br>The Tower Runway Controller issues the take-off clearance provided the runway is clear; in the case of mixed mode, or tactical enhanced arrival management, that any preceding interleaved arrival aircraft is confirmed as clear of the runway; in the case of crossing traffic, that the crossing traffic is confirmed as clear of the runway.<br>In the case of applying a "Not Before Take-Off Time", there is a need to monitor and record the "start of take-off roll time", which may be through a manual interaction in the electronic environment of the Tower Runway Controller, or in a non-electronic environment or an electronic environment may be through automatic surveillance based monitoring support. |

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| | In the case of applying a "Not Before Airborne Time", the notification of the "start of take-off roll" may be used as a trigger event to calculate the required Wake Separation time to the next follower aircraft.<br>Non-Nominal<br>The take-off clearance may be issued before the follower aircraft is lined-up and waiting at the line-up position. In these cases there is a need to wait until the follower aircraft has passed the normal line-up and wait position before recording the "start of take-off roll time". |
| Monitor for aircraft becoming airborne and record Airborne Time | Nominal<br>The Tower Runway Controller monitors the take-off roll of the departure aircraft, and the departure aircraft rotating and becoming airborne (back wheels airborne).<br>In the case of applying a "Not Before Airborne Time", there is a need to monitor and record the "airborne time" which is usually through a manual interaction in the electronic environment of the Tower Runway Controller, with the FDE or FPS being moved from the runway bay to the airborne bay, and the timing of this manual interaction being automatically recorded as the "airborne time" of the departure aircraft.<br>There may be automatic surveillance based monitoring support for determining and recording the "airborne time" of each departure aircraft; however there appear to be significant feasibility issues associated with the consistency of such an approach. This is because the Mode S airborne indicator is indicating the aircraft is airborne while the aircraft is still rolling on the runway for many aircraft types.<br>Non-Nominal<br>• The Flight Crew may be instructed to, or may self-determine, to abort the take-off roll and do not take-off. The Tower Runway Controller instructs the aircraft to vacate the runway and removes the aircraft from the runway bay in the electronic environment. |
| Monitor separation on initial departure path | Nominal<br>The Tower Runway Controller monitors the separation on the initial departure path, to ensure that the appropriate separation is being delivered to the TMA Departure Controller.<br>When a D-WDS-Xw reduced separation is being employed, the monitoring may also include that the lead aircraft correctly turns onto the planned SID, and both the lead and follower aircraft lateral navigation performance over the straight-out initial common departure path is appropriate to ensure the crosswind transport of the wake vortices out of the path follower aircraft.<br>Non-Nominal<br>When D-WDS-Xw reduced separation is being employed, and non-nominal behaviour of either the lead aircraft or the follower aircraft could result in an unacceptable increase in wake vortex encounter risk, there may be a need to take intervention action, and there may be a need to provide a cautionary wake advisory to the follower aircraft warning of the potential increase in wake vortex encounter risk.<br>• When D-WDS-Xw reduced separation is being employed, and there is a need to take intervention action to provide separation to other traffic, such as an arrival go-around or an intruder, there is a need to ensure that the intervention action does not result in an unacceptable increase in wake |

| | |
|---|---|
| | vortex encounter risk to the follower aircraft of a departure pair with D-WDS-Wx reduced separation. |
| Instruct the Flight Crew to contact the TMA Departure Radar Controller | Once the appropriate separation has been set up for the TMA Departure Radar Controller, the Tower Runway Controller instructs the Flight Crew to contact the TMA Departure Radar Controller. |
| **Flight Deck** | |
| Line-up and hold | The Flight Crew lines up the aircraft, using the entry taxiway and associated holding position instructed by the Tower Runway Controller. |
| Wait for Clearance | <u>Nominal</u><br>Once lined-up at the holding position, the Flight Crew await for the clearance to take-off.<br><u>Non-Nominal</u><br>If a problem occurs when lining-up or holding that needs to be addressed before take-off, the Flight Crew will inform the Tower Runway Controller that they are not ready for the take-off clearance. |
| Commence take-off roll | <u>Nominal</u><br>On receiving the clearance to take-off, the Flight Crew commence the take-off roll.<br><u>Non-Nominal</u><br>On receiving the clearance to take-off, the Flight Crew may delay the start of the take-off roll, or may query the Tower Runway Controller on the separation to the preceding departure aircraft when unsure whether sufficient separation is being provided. |
| Aircraft rotates and becomes airborne | <u>Nominal</u><br>The aircraft executes a normal take-off roll, and rotates and becomes airborne at the anticipated position for the prevailing operating conditions.<br><u>Non-Nominal</u><br>The Flight Crew abort the take-off roll, either due to a problem, or as a result of being instructed by the Tower Runway Controller. |
| Contact TMA Departure Radar Controller | As instructed by the Tower Runway Controller, the Flight Crew contact the TMA Departure Radar Controller. |

**Table 11: Activity Descriptions for [NOV-5] [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)**

| Issuer | Info Exchange | Addressee | Info Element | Info entity |
|---|---|---|---|---|
| Tower Runway Control | Instruct aircraft to line-up o--> Catching | Flight Deck | Line-up Clearance | RUNWAY_ENTRY_EXIT_NODE |
| Tower Runway Control | Instruct aircraft to line-up o--> Catching | Flight Deck | Entry Taxiway | RunwayCrossingClearance |
| Tower Runway Control | Issue take-off clearance and Monitor & Record Roll Time o--> Catching | Flight Deck | Take-off clearance | TakeOffClearance |
| Tower Runway Control | Instruct the flight crew to contact the TMA Departure Controller o--> Catching | Flight Deck | Transfer Initiation | CoordinationAndTransfer |

**Table 12: Information Exchange Descriptions for the Process Diagram for [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)**

#### 3.3.2.5.3 [NOV-5][DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)

***General Conditions (Scope and Summary)***

This Use Case describes in detail the steps involved for transitioning to and from Weather Dependent Separation for Departures (WDS-D).

***Pre Conditions***

The WDS-D system support is deployed and available for supporting WDS-D.

The required wind conditions service over the straight-out initial departure path from becoming airborne to the first SID turns is deployed and available for supporting WDS-D for each departure runway.

The Tower Supervisor and Approach Supervisor have coordinated tactically about departure rates when WDS-D reduced wake separations can be applied.

The Tower Supervisor and Tower Runway Controller have coordinated when WDS-D reduced wake separations are to be applied taking into account the wind information.

The Flight Crew are aware of the operation of the WDS-D reduction of wake turbulence separations, and have been fully briefed and aware of the WDS-D wake separation rules.

***Post Conditions***

The WDS-D system support has correctly indicated whether the WDS-D reduced wake separations can be applied.

### *Actors*

Tower Supervisor, Tower Runway Controller, Flight Crew, TMA Departure Radar Controller, Approach Supervisor.

### *Trigger*

The wind condition information over the straight-out initial departure path for the departures runway is available for determining whether or not the WDS-D reduced wake separations can be applied.

### *Nominal Flow Process Diagram*

The nominal flow is represented in the [NOV-5] Process Diagram for [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D) in Figure 7.

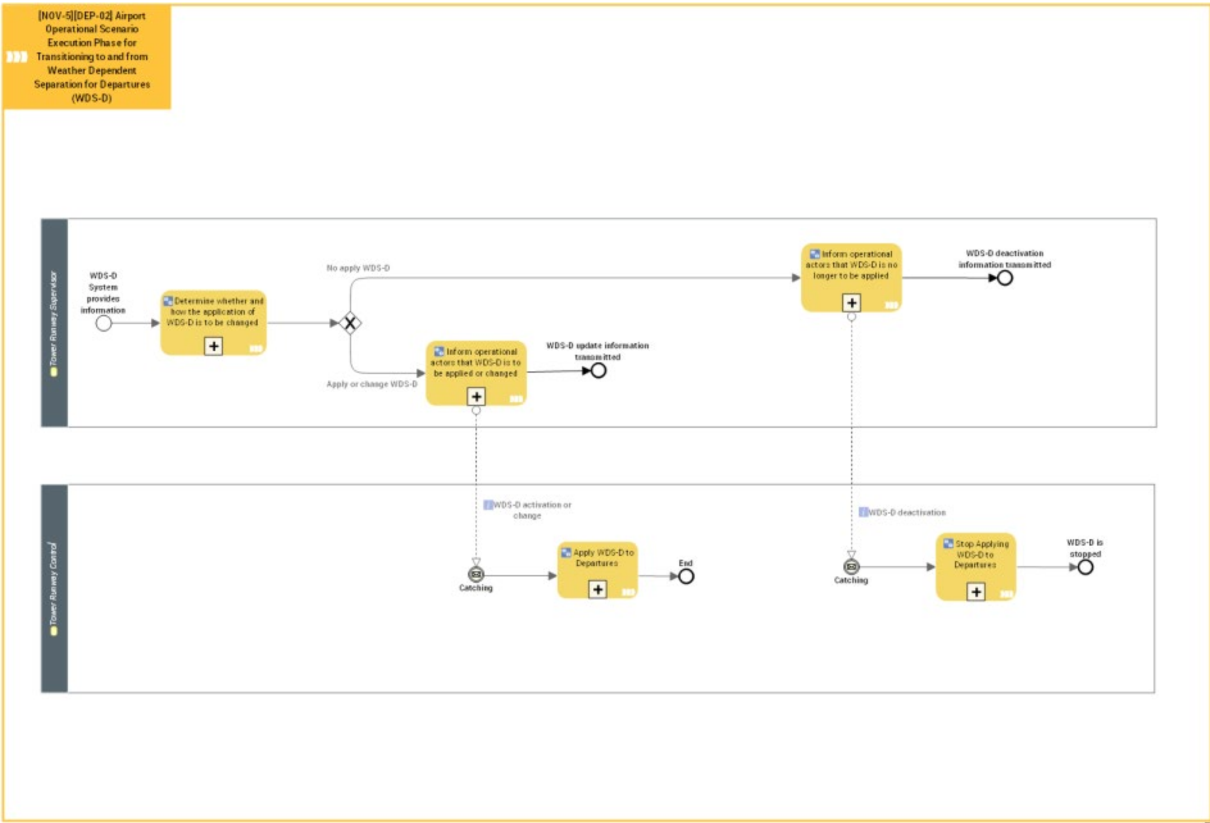


**Figure 7: [NOV-5] Process Diagram for [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)**

The Process Diagram for [DEP-02] in Figure 7 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-DEP-02.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 13 and Table 14 respectively.

| Activity | Description |
|---|---|
| | **Tower Supervision** |
| Determine whether and how the application of WDS-D is to be changed | The WDS-D system support provides a GO / NO GO indication of whether the WDS-D wake separation reduction can be applied for the departure runway-in-use.<br>The Tower Supervisor evaluates the possibility to apply or change the WDS-D wake separation reduction, using the WDS-D system GO / NO GO indication, and the nowcast and forecast wind conditions stability and trends, and other operational criteria such as the queued departure traffic situation. This may be supported by automatic changing of the WDS-D wake separation reduction to keep in step with the nowcast and forecast crosswind speed and total wind speed.<br>The Tower Supervisor evaluates when to end the application of the WDS-D wake separation reduction taking into account the nowcast and forecast wind conditions stability and trends and other operational criteria such as the queued departure traffic situation. This may be supported by automatic monitoring and switching to NO GO when the nowcast and forecast crosswind speed or total wind speed is no longer sufficient to support the WDS-D wake separation reduction. |
| Inform operational actors that WDS-D is to be applied or changed | The Tower Supervisor coordinates with and informs all other operational actors that the WDS-D wake separation reductions are to be applied or changed.<br>The Tower Runway Controller is informed that the WDS-D wake separation reductions are to be applied or changed, with the WDS-D system support GO indication activated when first authorised to be applied.<br>The Enhanced OSD system support is informed that the WDS-D wake separation reductions are to be applied or changed, together with the associated wake separation reductions in the case where there are several pre-defined wake separation reductions depending on the crosswind speed or total wind speed.<br>The Tower Clearance Delivery Manager and the Tower Ground Movement Controllers may be informed that the WDS-D wake separation reductions are to be applied or changed so that this can be taken into account in the process of delivering the appropriate pressure of departure traffic to the runway holding points.<br>The TMA Supervisor and TMA Departure Controller may be informed that the WDS-D wake separation reductions are to be applied or changed so that the necessary TMA flow measures may be applied.<br>The Airspace Users and the Flight Crew may be informed when WDS-D wake separation reductions are being applied. |
| Inform operational actors that WDS-D is no longer to be applied | The Tower Supervisor coordinates with and informs all other operational actors that the WDS-D wake separation reductions are no longer being applied.<br>The Tower Runway Controller is informed that the WDS-D wake separation reductions are no longer to be applied, with the WDS-D system support NO GO indication activated.<br>The Enhanced OSD system support is informed that the WDS-D wake separation reductions are no longer to be applied.<br>The Tower Clearance Delivery Manager and the Tower Ground Movement Controllers may be informed that the WDS-D wake separation reductions are no longer being applied |

| | |
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| | so that this can be taken into account in the process of delivering the appropriate pressure of departure traffic to the runway holding points.<br>The TMA Supervisor and TMA Departure Controller may be informed that the WDS-D wake separation reductions are no longer being applied.<br>The Airspace Users and the Flight Crew may be informed when WDS-D wake separation reductions are no longer being applied. |
| **Tower Runway Control** | |
| Apply WDS-D to Departures | When the WDS-D wake separation reduction is authorised the WDS-D wake separation reductions are applied to the associated wake pairs with the aid of the Enhanced OSD tool support. |
| Stop Applying WDS-D to Departures | When the WDS-D wake separation reductions is no longer authorised the PWS-D wake separations are applied to all wake pairs with the aid of the Enhanced OSD tool support. |

**Table 13: Activity Descriptions for [NOV-5] [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)**

| Issuer | Info Exchange | Addressee | Info Element | Info entity |
|---|---|---|---|---|
| Tower Supervision | Inform operational actors that WDS-D is to be applied or changed o--> Catching | Tower Runway Control | WDS-D activation or change | SeparationMode |
| Tower Supervision | Inform operational actors that WDS-D is no longer to be applied o--> Catching | Tower Runway Control | WDS-D deactivatio n | SeparationMode |

**Table 14: Information Exchange Descriptions for [NOV-5] [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)**

### 3.3.3 Differences between new and previous Operating Methods

| Activities (in EATMA) that are impacted by the SESAR Solution | Current Operating Method | New Operating Method |
|---|---|---|
| Present the departure separation to the Tower Runway Controller | Tower Runway Controller provided with an aide-memoire table of the wake category based departure wake separations.<br>In some local environment Tower Runway Controller provided with count-down support for the wake | Tower Runway Controller provided with an aide-memoire table of RECAT EU 6-CAT wake category based departure wake separations.<br>Tower Runway Controller presented with the required PWS-D or wake category-based 20-CAT wake separation for each wake separated departure pair and supporting related earliest rotation time or clearance to take-off time when standard wake separations are to be applied.<br>Tower Runway Controller presented with the required WDS-D reduction in separation for |

| | | |
|---|---|---|
| | category based wake separations. | each wake separated departure pair and supporting earliest rotation time or clearance to take-off time when reduced wake separations are authorised to be applied. |
| Apply PWS-D wake separation rules | N/A to current operations. | Changing the Tower Runway Controller separation procedures to be consistent with the application of reduced wake separations including the transition in / out of the concept.<br>Changing the Tower and Approach Supervisor procedures regarding coordinating a change in wake separation rules for departures. |
| Adjust departure wake separation rules according to WDS-D rules | N/A to current operations | Wake separation rules for departures are reduced depending on the magnitude of the wind. |
| Decide and agree to the application of WDS-D rules | N/A to current operations | Improved wind measurement and forecast capability is required for the initial climb phase to predict when the concept can be implemented. |
| Inform Airspace Users of the application of WDS-D rules | N/A to current operations | Airspace Users will need to be briefed on the applicable concept and made aware of the current mode of operation (i.e. via D-ATIS). |

**Table 15: Differences between new and previous Operating Method**

Table 16 is the table of differences exported from EATMA.

| **OI Step code – title**<br>**(OI Step CR)** | | |
|---|---|---|
| **AO-0304 - Weather-Dependent Reductions of Wake Turbulence Separations for Departures**<br>**(CR 03427 Update AO-0304 (PJ.02-01-06))** | | |
| Activity | Impact | Change |
| Apply WDS-D to Departures | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. |
| Commence take-off roll | Update | Pilots will experience clearances to take-off earlier than current day operations when applying an optimised wake turbulence separation. |
| Determine the most restrictive Time satisfying Wake | Update | The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower |

| | | |
|---|---|---|
| Separation or SID Separation | | Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation. |
| Determine the most restrictive Wake Separation or SID Separation Distance | Update | The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation. |
| Determine Wake Separation Distance to preceding aircraft | Update | The determination of the Wake Separation will be supported by the OSD tool. |
| Determine Wake Separation Time to preceding aircraft and associated Time | Update | The determination of the Wake Separation will be supported by the OSD tool. |
| Determine whether and how the application of WDS-D is to be changed | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. |
| Formulate optimised sequence order for departing aircraft | Update | Controllers need to take into account the wake separation requirements when formulating the optimised sequence order either as today without ATC tool support or possibly in the future with ATC tool support. |
| Inform operational actors that WDS-D is no longer to be applied | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. |
| Inform operational actors that WDS-D is to be applied or changed | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. |
| Issue take-off clearance and Monitor and Record Roll Time | Update | The take-off will be earlier than current day operations when applying an optimised wake turbulence separation. |
| Monitor separation on initial departure path | Update | The Tower Runway Controller will need to take into account the optimised wake separation being applied. |
| Stop Applying WDS-D to Departures | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. |
| **AO-0323 - Wake Turbulence Separations (for Departures) based on Static Aircraft Characteristics**<br><br>**(CR 03477 Update AO-0323 (PJ.02-01-06))** | | |
| Activity | Impact | Change |
| Commence take-off roll | Update | Pilots will experience clearances to take-off earlier than current day operations when applying an optimised wake turbulence separation. |

| | | |
|---|---|---|
| Determine the most restrictive Time satisfying Wake Separation or SID Separation | Update | The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation. |
| Determine the most restrictive Wake Separation or SID Separation Distance | Update | The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation. |
| Determine Wake Separation Distance to preceding aircraft | Update | The determination of the Wake Separation will be supported by the OSD tool. |
| Determine Wake Separation Time to preceding aircraft and associated Time | Update | The determination of the Wake Separation will be supported by the OSD tool. |
| Formulate optimised sequence order for departing aircraft | Update | Controllers need to take into account the wake separation requirements when formulating the optimised sequence order either as today without ATC tool support or possibly in the future with ATC tool support. |
| Issue take-off clearance and Monitor and Record Roll Time | Update | The take-off will be earlier than current day operations when applying an optimised wake turbulence separation. |
| Monitor separation on initial departure path | Update | The Tower Runway Controller will need to take into account the optimised wake separation being applied. |
| **AO-0329 - Optimised Separation Delivery for Departure**<br>**(CR 03433 Update AO-0329 (PJ.02-01-06))** | | |
| Activity | Impact | Change |
| Apply WDS-D to Departures | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. When WDS-D is being employed the Enhanced OSD tool will need to support the switching to applying the WDS-D reduced wake turbulence separations. |
| Determine earliest take-off clearance time taking into account any other separation | Update | All separation criteria may optionally be supported by the OSD tool. |
| Determine preceding aircraft earliest distance position taking into account any other separation | Update | All separation criteria may optionally be supported by the OSD tool. |

| | | |
|---|---|---|
| Determine SID Separation and earliest Time to each preceding aircraft | Update | SID Separation criteria may optionally be supported by the OSD tool. |
| Determine SID Separation Distance to each relevant preceding aircraft | Update | SID Separation criteria may optionally be supported by the OSD tool. |
| Determine the most restrictive Time satisfying Wake Separation or SID Separation | Update | The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a SID separation. |
| Determine the most restrictive Wake Separation or SID Separation Distance | Update | The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation. |
| Determine Wake Separation Distance to preceding aircraft | Update | The determination of the Wake Separation will be supported by the OSD tool. |
| Determine Wake Separation Time to preceding aircraft and associated Time | Update | The determination of the Wake Separation will be supported by the OSD tool. |
| Inform operational actors that WDS-D is no longer to be applied | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. The Enhanced OSD tool will need to support being informed to not applying the WDS-D reduced wake turbulence separations. |
| Inform operational actors that WDS-D is to be applied or changed | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. The Enhanced OSD tool will need to support being informed to applying the WDS-D reduced wake turbulence separations. |
| Issue take-off clearance and Monitor and Record Roll Time | Update | The take-off will be earlier than current day operations when applying an optimised wake turbulence separation. |
| Monitor for aircraft becoming airborne and record Airborne Time | Update | There is a need to assure the recorded airborne time provided to the OSD tool when "airborne time" procedures are being applied. |
| Monitor separation on initial departure path | Update | The Tower Runway Controller will need to take into account the optimised wake separation being applied. |

| | | |
|---|---|---|
| Stop Applying WDS-D to Departures | Introduce | The application of reduced wake turbulence separations dependent on the crosswind conditions is new. When WDS-D is being employed the Enhanced OSD tool will need to support the stopping of applying the WDS-D reduced wake turbulence separations. |

**Table 16: Difference between new and previous Operating Method for Departures Concepts Solutions exported by EATMA**

# 4 Safety, Performance and Interoperability Requirements (SPR-INTEROP)

This section provides the Safety, Performance and Interoperability Requirements applicable to the departures Concepts Solutions

To facilitate the traceability between requirements and relevant concept the provided identifiers have the following structure:

- REQ-02.01-SPRINTEROP-XXXZ.YYYY where:
    - DEP for Departures Concepts Solutions
    - Z is:
        - 1 for Static Pair Wise Separation
        - 2 for Weather Dependent Separation
        - 3 for the Tools (ORD or OSD depending on XXX)
        - 0 for wake monitoring concept, for wake decay concept, for arrival and departure concepts when it applies to more than 1 concept
    - YYYY is:
        - A progressive number.

## 4.1 Functional Requirements

The latest consolidated list of requirements for the Departures Concepts Solutions has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0001 |
| Title | Provision of optimised departure sequence plan for pushback and taxi-out |
| Requirement | The Tower ATC Roles should be provided with an initial optimised departure sequence plan for pushback and taxi-out. |
| Status | <validated> |

| | |
|---|---|
| Rationale | The level of support which is currently given would need to be enhanced in the new operating environment (i.e. the allocation of the task between human actors and technical systems would shift to placing the onus on the technical system). This should help to mitigate any risks associated with reduced or lost information processing capacity.<br><br>It is anticipated that A-CDM/DMAN support will be provided to formulate and optimise the departure sequence order and departure rate for coordinating the TOBTs and TSATs and managing the taxi-out flow of departure aircraft to the runway holding points. This support is primarily provided to the Ground Movement Planner Controller and possibly to the Ground Movement Controllers.<br><br>In order to optimise the departure rate, the A-CDM/DMAN support should take into account the optimised wake turbulence separations that are being employed.<br><br>In NATS RTS5 the departure rate was increased by 10% above that of the traffic from the recorded operational day in order to provide the appropriate sustained pressure of departure traffic on taxi-out to the runway holding points. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.1001 |
| Title | Provision of optimised departure sequence plan for line-up and take-off |
| Requirement | The Tower ATC Roles should be provided with an optimised departure sequence plan for line-up and take-off. |
| Status | <validated> |

| | |
|---|---|
| Rationale | The level of support which is currently given may need to be enhanced in the new operating environment (i.e. the allocation of the task between human actors and technical systems would shift to placing the onus on the technical system). This should help to mitigate any risks associated with reduced or lost information processing capacity.<br><br>It is considered as optional as to whether this support is provided to the Tower Runway Controller and whether this support extends to supporting late changes to departure sequence order due to for example aircraft not being ready to line-up and take-off or because of a change of CTOT.<br><br>This support was not provided in NATS RTS5 where controller feedback suggested that this support should be considered in the future.<br><br>An outcome of ECTL RTS4b is that If the OSD tool is to be applied in partially segregated / mixed mode runway operations, additional HMI support is required to visualise the planned arrivals and departures sequence on the runway and so this requirement is mandatory for partially segregated / mixed mode. This could be supported by electronic flight strips, or by an AMAN/DMAN or by a bespoke sequencing tool. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Formulate optimised sequence order for departing aircraft<br><br>Determine next aircraft to be given a line-up clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0002 |
| Title | Aircraft separation monitoring for distance-based separation |
| Requirement | The Tower Runway Controller shall be able to check the delivery conformance to the required wake separation distance on the HMI. |

| | |
|---|---|
| Status | <validated> |
| Rationale | Part II SAR SR#D35 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D).<br><br>Part II SAR SR#D60 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>The Controller shall be able to check on the HMI if the right wake separation distance is delivered between aircraft to avoid separation minima infringement and to confirm the appropriate application of the OSD tool support.<br><br>This applies to the application of both standard static wake separation rules (e.g. ICAO, RECAT-EU, RECAT-EU-PWS) and dynamic WDS-D Xw reduced wake separation rules.<br><br>For the delivery of the wake separation distance, the controller shall be able to check that the required wake separation distance is delivered as the follower aircraft becomes airborne using the situation view display.<br><br>In the ECTL RTS4a and RTS4b ATCO were measuring with "click and drag" tool the distance delivered between aircraft, this has also been assessed and discussed in RTS4b report. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.1002 |
| Title | Aircraft separation monitoring for time based separation |
| Requirement | The Tower Runway Controller shall be able to check the delivery conformance to the required wake separation time on the HMI. |

| | |
|---|---|
| Status | <validated> |
| Rationale | Part II SAR SR#D37 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D).<br><br>Part II SAR SR#D62 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>The Controller should be able to check on the HMI that the required wake separation time has been delivered between aircraft to confirm the appropriate application of the OSD tool support so as to avoid inadvertently inducing further wake separation time infringements if this has not been the case. For example if inadvertently employing an anticipated roll time that is more than the actual roll time in the prevailing operating conditions resulting in an earlier airborne time than anticipated.<br><br>This applies to the application of both standard static wake separation rules e.g. (ICAO, RECAT-EU, RECAT-EU-PWS) and dynamic WDS-D Xw reduced wake separation rules.<br><br>For wake separation time procedures the controller should be able to check that the required wake separation time is delivered as the follower aircraft becomes airborne from the recorded airborne times of the follower and preceding aircraft with the appropriate checking support in the electronic environment.<br><br>In NATS RTS5 no automatic checking support was provided in the electronic environment. As a result the controllers were hand recording the seconds field of the NBAT on the FDE in the runway bay so that this was retained for checking when the FDE was moved to the airborne bay. This requirement is validated as a result of the actions of the controllers in NATS RTS5. The automated HMI support has still to be developed and validated. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

| | | |
|---|---|---|
| | | Monitor for aircraft becoming airborne and record Airborne Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0003 |
| Title | Amendment of departure sequence plan |
| Requirement | The Tower Runway Controller shall be able to amend the departure sequence plan/order used by the OSD tool as required. |
| Status | <validated> |
| Rationale | Part II SAR SR#D73 in relation to the SO#D16: Maintain the ability of ATCOs to tactically rearrange the departure sequence.<br><br>It was recognised that whilst many of the factors which determine the departure sequence are predictable and/or stable over time, controllers still needed to retain the ability to override system algorithms and amend sequences on a tactical basis.<br><br>There is always the need to be able to react to situations where an aircraft may not be able to line-up and take-off at the associated position and time in the departure sequence plan/order.<br><br>From a safety perspective, if an aircraft which was expected to depart is not able to anymore, the departure sequence provided to the OSD tool needs to be updated so that the OSD tool can invoke the clearance of any stale displayed separation information associated with the departure aircraft not able to depart any more, and so that the OSD tool can correctly calculate the separation information for the next departure aircraft.<br><br>This was validated in NATS RTS5. |
| Category | <Human Performance>, <Operational>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Formulate optimised sequence order for departing aircraft<br><br>Determine next aircraft to be given a line-up clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0004 |
| Title | Wake separation time remaining to next departure |
| Requirement | In the case of wake separation time application, the Tower Runway Controller shall be presented with a means to monitor the remaining time to satisfy the wake separation. |
| Status | <validated> |
| Rationale | Part II SAR SR#D34 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D) and SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>To help the Controller in providing the right time based wake separation between each departure, they shall be supported with an indication of the time left until the next departure to satisfy the wake separation, either the "airborne time" separation or "start of take-off roll time" separation depending on local procedures.<br><br>NATS RTS5 validated the "airborne time" wake separation procedures. A countdown timer was evaluated where the zero of the countdown corresponded to the earliest airborne time to satisfy the required wake separation time. When using the countdown timer the Tower Runway Controller was required to wait until the countdown corresponded to their anticipated time that it would take the aircraft to become airborne before issuing the take-off clearance.<br><br>ECTL RTS4b validated the "start of take-off roll time" wake separation procedures. A countdown timer was evaluated where the zero of the countdown corresponded to the earliest take-off clearance time to satisfy the required wake separation time. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0005 |
| Title | SID separation minima support |
| Requirement | The Tower Runway Controller should be informed of the SID separation to apply by the OSD tool support. |
| Status | <validated> |
| Rationale | The Tower Runway Controller should be informed of the SID separation minima to apply by the OSD tool support.<br><br>In NATS RTS5 the controllers decided that they did not require the OSD tool to support the SID separation.<br><br>SID separation support was provided and validated in ECTL RTS4a. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0006 |
| Title | Calculating time to next departure |
| Requirement | Time until next departure shall be calculated to correctly and accurately represent the WDS (departure) or standard wake separation (according to the wake separation in use) for all departure pairs, in all normal ranges of weather and operating conditions. |
| Status | <validated> |
| Rationale | Part II SAR SR#D23 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircrafts and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>The time to next departure shall be calculated taking into account the wake separation rules in use.<br><br>For time separation procedures this shall include adding 60s if taking off from an intermediate position relative to the preceding departure aircraft take-off position.<br><br>In NATS RTS5 the Enhanced OSD tool applied either the PWS-D wake separation rules or the WDS-D Xw reduced wake separation rules depending on whether there were appropriate crosswind conditions with authorisation to apply the WDS-D Xw reduced wake separation rules.<br><br>When applying the WDS-D Xw reduced wake separation rules, the PWS-D wake separation was applied if it was equal to or less than the WDS-D reduced wake separation or when the planned SID of the follower departure aircraft was not upwind of the planned SID of the lead departure aircraft beyond the position of the first SID turn.<br><br>This is a system requirement and so should also be in the TS/IRS. |
| Category | <System>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures<br><br>Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0007 |
| Title | Radar separation minima support |
| Requirement | The Tower Runway Controller should be informed of the radar separation minima to apply by the OSD tool support. |
| Status | <validated> |
| Rationale | The Tower Runway Controller should be informed of the radar separation minima to apply.<br><br>In NATS RTS5 the controllers did not require support for applying the radar separation minima. The separation delivery performance of non-wake pairs was acceptable.<br><br>Radar separation minima support was provided and validated in ECTL RTS4a and RTS4b. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine earliest take-off clearance time taking into account any other separation<br><br>Determine preceding aircraft earliest distance position taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0008 |
| Title | Wake separation provision |
| Requirement | The Tower Runway Controller (ATC Departure Controller) shall be provided with a tool that provides accurate and robust information on the required wake turbulence separation interval between each successive departing aircraft. |
| Status | <validated> |
| Rationale | Part II SAR SR#D29 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D).<br><br>Part II SAR SR#D57 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>The Controller shall provide the correct wake separation between each pair of departure aircraft whether the WDS-D Xw concept or standard departure wake separation rules such as ICAO, RECAT-EU or RECAT-PWS-EU are in use.<br><br>This applies to both wake separation time procedures and the wake separation distance-based procedures.<br><br>NATS RTS5 validated the "airborne time" wake separation procedures.<br><br>ECTL RTS4a validated the "start of take-off roll time" wake separation procedures.<br><br>ECTL RTS4a validated the distance-based wake separation procedures. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0009 |
| Title | Determining when aircraft become airborne |
| Requirement | The Tower Runway Controller should be supported through automatically determining when aircraft become airborne. |
| Status | <validated> |
| Rationale | Part II SAR SR#D32 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D) and SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>When separations are reduced it is important that decisions as to when to issue take-off clearances are based on accurate information.<br><br>Currently the time that an aircraft is deemed to have become airborne is when the runway controller completes the actions necessary to move a flight's FDE strip from the runway bay into the airborne bay. Whilst this is suitable for current operations, it is possible that the level of accuracy will be unacceptable from both a safety (too early could be unsafe) and service delivery (too late is inefficient) perspective for the future.<br><br>NATS RTS5 validated using the event time of the controller "airborne hide" action which resulted in the FDE being automatically moved from the runway bay to the airborne bay. On some occasions the controller was late in recognising the aircraft becoming airborne due to being busy with other tasks.<br><br>The downlinked Mode S airborne parameter is known to be unreliable due to triggering early as the aircraft is rolling on the runway. The use of conventional surveillance data (e.g. radar surveillance, multilateration) is also known to be unreliable with respect to determining precisely when an aircraft becomes airborne. It remains to be investigated as to whether |

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|---|---|
| | video/optical sensor/camera based surveillance could be used in determining precisely when an aircraft becomes airborne. |
| Category | <Operational>, <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor for aircraft becoming airborne and record Airborne Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.1009 |
| Title | Determining when aircraft start their take-off roll |
| Requirement | The Tower Runway Controller shall be supported through automatically determining when aircraft start their take-off roll. |
| Status | <validated> |
| Rationale | Part II SAR SR#D33 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D) and SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>When separations are reduced it is important that decisions as to when to issue take-off clearances are based on accurate information.<br><br>Whilst a manual approach to determining the "start of take-off roll" may be suitable for current operations, it is possible that the level of accuracy will be unacceptable from both a safety (too early could be unsafe) and service delivery (too late is inefficient) perspective for the future.<br><br>The "start of take-off roll" may be able to be reliably determined using conventional surveillance (radar surveillance, multilateration).<br><br>Validated in ECTL RTS4a and RTS4b. |

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|---|---|
| Category | <Operational>, <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0010 |
| Title | WTE risk for unmanaged under separation |
| Requirement | The probability per departure of imminent wake encounter under unmanaged under-separation on the Initial Common Departure path shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline). |
| Status | <deleted> |
| Rationale | There is a need to cap the safety risk from the case where the correctly defined WT separation minima are not correctly applied, with potential for severe wake encounter higher than if those minima were correctly applied.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor for aircraft becoming airborne and record Airborne Time<br><br>Monitor separation on initial departure path<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0011 |
| Title | WTE risk for unmanaged under separation 1 |
| Requirement | The probability per departure of unmanaged under-separation (WT or radar) in adequate separation mode on the Initial Common Departure path shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline). |
| Status | <deleted> |
| Rationale | There should be no increase in unmanaged under-separation (WT or radar) in adequate separation mode on the Initial Common Departure path.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine Wake Separation Distance to preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0012 |
| Title | WTE risk for unmanaged under separation 2 |
| Requirement | The probability per departure of unmanaged under-separation (WT or radar) on the Initial Common Departure path shall not increase due to inadequate selection of or transition between any adequate modes of operation. |
| Status | <deleted> |
| Rationale | There should be no increase in unmanaged under-separation induced by inadequate selection and management of separation modes; that is selection and transition between the adequate modes of operation of ICAO, RECAT-EU, PWS-RECAT-EU, WDS-Xw and WDS-Tw.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0013 |
| Title | Imminent infringement |
| Requirement | The probability per departure of Imminent infringement (WT or radar) on the Initial Common Departure path shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline). |
| Status | <deleted> |
| Rationale | There should be no increase of imminent infringement (WT or radar) on the Initial Common Departure path due to ineffective separation management of spacing conflicts on departure performed when the follower aircraft is not yet airborne.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor for aircraft becoming airborne and record Airborne Time<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0014 |
| Title | Crew/Aircraft induced spacing conflicts |
| Requirement | The probability per departure of Imminent infringement (WT or radar) on the Initial Common Departure path due to 1st or 2nd a/c deviation from expected behaviour while second a/c already airborne shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline). |
| Status | <deleted> |
| Rationale | There should be no increase of imminent infringement (WT or radar) on the Initial Common Departure path due to preceding or following aircraft deviation from expected behaviour while the follower aircraft is already airborne.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety>, <Functional> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0015 |
| Title | ATC induced spacing conflicts |
| Requirement | The probability per departure of Imminent infringement (WT or radar) on the Initial Common Departure path induced by ATC while second a/c already airborne shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline). |
| Status | <deleted> |
| Rationale | There should be no increase of imminent infringement (WT or radar) on the Initial Common Departure path induced by ATC while the follower aircraft is already airborne.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine earliest take-off clearance time taking into account any other separation<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Monitor separation on initial departure path<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0016 |
| Title | Runway conflicts |
| Requirement | The probability per departure of Runway conflict due to premature take-off shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline). |
| Status | <deleted> |
| Rationale | There should be no increase of runway conflicts due to premature take-off.<br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Issue take-off clearance and Monitor and Record Roll Time<br>Commence take-off roll |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0017 |
| Title | Runway incursion |
| Requirement | The probability per departure of Runway incursion shall not increase in operations based on WT scheme under consideration (due to ATCO decreased situation awareness & overload in relation to RWY increased throughput enabled by the Concept) compared to current operations applying reference minima (e.g. ICAO or an established operational baseline). |
| Status | <deleted> |
| Rationale | There should be no increase of runway incursion due to ATCO decreased situation awareness & overload in relation to runway increased throughput enabled by the concept, affecting take-off management, runway entry management and runway monitoring.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance<br><br>Instruct aircraft to line-up |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0018 |
| Title | SID information provision |
| Requirement | SID information shall be provided to the Tower Runway Controller. |
| Status | <validated> |
| Rationale | Part II SAR SR#D49 in relation to the SO#D03: Ensure no reduction in SID route spacing or any other non-wake constraints between successive departures when applying WDS or S-PWS and SO#D04: Ensure the application of WDS-D only when pre-defined SID/Route combinations are met and SO#D10: Ensure the application of the greatest applicable departure separation constraint. i.e. wake, SID and MRS separation requirement(s).<br><br>To enable the Controller to formulate and execute an efficient departure plan taking into account the intended SID of each departure aircraft.<br><br>To enable the controllers to apply the SID separations without OSD tool support.<br><br>For the application of the WDS-D Xw reduced wake separation in order to facilitate the controller awareness of when a departure pair can apply a WDS-D Xw reduced wake separation, prior to the aircraft being given line-up clearance and moved to the runway bay, and so before the OSD tool calculates the wake separation time and NBAT.<br><br>Note that the SID information should already be provided to support the application of SID separations as is the case of Heathrow where the planned SID is displayed on the FDE of each departure aircraft, so there is no change required to the current system.<br><br>For other local environments there may be a need to supplement the provision of SID information. |
| Category | <Safety>, <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Formulate optimised sequence order for departing aircraft<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0019 |
| Title | Flight crew adherence to instruction |
| Requirement | Flight Crew shall follow Controller instructions. |
| Status | <deleted> |
| Rationale | If Flight Crew do not adhere to Controller instruction, it is not possible for him/her to provide right separation, whether WDS (departures) or standard separation rule is in use.<br><br>It is already the case that the Flight Crew are required to adhere to ATC instructions while at the same time being responsible for the safety of the aircraft. The PJ.02-01-06 Wake Turbulence Optimisation Concepts do not change this.<br><br>As no change to current operations delete requirement. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Commence take-off roll<br><br>Line up and hold |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0020 |

| | |
|---|---|
| Title | Aircraft route display for distance-based separation |
| Requirement | The Tower Runway Controller shall be able to visualise the planned route of each aircraft when applying distance-based separation. |
| Status | <validated> |
| Rationale | Part II SAR SR#D36 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D).<br><br>Part II SAR SR#D61 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>When applying distance-based wake separations the controller needs to apply visualisation of how far along the SID path the lead aircraft needs to progress before giving the take-off clearance to the follower aircraft. This is in order to deliver the required wake separation distance when the follower aircraft becomes airborne.<br><br>This applies to the application of both standard distance-based wake separations (ICAO, RECAT-EU and RECAT-PWS-EU) and WDS-D reduced distance-based wake separations.<br><br>This may already be provided for in some local environments. For other local environments there may be a need to supplement the provision of the visualisation of the planned route of each departure aircraft.<br><br>Validated in ECTL RTS4a. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation |

| | | |
|---|---|---|
| | | Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Wake Separation or SID Separation Distance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0021 |
| Title | Procedures for greater departure spacing/separation requirements |
| Requirement | Procedures shall be implemented such that greater departure spacing/separation requirements are not eroded by the introduction of more efficient wake turbulence separation standards. |
| Status | <validated> |
| Rationale | Part II SAR SR#D02 in relation to the Hazard: ATCO issues a premature take-off clearance with respect to SID separation.<br><br>Greater departure spacing/separation requirements include SID separations, MDIs, ADIs and LVO separations.<br><br>Validated in NATS RTS5. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0022 |
| Title | Alerted to the possibility of catch-up |
| Requirement | ATCOs shall be alerted to the possibility of catch-up by following aircraft, that may lead to an erosion of wake separation requirements. |
| Status | <in progress> |
| Rationale | Part II SAR SR#D03 in relation to the Hazard of Aircraft deviates from planned trajectory.<br><br>Still in progress as the definition of catch-up and corresponding erosion in wake turbulence separation will need to be agreed at local level. This requirement requires further consideration in the local V4 maturity validation activities. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0023 |
| Title | Stopping premature take-off roll |
| Requirement | ATCOs shall, when possible, instruct aircraft to stop a premature take-off roll (in the context of an aircraft has started the take-off roll and is able to safely stop subject to speed). |
| Status | <in progress> |

| | |
|---|---|
| Rationale | Part II SAR SR#D04 in relation to the Hazard of ATCO issues premature take-off clearance regarding wake separation.<br><br>Also in relation to the Hazard of Aircraft deviates from planned trajectory in the particular case where the preceding departure aircraft deviates in the context of applying a WDS-D Xw reduced separation such that cross wind transport is no longer assured.<br><br>This would also apply if the Flight Crew started a premature take-off roll before the take-off clearance from ATC.<br><br>EGLL ATCOs suggest that this may not be a reasonable requirement as a take-off may only be cancelled if an aircraft is below 80kts IAS.<br><br>This requirement requires further consideration in the local V4 maturity validation activities. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0024 |
| Title | Training in the operation of new wake turbulence separation standards |
| Requirement | ATCOs shall be provided with sufficient training in the operation of new wake turbulence separation standards. |
| Status | <validated> |
| Rationale | Part II SAR SR#D05 in relation to the Hazard of ATCO issues premature take-off clearance regarding wake separation.<br><br>Validated in NATS RTS5. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0025 |
| Title | Training in the operation of OSD tool |
| Requirement | ATCOs shall be provided with appropriate training in the operation of the OSD Tool. |
| Status | <validated> |
| Rationale | Part II SAR SR#D30 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D).<br><br>Part II SAR SR#D58 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>Validated in NATS RTS5. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Monitor separation on initial departure path<br><br>Instruct aircraft to line-up<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures<br><br>Apply WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Formulate optimised sequence order for departing aircraft<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0026 |
| Title | Training on inputting take-off time information |
| Requirement | ATCOs shall be trained to recognise the importance of inputting consistent and accurate take-off time information. |

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|---|---|
| Status | <validated> |
| Rationale | Part II SAR SR#D31 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D).<br><br>Part II SAR SR#D59 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone).<br><br>Validated in NATS RTS5. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0027 |
| Title | Training on consistently applying SID route spacing and any other non-wake constraints |
| Requirement | ATCOs shall be trained to recognise and consistently apply SID route spacing and any other larger non-wake constraints when applying WDS-D or S-PWS-D. |
| Status | <validated> |
| Rationale | Part II SAR SR#D48 in relation to the SO#D03: Ensure no reduction in SID route spacing or any other non-wake constraints between successive departures when applying WDS-D or PWS-D and SO#D10: Ensure the application of the greatest applicable departure separation constraint. i.e. wake, SID and MRS separation requirement(s).<br><br>Validated in NATS RTS5. |

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| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0028 |
| Title | Ensuring runway entry point information |
| Requirement | ATCOs shall ensure that the runway entry point information on the electronic flight progress strip reflects the corresponding runway entry point issued to the departing aircraft. |
| Status | <validated> |
| Rationale | Part II SAR SR#D56 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path.<br><br>This is used to determine when a departure aircraft is taking off from an intermediate position relative to the take-off position of the preceding departure aircraft, and thus whether 60 seconds needs to be added to the wake separation time.<br><br>Validated in NATS RTS5. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0029 |
| Title | Applying the applicable safe departure intervals |
| Requirement | ATCOs shall apply the applicable safe departure intervals fully taking into account all of the SID route separation, MRS and wake turbulence separation requirements. |
| Status | <validated> |
| Rationale | Part II SAR SR#D67 in relation to the SO#D10: Ensure the application of the greatest applicable departure separation constraint. i.e. wake, SID and MRS separation requirement(s).<br><br>Validated in NATS RTS5. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft |

| | | |
|---|---|---|
| | | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0030 |
| Title | Flight Crew training on the optimised wake separation standards |
| Requirement | All Flight Crew shall be briefed/trained on the optimised wake separation standards and informed of the wake separation standards being applied at each departing airport. |
| Status | <validated> |
| Rationale | Part II SAR SR#D68 in relation to the SO#D10: Not to negatively affect the ability of Crew/Aircraft, to be able to follow ATC instructions.<br><br>In the ECTL validation activities Paris CDG and Vienna ATCOs indicated that they do not consider it necessary for the ATCOs to provide notification of the wake separation standards being applied to every flight as it would burden the R/T frequency and because it is the responsibility of pilots to follow ATC instructions.<br><br>The applicability of reduced separation (whatever the procedures) shall be made available in the flight information documents as NOTAM and AIP (under weather conditions) with the notification that at the particular airport it is to be expected that in particular wind conditions reduced wake separation procedures apply.<br><br>In the case that a pilot does not want to comply with the reduced wake separation, they can delay their take-off roll, and when this happens ATC can file a report, as it is expected that pilots should normally comply with the ATC take-off instruction. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]



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| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0031 |
| Title | Tower Runway Controller separation responsibilities |
| Requirement | The Tower Runway Controller shall apply the applicable time or distance separation until separation responsibility is transferred to the TMA Departure Radar Controller. |
| Status | <validated> |
| Rationale | Part II SAR SR#D63 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector.<br><br>Validated in NATS RTS5. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft |

| | | |
|---|---|---|
| | | Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0032 |
| Title | ATCO training on safe instructions to go-around/missed approach aircraft |
| Requirement | ATCOs shall be trained to issue safe instructions to aircraft on a go-around/missed approach that will minimise the possibility of a WTE (to be developed at local level). |
| Status | <validated> |
| Rationale | Part II SAR SR#D70 in relation to the SO#D12: Ensure wake turbulence separation between departing aircraft and an aircraft executing a go-around/missed approach.<br><br>In conformance with good HF practices. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0033 |
| Title | ATC checking of the SID |
| Requirement | Prior to push-back (or at the latest before line-up) ATC shall check with the Pilot that the SID in the ATC flight plan information matches the SID selected in the FMS. |
| Status | <validated> |
| Rationale | This was established as a preventative mitigation in the ECTL SAF & HP workshop.<br><br>ATC must ensure the consistency of the SID in the ATC information when applying WDS-D Xw reduced separations.<br><br>The consistency of the SID in the ATC information is also required with respect to the OSD tool determining the positioning of the DDI-D when support the application of distance-based separation. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Formulate optimised sequence order for departing aircraft<br><br>Determine next aircraft to be given a line-up clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0034 |
| Title | Informative MRS and SID separation support |
| Requirement | The display of the countdown time shall be differentiated between “informative” MRS and SID separation support that the ATCO has the discretion to interpret and WT “separation” support that the ATCO must apply. |
| Status | <validated> |
| Rationale | This requirement applies when the OSD tool is providing informative support for SID and MRS constraints that the ATCO has the discretion to interpret and issue an earlier take-off clearance. This is so as to clearly distinguish from the WT separation support that the ATCO is required to apply.<br><br>This is so as to avoid ATCO confusion as to when they can apply discretion and interpret the countdown timer.<br><br>This was established as a requirement in the ECTL SAF & HP workshop. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0035 |
| Title | Training on informative MRS and SID separation support |
| Requirement | It shall be made clear to ATCOs (through training and differentiated display support) that the tool is just informative for MRS and SID separation constraints, while remaining a separation tool for WT constraints. |
| Status | <validated> |
| Rationale | This applies in case when the separation/ spacing tools are not fully refined to efficiently and accurately account for all constraints (MRS/ SID and WT).<br><br>This was established as a requirement in the ECTL SAF & HP workshop. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0036 |
| Title | Training for retention of skills |

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|---|---|
| Requirement | Training of TWR ATCO's shall emphasize the need for retaining current skills in A/C WV category acknowledgement and the related spacing. |
| Status | <validated> |
| Rationale | Both the RTS5 and the Post RTS5 workshop confirmed the need for this requirement; although a new element of automation is proposed for the operation, controller training in the mental processing of A/C types and the associated wake category shall be retained. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine earliest take-off clearance time taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine Wake Separation Distance to preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0037 |
| Title | Procedures for degraded mode operations |
| Requirement | Procedures shall be defined for degraded mode operations. |


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|---|---|
| Status | <validated> |
| Rationale | In the case of technical failure that comprises the tool procedures are required for the degraded mode steps.<br><br>In the case of WDS-D, in the event of a WDS-D tool support failure there will be a need to revert to applying PWS-D with the OSD tool support.<br><br>In the case of an OSD tool support failure there will be a need to revert to manually applying the WT separation constraints; either RECAT-EU, UK 5-CAT or ICAO 4-CAT as per local procedures.<br><br>This was established as a requirement at the Post RTS5 SAF & HP workshop. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0038 |
| Title | Training in roll time variations |
| Requirement | Training of ATC staff shall include roll time variations for different aircraft types, checking wind conditions, air temperature, surface runway conditions and take-off weight. |
| Status | <validated> |

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|---|---|
| Rationale | This mitigation originated from the EGLL workshop held on March 28, 2019, as a preventative one against CF "ATCO mis-judges take-off roll-time", Hazard 1 ATCO issues a premature take-off clearance with respect to wake separation.<br><br>When using the NBAT and the associated countdown time when applying "airborne time" procedures, if the ATCO applies a longer anticipated roll time than the actual roll time the "airborne time" will be earlier than anticipated which could result in under separating against the required wake turbulence separation. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0039 |
| Title | Training on the application of SID separation constraints |
| Requirement | Controller training shall emphasize that the OSD/Enhanced OSD tool support represents advice only and that the controller is still responsible for the application of any SID separation constraint. |
| Status | <validated> |

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|---|---|
| Rationale | This requirement originated from the EGLL workshop held on March 28 as a preventative mitigation against a CF "ATCO ignores the tool" and "ATCO mis-judges take-off roll-time".<br><br>This is in the context of the OSD tool providing no support for the SID separation constraints.<br><br>In order to prevent the controller from applying the WV separation only and omitting to include consideration of the required SID separation constraints, SID information of an adequate prominence shall be available. SID information is included on the A/C FDE strip already.<br><br>SID information prominence was identified as a preventative mitigation against CF "ATCO fails to take into account a SID separation constraint within the departure clearance (even though appropriate wake separation applied)", Hazard 2 ATCO issues a premature take-off clearance with respect to a SID separation constraint; held at EGLL on 28 March 2019. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0040 |
| Title | Training on alerts/alarms and support information |
| Requirement | The training shall appropriately familiarize the ATCOs with the meaning of all alerts/ alarms and support information. |
| Status | <validated> |

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| Rationale | This was established as a preventative mitigation in the ECTL SAF & HP workshop. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0041 |
| Title | Prominence of SID information |
| Requirement | SID information on the HMI shall be afforded adequate prominence. |
| Status | <validated> |
| Rationale | SID information prominence was identified as a preventative mitigation against CF "ATCO fails to take into account a SID separation constraint within the departure clearance (even though appropriate wake separation applied)", Hazard 2 ATCO issues a premature take-off clearance with respect to SID separation constraint; held at EGLL on 28 March 2019.<br><br>SID information is included on the A/C FDE strip already.<br><br>Note that the SID information should already be provided to support the application of SID separation constraints as in the case of Heathrow. RTS5 exercise revealed that due to the new HMI element (OSD tool) being "easy to follow", controllers might omit to include the SID separation constraints, when applicable, into the departure clearance.<br><br>RTS5 confirmed an HP hazard when ATCO follows the WV separation provided by the tool and omits to consider an additional SID separation constraint, where applicable. Therefore, it is important for the SID information to be adequately prominent on the HMI and captured by the controller when scanning the sources of information. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine SID Separation and earliest Time to each preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0042 |
| Title | Distinguishing an OSD tool failure |
| Requirement | All HMI elements of the OSD tool shall display the wake separation time or the non-wake pair informative information for each departure pair so as enable the ATCO to distinguish when there is an OSD tool failure. |
| Status | <validated> |
| Rationale | The reason for providing information for a non-wake pair is to give an indication that the tool is working correctly. If nothing is displayed, that means that the tool is unable to provide accurate information to the controller.<br><br>When this occurs the controller will need to revert to manually applying the WT separation for the impacted departure pairs as per the degraded mode procedures.<br><br>This was established as a requirements in the Post RTS5 SAF & HP workshop. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0043 |
| Title | Distinguishing non-wake pair |
| Requirement | HMI associated with the NBAT and the value displayed by the Countdown timer for a non-wake pair shall be unambiguous. |
| Status | <validated> |
| Rationale | "NONE" was displayed in the NBAT field on the FDE in RTS 5. This signified that there was no wake separation constraint to the preceding departure aircraft. This was instead of displaying "0000" which was considered as confusing.<br><br>There were also issues associated with "NONE" being interpreted as also implying that there was no SID separation constraint and so the suggestion is that "----" is displayed instead.<br><br>"0" was displayed in the Countdown timer for a non-wake pair which may have been confused as the countdown having counted down to 0s.<br><br>There is a need to further address this issue in the local V4 maturity development and validation activities. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0044 |
| Title | Controller training |
| Requirement | Controllers shall undergo briefing on the functionality of the tool, its use and sufficient simulation training. |
| Status | <validated> |
| Rationale | This was established as a requirements in the Post RTS5 SAF & HP workshop. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine next aircraft to be given a line-up clearance<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Formulate optimised sequence order for departing aircraft<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied |

| | | |
|---|---|---|
| | | Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures<br><br>Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0045 |
| Title | Distinguishing countdown timer status |
| Requirement | The display of the countdown timer should distinguish a passive status (ticking has not started yet) from an active status (ticking has started). |
| Status | <validated> |
| Rationale | This recommendation originates from NATS RTS5, where users reflected on the practical use of the tool HMI elements and identified areas where errors or mis-seeing or mis-judgement of the displayed information might occur. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0046 |
| Title | Training on countdown timer format |
| Requirement | Training on the countdown timer format should emphasize that the value displayed is in seconds. |
| Status | <validated> |
| Rationale | Various formats were analysed (80s, 80, 1m20s). Eventually 80 was the preferred option, controllers familiarised themselves with the format and did not misunderstand the value any further. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.0047 |
| Title | Countdown timer on FDE |
| Requirement | The OSD tool should include the countdown timer on the FDE. |
| Status | <validated> |
| Rationale | This was at the beginning the preferred option of the HMI prototype, however this was not able to be supported in RTS5 due to technical constraints.<br><br>The countdown timer on the ADIS display increased heads-up time which was seen as a positive benefit of the prototyped option in RTS5. |

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|---|---|
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.2001 |
| Title | SID and other constraints |
| Requirement | The PWS-D/OSD tool should include SID constraints and aircraft type speed considerations in the NBAT/NBTOT calculations in order to work properly. |
| Status | <validated> |
| Rationale | The separation tool should take into consideration all of the constraints related to the separations rather than just the wake turbulence separation constraints.<br><br>This was feedback from the ATCOs in the ENAIRE RTS6. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine earliest take-off clearance time taking into account any other separation |

| | | |
|---|---|---|
| | | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.2002 |
| Title | Support for traffic in the holding bay |
| Requirement | The PWS-D/OSD take-off clearance time indicator should be displayed for all the traffic in the holding bay (for segregated mode operations). |
| Status | <validated> |
| Rationale | The controllers participating in RTS6 suggested adding the countdown timer to the electronic flight progress strip of all the departure aircraft waiting at the holding point, not just waiting for the aircraft that has been given the line-up clearance, This would help the controller choose the best option from the departure aircraft at the holding point.<br><br>This was feedback for the ATCOs in the ENAIRE RTS6.<br><br>Note that this requirement shall only be applied to segregated mode operations. This does not apply to mixed mode and partially segregated mode operations where a requirement has been established that the departure aircraft shall be provided with a line-up clearance before providing the take-off time support information. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |



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| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Formulate optimised sequence order for departing aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3001 |
| Title | Future assessments |
| Requirement | Local implementation shall assess the operational feasibility of the tool in challenging and different wind conditions. |
| Status | <validated> |
| Rationale | To ensure the applicability of the concept in a wide array of conditions.<br><br>This is a requirement from ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine earliest take-off clearance time taking into account any other separation<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation |

| | | |
|---|---|---|
| | | Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3002 |
| Title | HF design principles |
| Requirement | In case there are more than just one tool supporting the ATCO with the departure clearances all displays shall present the same information in a synchronized way. |
| Status | <validated> |
| Rationale | In the validations performed by ECTL, both the DDI-D and the DDI-T were used, in conjunction with a simplified sequence list. In line with HF design principles, all displays shall be synchronised, ensuring the ATCO has the appropriate level of SA, without enhancing workload. Thus, the timers, if available, shall all display "minutes" or "seconds" and not both on different displays.<br><br>This is a requirement validated in ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3003 |
| Title | Alarms and alerts |
| Requirement | In case a departure clearance is issued too early (against the timer display) an alarm shall be available on the CWP. |
| Status | <validated> |
| Rationale | To represent a barrier against a possible runway incursion there is a means of protection and/ or warning (safety net) to indicate to the controller that the runway is engaged, and no departures or crossing are allowed until the arriving aircraft has vacated the runway.<br><br>This is a requirement validated in ECTL RTS4a. |
| Category | |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance<br><br>Instruct aircraft to line-up |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3004 |
| Title | Gap value updates |
| Requirement | The OSD gap spacing delivery information shall be stable and reliable in order to avoid the recalculation and constant updates of the gap values. |
| Status | <validated> |
| Rationale | One potential solution to achieve it could be to use the predicted touch down time based on the standard descent profiles in order to avoid the recalculation and constant updates of the gap values.<br><br>This is a requirement from ECTL RTS4a and ECTL RTS4b. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine earliest take-off clearance time taking into account any other separation<br><br>Determine preceding aircraft earliest distance position taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3005 |
| Title | HF design principles II |
| Requirement | The OSD gap spacing delivery information shall be displayed in a coherent manner both for APP and TWR CWPs. |
| Status | <validated> |
| Rationale | HF design principles & design standards should be used to develop such requirements.<br><br>This is a requirement validated in ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine earliest take-off clearance time taking into account any other separation<br><br>Determine preceding aircraft earliest distance position taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3006 |
| Title | Mixed mode |
| Requirement | If the OSD tool is to be applied in partially segregated/ mixed mode runway operations, the OSD tool (DDI-T) shall take into consideration the arrival flights and indicate to the controller when to line up a departure only when it is safe to do so. |
| Status | <validated> |
| Rationale | This could be done by integrating information on the arrivals such as from an arrival management tool into the OSD tool. When an arrival is imminent the OSD tool should indicate that no departures are allowed to be cleared for line-up.<br><br>This is a requirement validated in ECTL RTS4b. |

| | |
|---|---|
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance<br><br>Instruct aircraft to line-up |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3007 |
| Title | Mixed mode II |
| Requirement | If the OSD tool is to be applied in partially segregated/ mixed mode runway operations, an additional HMI support shall be provided to visualise the planned arrivals and departures sequence on the runway in partially segregated / mixed mode. |
| Status | <validated> |
| Rationale | This could be done using electronic flight strips, or with an AMAN/DMAN or with a bespoke sequencing tool.<br><br>This is a requirement validated in ECTL RTS4b. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3008 |
| Title | Separation Infringements |
| Requirement | In order to prevent any separation infringement, the OSD tool shall integrate the adequate buffers to accommodate for variability related to aircraft performance on the climb profiles. |
| Status | <validated> |
| Rationale | The size of the buffer should be based on the analysis of the aircraft performance data derived from operational data collected from the local airport where the OSD is to be implemented. This should be done as part of the local safety case conducted prior to implementation.<br><br>This is a requirement validated in ECTL RTS4b. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3009 |

| | |
|---|---|
| Title | Required time elapsed |
| Requirement | The OSD tool should indicate to the controller that the required time has elapsed to enable a subsequent departure even though an arriving aircraft is imminent, and no departures are allowed on the runway until the arriving aircraft has landed and exited the runway. |
| Status | <validated> |
| Rationale | In order to increase efficiency and enhance situation awareness.<br>This is a recommendation from ECTL RTS4b. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3010 |
| Title | Taking into account the 1,000ft vertical separation |
| Requirement | If applicable, the DDI-T and DDI-D values for the MRS separation minima should take into account the 1000ft vertical separation as well as the 3NM lateral separation constraint between the departing aircraft under the condition that the separation is also achieved on hand-over to the next sector. |
| Status | <validated> |
| Rationale | To ensure an appropriate separation are maintained during the departure phase, lowering the potential of human error.<br>This is validated in ECTL RTS4a and RTS4b. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3011 |
| Title | Automatic detection of take-off |
| Requirement | In case the controller forgets to input the take-off instruction in the EFS system, the DDI-T and DDI-D should automatically detect the aircraft take-off based on the aircraft rolling speed. The DDI for the next aircraft should adapt accordingly to the actual take-off time. |
| Status | <validated> |
| Rationale | To ensure efficiency as well as to ensure appropriate separations are maintained during the departure phase, lowering the potential of human error.<br><br>This is a recommendation validated in ECTL RTS4a and RTS4b. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor for aircraft becoming airborne and record Airborne Time<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3012 |
| Title | Timestamping of instructions |
| Requirement | The OSD tool/ CWP HMI should timestamp the time of the instructions given/inputted by the controllers. |
| Status | <validated> |
| Rationale | In current operations, the TWR ATCO usually writes down time of instruction, or in case the electronic flight strips the time of the instruction is marked automatically on the strip.<br><br>This is a recommendation validated in ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Instruct aircraft to line-up<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3013 |
| Title | Alert of abnormal departure aircraft performance |
| Requirement | An alert of a departing aircraft performance that is outside its normal performance envelope should be provided to the controller to avoid the separation infringement due to the aircraft not conforming to the speed. One potential solution could be to display of a ruler indicating distance to the leader aircraft to make controllers aware of possible decrease of separation to the leader aircraft. |
| Status | <validated> |
| Rationale | To ensure speed conformance or timely correction if needed.<br><br>This is a recommendation from ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3015 |
| Title | Regular refresher training |
| Requirement | Regular refresher training should be conducted to ensure that the controllers maintain their skills with no controller support tool in case of OSD tool degradation. |
| Status | <validated> |
| Rationale | Potentially ATCOs should have the opportunity to work without the use of the OSD tool, to maintain their skills.<br>This is a recommendation from ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br>Monitor for aircraft becoming airborne and record Airborne Time<br>Issue take-off clearance and Monitor and Record Roll Time<br>Determine Wake Separation Distance to preceding aircraft<br>Determine the most restrictive Wake Separation or SID Separation Distance<br>Determine preceding aircraft earliest distance position taking into account any other separation<br>Determine SID Separation Distance to each relevant preceding aircraft<br>Determine SID Separation and earliest Time to each preceding aircraft<br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br>Determine Wake Separation Time to preceding aircraft and associated Time<br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3016 |
| Title | Warning message for mixed mode |
| Requirement | For mixed mode operations, a warning message should be made available to show whether sequence changes are possible. (e.g. Highlighted in red in case the proposal is not accurate). |
| Status | <validated> |
| Rationale | To ensure the ATCO has an appropriate view with regard to both arrivals and departures, lowering the potential for human error.<br>This is a recommendation from ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3017 |
| Title | Distinguishing wake separations |
| Requirement | The HMI should allow the ATCOs to easily distinguish the wake separations. |
| Status | <validated> |
| Rationale | In order for them to quickly distinguish which separations are based on wake minima compared to separations based on MRS or SID constraints.<br>This is a recommendation from ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3018 |
| Title | Support for complex environments |
| Requirement | The OSD tool should be developed to ensure it can be used for aircraft departing from different runway entry points, and also developed to take into consideration any regulations related to the TMA exit point. |
| Status | <validated> |
| Rationale | To be applicable in complex environments.<br><br>This is a recommendation from ECTL RTS4b, the different entry runway points feature has been validated. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3019 |
| Title | AMAN/DMAN integration |
| Requirement | The integration the ORD and OSD (including the DDI-T, DDI-D and gap spacing management tool) should be merged with the AMAN / DMAN. |
| Status | <validated> |
| Rationale | To synchronize all data and ensure the ATCO does not have redundant information or different displays.<br><br>This is a recommendation from ECTL RTS4a. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine preceding aircraft earliest distance position taking into account any other separation |

| | | |
|---|---|---|
| | | Determine earliest take-off clearance time taking into account any other separation<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3020 |
| Title | OSD in mixed mode |
| Requirement | If used in mixed mode or partially segregated operations, the OSD tool shall not display the departure separation to be applied to the preceding departure aircraft when the immediately preceding aircraft in the sequence is an arrival aircraft, unless the Tower Runway Controller gives the departure aircraft a line-up clearance behind the arrival aircraft. |
| Status | <validated> |
| Rationale | Part II SAR SR#D55 in relation to the SO#D06: Ensure that the runway is free from obstruction before issuing a take-off clearance.<br><br>If the OSD tool is not taking into account the arrivals in mixed mode, when the DDI-T starts counting down or if the DDI-D is shown, it might suggest to the controller that the follower a/c to use the runway could be a departure.<br><br>This requirement could be achieved via a procedure, by not starting the countdown timer unless the next a/c has been given line-up clearance so separation will be displayed always for a departure pair, or via the system by making the OSD tool take into account the arrival sequence. The exact solution is to be determined at local level. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance<br><br>Line up and hold |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3021 |
| Title | OSD tool buffers |
| Requirement | If the OSD tool takes into account aircraft performance, it shall integrate the adequate buffers to accommodate for aircraft performance variability on the runway and airborne. |
| Status | <validated> |
| Rationale | Part II SAR SR#D66 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector.<br><br>The size of the buffer should be based on the analysis of the aircraft performance data derived from operational data collected from the local airport where the OSD is to be implemented. This should be done as part of the local safety case conducted prior to implementation.<br><br>Aircraft performance could be speed and climb profile per aircraft type or for example in the form of speed group additional spacing rules.<br><br>This requirement has been validated in RTS4a and RTS4b. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

| | | |
|---|---|---|
| | | Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3022 |
| Title | A/C outside the climb envelope considered by the tool |
| Requirement | If the local airport departure route structure permits catch-up situations, prior to giving a take-off clearance, the TWR controller shall be warned when an a/c is outside the climb profile envelope used by the OSD tool such that the controller takes the appropriate action to manage the possible catch-up between that pair of a/c. |
| Status | <validated> |
| Rationale | Part II SAR SR#D66 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector.<br><br>This is in order to avoid catch-up situations between two consecutive departures. Note this information is only useful when the follower is not yet airborne.<br><br>This is dependent on the local environment. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP0.3023 |
| Title | Apply separation between multiple aircraft |
| Requirement | If the OSD tool calculates SID, MRS and Wake separations, it shall take into account the separation not only between the first pair of aircraft but also between the leader and other aircraft in the sequence (e.g. 1st and 3rd, etc.). |
| Status | <validated> |
| Rationale | Part II SAR SR#D66 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector.<br><br>This is to mitigate the case when there is still some separation/spacing to be applied between e.g. the first and the third departure, after the separation/spacing between the second the third departure has been achieved. I.e. if given take-off clearance, the third departure will be separated with the second departure but it will not be separated compared with the first departure (e.g. MRS constraint between 1st and 2nd a/c and between 2nd and 3rd aircraft but at the same time there is a SID constraint between the 1st and 3rd a/c).<br><br>This requirement has been validated in RTS4a and RTS4b. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation |

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| | | Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0001 |
| Title | PWS-D wake separation minima |
| Requirement | The Tower Runway Controller shall be informed of the PWS-D wake separation minima to apply. |
| Status | <validated> |
| Rationale | The Tower Runway Controller shall be informed of the PWS-D wake separation minima to apply.<br><br>NATS RTS5 validated the "airborne time" wake separation procedures.<br><br>ECTL RTS4a validated the "start of take-off roll time" wake separation procedures.<br><br>ECTL RTS4a validated the distance-based wake separation procedures. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine earliest take-off clearance time taking into account any other separation |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0002 |
| Title | WTE risk for PWS minima |
| Requirement | For an aircraft type pair at RECAT-PWS minima on Initial Common Departure path, the pair-wise wake turbulence encounter severity shall not be higher than the severity of reference aircraft type pair (selected as acceptable baseline with proven extensive operations) at ICAO minima and in reasonable worst-case conditions. |
| Status | <deleted> |
| Rationale | There should be no increase in the risk of wake turbulence encounter severity on the Initial Common Departure path related to the correct application of the WT scheme under consideration compared to the severity of the reference aircraft type pairs that have been selected as the acceptable baseline with proven extensive operations employment.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0003 |
| Title | PWS-D capacity requirements |
| Requirement | The application of PWS-D optimised wake separations shall increase runway throughput compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme. |

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| Status | <deleted> |
| Rationale | The application of PWS-D optimised wake separations shall increase runway throughput compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement.<br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br>Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules.<br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D capacity requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br>Determine Wake Separation Time to preceding aircraft and associated Time<br>Issue take-off clearance and Monitor and Record Roll Time<br>Monitor for aircraft becoming airborne and record Airborne Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0004 |
| Title | PWS-D predictability requirements |
| Requirement | The application of PWS-D optimised wake separations shall decrease departure ground delay compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme. |



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|---|---|
| Status | <deleted> |
| Rationale | The application of PWS-D optimised wake separations shall decrease departure ground delay compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement.<br><br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br><br>Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft 96x96 aircraft type pairwise and 20-CAT wake category time-based wake separation rules.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D predictability requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0005 |
| Title | PWS-D wake separation rules |
| Requirement | PWS-D wake separation rules shall be provided to the Optimised Separation Delivery tool and shall be based on the pairwise aircraft type rules and the pairwise refined wake category rules. |
| Status | <deleted> |

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| Rationale | PWS-D wake separation rules shall be provided to the Optimised Separation Delivery tool. These shall and based on the pairwise aircraft type rules and the pairwise refined wake category rules.<br><br>For the distance-based wake separation rules these are the RECAT-EU-PWS distance-based 96x96 aircraft type pairwise wake separation rules and the distance-based 20-CAT wake separation rules.<br><br>For the wake separation time rules, draft rules are defined in SPR-INTEROP/OSED derived from the distance-based rules. The full development of these rules has been deferred to SESAR 2020 Wave 2.<br><br>Validated in NATS RTS5 for the wake separation time rules. Validated in ECTL RTS4a and RTS4b for both the wake separation time rules and the distance-based wake separation rules.<br><br>This is a system requirement and so should also be in the TS/IRS.<br><br>Deleted from the OSED as covered by REQ-02.01-SPRINTEROP-DEP1.0007 as an operational requirement. |
| Category | <Operational>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0006 |
| Title | PWS-D fuel efficiency requirements |
| Requirement | The application of PWS-D optimised wake separations shall decrease ground departure fuel burn compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme. |
| Status | <deleted> |

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|---|---|
| Rationale | The application of PWS-D optimised wake separations shall decrease ground departure fuel burn compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement.<br><br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br><br>Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D fuel efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0007 |
| Title | PWS-D concept |
| Requirement | The PWS-D concept shall apply wake turbulence separation rules defined between aircraft type pairs and defined between refined wake categories on the straight-out initial common departure path. |
| Status | <validated> |

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| Rationale | The PWS-D optimised wake separation rules are to be applied over the straight-out initial common departure path to the position of the first SID turn.<br><br>Soon after the first SID turn separation responsibility becomes the responsibility of the TMA Departure Controller and the follower departure aircraft either turns on to a wake independent path or the distance-based TMA wake separation rules apply and also a SID separation.<br><br>Validated in NATS RTS5 for the "airborne time" separation procedures.<br><br>ECTL RTS4a validated the "start of take-off roll time" wake separation procedures.<br><br>ECTL RTS4a validated the distance-based wake separation procedures. |
| Category | <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0008 |
| Title | PWS-D no negative impact on human performance |
| Requirement | PWS-D application shall not have negative impact on human performance. |
| Status | <deleted> |



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| Rationale | PWS-D application shall not have negative impact on human performance.<br><br>This is a performance requirement to facilitate traceability to the associated HP validation objectives. However this is an HP objective rather than a requirement, and there are several HP requirements to facilitate traceability to the HP validation objectives, so this requirement is deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0009 |
| Title | PWS-D cost efficiency requirement |
| Requirement | PWS-D application shall have a positive return on investments. |
| Status | <deleted> |

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| Rationale | PWS-D application shall have a positive return on investments.<br>To be validated in the CBA.<br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D cost efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP1.0010 |
| Title | PWS-D no negative impact on safety |
| Requirement | PWS-D application shall not have a negative impact on safety. |
| Status | <deleted> |
| Rationale | PWS-D application shall not have a negative impact on safety.<br>This is a performance requirement to facilitate traceability to the associated safety validation objectives. However this is a safety objective rather than a requirement, and there are several safety requirements to facilitate traceability to the safety validation objectives, so this requirement is deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br>Determine Wake Separation Time to preceding aircraft and associated Time |

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|---|---|---|
| | | Monitor separation on initial departure path<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0001 |
| Title | WDS-D Xw concept traffic situation picture |
| Requirement | For the WDS-D Xw concept the Runway Controller shall be provided with the traffic situation picture covering the departure phase of aircraft and that includes the identification, position and optionally the horizontal and vertical speed for all departing flights during their initial climb phase. |
| Status | <validated> |
| Rationale | The runway controller requires the traffic situation picture to support the application and monitoring of the WDS-D Xw concept reduced wake separations; particularly for the application of distance-based separation.<br><br>A traffic situation picture is already provided in current operations at Heathrow through the A-SMGCS display and the ATM display. It is not clear that there is a mandatory requirement for the traffic situation picture to include the horizontal and vertical speeds when applying "airborne time" procedures as these do not appear necessary for Heathrow.<br><br>NATS RTS5 validated the "airborne time" wake separation procedures.<br><br>The WDS-D concept was not validated with respect to distance-based procedures. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor for aircraft becoming airborne and record Airborne Time |

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|---|---|---|
| | | Monitor separation on initial departure path<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0002 |
| Title | WDS-D Xw concept undetected error in wind forecast |
| Requirement | For the WDS-D Xw concept the probability of an undetected error in the wind forecast, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off. |
| Status | <in progress> |
| Rationale | An undetected error can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-01.<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0003 |
| Title | WDS-D Xw concept capacity requirements |
| Requirement | The application of WDS-D Xw concept reduced wake separations shall increase runway throughput compared to the application of PWS-D wake separations or locally deployed static wake separation scheme. |
| Status | <deleted> |
| Rationale | The application of WDS-D Xw concept reduced wake separations shall increase runway throughput compared to the application of PWS-D wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement.<br><br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br><br>Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft WDS-D Xw concept reduced wake separations in the context of draft PWS-D 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept capacity requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft |

| | | |
|---|---|---|
| | | Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0004 |
| Title | WDS-D Xw concept wind information |
| Requirement | The Tower Runway Controller and the Tower Supervisor shall be provided with an adequate meteorological situation picture covering the area encompassing the initial climb phase of departing flights with respect to the direction of the runway intended for the application of WDS-D Xw concept reduced wake separations. |
| Status | <validated> |
| Rationale | Tower Controllers and Supervisors need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the WDS-D Xw concept procedures.<br><br>The WDS-D tool support requires the complete picture of the wind conditions (nowcast and forecast). It is not necessary for the complete picture of the wind conditions to be displayed to the Tower Runway Controller and Tower Supervisor.<br><br>From the Heathrow User Groups and RTS5 the Tower Runway Controller feedback was that the runway surface crosswind speed, together with the implied Controller GO status is required to be displayed for employing the WDS-D reduced separation. This is on the basis that there is justifiable confidence in the surface wind speed and implied GO status displayed to the controllers.<br><br>The complete wind aloft profile is taken into consideration in the WDS-D tool processing when determining the GO status. Only the latest measurements representing the nowcast provision have so far been considered. It is unclear whether there is a suitable forecast service.<br><br>The Tower Supervisor requirements have still to be addressed taking into account the Supervisor workload and other task |

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| | commitments with the recommendation that as much as possible should be automated. These requirements will need to be addressed in the local V4 maturity development and validation activities. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0005 |
| Title | WDS-D Xw concept undetected error in wind now-cast |
| Requirement | For the WDS-D Xw concept the probability of an undetected error in the wind now-cast, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off. |
| Status | <in progress> |
| Rationale | An undetected error can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-02.<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0006 |
| Title | WDS-D Xw concept predictability requirements |
| Requirement | The application of WDS-D Xw concept reduced wake separations shall decrease departure ground delay compared to the application of PWS-D wake separations or locally deployed static wake separation scheme. |
| Status | <deleted> |
| Rationale | The application of WDS-D Xw concept reduced wake separations shall decrease departure ground delay compared to the application of PWS-D wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement.<br><br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br><br>Validated in NATS RTS5 for "airborne time" separation procedures when applying the draft WDS-D Xw concept reduced wake separations in the context of draft PWS-D 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept predictability requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0007 |
| Title | WDS-D Xw concept wake turbulence advisory |
| Requirement | The Runway Controller, Tower Supervisor and Ground Controller shall be provided with wake turbulence advisory information that relates to the applicability of WDS-D Xw concept reduced wake separations for a period of time (based on aircraft wake turbulence categories and pre-defined departure profiles). |
| Status | <deleted> |
| Rationale | To support notifying the flight crew of the application of WDS-D reduced wake separations.<br><br>Obsolete as the CREDOS concept has now evolved to having Enhanced OSD tool support.<br><br>This is now covered by new SESAR 2020 requirements and so the requirement has been deleted. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0008 |
| Title | WDS-D Xw concept undetected error in departure planning |
| Requirement | For the WDS-D Xw concept the probability of an undetected error in the departure planning, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off. |
| Status | <deleted> |
| Rationale | An undetected error can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br>Note that this is CREDOS Safety Requirement SR-03.<br>This requirement is deleted as the Go/No-Go indication is not applied directly to each departure pair as it was in CREDOS. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br>Inform operational actors that WDS-D is no longer to be applied<br>Determine whether and how the application of WDS-D is to be changed<br>Stop Applying WDS-D to Departures<br>Determine Wake Separation Distance to preceding aircraft<br>Determine Wake Separation Time to preceding aircraft and associated Time<br>Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0009 |
| Title | WDS-D Xw concept fuel efficiency requirements |
| Requirement | The application of WDS-D Xw concept reduced wake separations shall decrease ground departure fuel burn compared to the application of PWS-D wake separations or locally deployed static wake separation scheme. |
| Status | <deleted> |
| Rationale | The application of WDS-D Xw concept reduced wake separations shall decrease ground departure fuel burn compared to the application of PWS-D wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement.<br><br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br><br>Validated in NATS RTS5 for "airborne time" separation procedures when applying the draft WDS-D Xw concept reduced wake separations in the context of draft PWS-D 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept fuel efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures |

| | | |
|---|---|---|
| | | Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine next aircraft to be given a line-up clearance<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0010 |
| Title | WDS-D Xw concept departure planning |
| Requirement | The Runway Controller shall be provided with the departure flight information required to support the departure planning. |
| Status | <validated> |
| Rationale | To support the consistent application of WDS-D Xw concept reduced wake separations. This includes the aircraft type and wake turbulence category, the designated runway and SID and possibly the first cleared flight level of each departure aircraft.<br><br>This is information that is already provided to the Tower Runway Controller in the local Heathrow environment. The first cleared flight level is not required in the local Heathrow environment. This was validated in NATS RTS5 for the "airborne time" separation procedures.<br><br>This information is also already provided in the local Paris Charles de Gaulle and Vienna environments.<br><br>The provision of this information may need to be supplemented in other local environments. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft |

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|---|---|---|
| | | Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0011 |
| Title | WDS-D Xw concept undetected failure of the WTA module |
| Requirement | The probability of an undetected failure of the Wake Turbulence Advisory (WTA) module, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off. |
| Status | <deleted> |
| Rationale | An undetected error can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-04.<br><br>The SESAR 2020 WDS-D Xw concept does not have an explicit Go/No-Go indication for each departure pair so delete requirement. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0012 |
| Title | WDS-D Xw concept Flight Crew notification |
| Requirement | Flight Crew shall be notified about the employment of WDS-D Xw concept reduced wake separations at an aerodrome. |
| Status | <validated> |
| Rationale | Part II SAR SR#D69 in relation to the SO#D10: Not to negatively affect the ability of Crew/Aircraft, to be able to follow ATC instructions.<br><br>The Flight Crew are required to be informed of the application of the WDS-D Xw concept reduced wake separation at an aerodrome so that they are fully aware of the reduced separation so that they can consistently apply the associated procedures.<br><br>It has been established through Airspace User and ATCO discussions that the Flight Crew should be prepared for the WDS-D Xw reduced separation to be applied at all times without the need for specific notification of when it is being applied. To support this the notification can be through the AIP and through the Flight Crew briefing material for the aerodrome.<br><br>Specific notification of when the WDS-D Xw reduced wake separation is being applied is not seen as necessary and so is optional. In NATS RTS5 the NBAT was highlighted when a WDS-D Xw reduced wake separation was being applied. The runway surface crosswind speed was also provided on the ADIS display so as to support the Tower Runway Controller in providing the runway surface crosswind speed to the Flight Crew in the take-off clearance instruction. |
| Category | <Human Performance>, <Safety>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0013 |
| Title | WDS-D Xw concept advisory trigger line displayed wrongly |
| Requirement | For the WDS-D Xw concept the probability that the advisory trigger line is displayed wrongly on the radar display shall be no greater than 9×10-6 per take-off. |
| Status | <in progress> |
| Rationale | The advisory trigger line being displayed wrongly can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-05.<br><br>This applies to the application of distance-based separation for departures where the advisory trigger line is the Dynamic Departure Indicator - Distance (DDI-D).<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures<br><br>Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.1013 |

| | |
|---|---|
| Title | WDS-D Xw concept time separation displayed wrongly |
| Requirement | For the WDS-D Xw concept the probability that the advisory time separation is displayed wrongly shall be no greater than 9×10-6 per take-off. |
| Status | <in progress> |
| Rationale | The advisory time separation being displayed wrongly can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is the time separation equivalent to the CREDOS Safety Requirement SR-05 on the wrong display of the advisory trigger line for distance-based separation.<br><br>This applies to the application of time separation for departures where the advisory time separation is the NBAT/NBTOT and the associated Countdown Timer.<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]





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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0014 |
| Title | WDS-D Xw concept no negative impact on human performance |
| Requirement | WDS-D Xw concept application shall not have a negative impact on human performance. |
| Status | <deleted> |
| Rationale | WDS-D Xw concept application shall not have a negative impact on human performance.<br><br>This is a performance requirement to facilitate traceability to the associated HP validation objectives. However this is an HP objective rather than a requirement, and there are several HP requirements to facilitate traceability to the HP validation objectives, so this requirement is deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Formulate optimised sequence order for departing aircraft<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

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| | | Inform operational actors that WDS-D is no longer to be applied<br><br>Monitor separation on initial departure path<br><br>Apply WDS-D to Departures<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0015 |
| Title | WDS-D Xw concept runway controller misreading Go/No-Go indication |
| Requirement | For the WDS-D Xw concept the probability that that the runway controller misreads the Go/No-Go indication shall be no greater than 5×10-5 per take-off. |
| Status | <deleted> |
| Rationale | The runway controller misreading the Go/No-Go indication may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-06.<br><br>The SESAR 2020 WDS-D Xw concept does not have an explicit Go/No-Go indication for each departure pair. There is now a Supervisor Go/No-Go indication about the suitability of the prevailing crosswind conditions over the straight-out initial common departure path and a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs.<br><br>This requirement is now out-of-date, so this requirement is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Stop Applying WDS-D to Departures<br><br>Apply WDS-D to Departures |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0016 |
| Title | WDS-D Xw concept cost efficiency requirement |
| Requirement | WDS-D Xw concept application shall have a positive return on investments. |
| Status | <deleted> |
| Rationale | WDS-D Xw concept application shall have a positive return on investments.<br><br>To be validated in the CBA.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept cost efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0017 |
| Title | WDS-D Xw concept runway controller failure to check the actual wind |
| Requirement | For the WDS-D Xw concept the probability that the runway controller fails to check the actual wind shall be no greater than 1×10-2 per take-off. |
| Status | <deleted> |
| Rationale | The runway controller failure to check the actual wind may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-07.<br><br>The basic HMI in CREDOS just had a Go/No-Go indication for each departure pair, no advisory trigger line or countdown timer. This was seen as an important engagement issue in this context with respect to reducing the potential for Controller error of wrongly suspending the application of the wake separation minimum between the departure pair.<br><br>The SESAR 2020 WDS-D Xw concept now has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation.<br><br>There is now no longer a need for the runway controller to check the actual wind before issuing the clearance to take-off, so this requirement is deleted. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]





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| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures<br><br>Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0018 |
| Title | WDS-D Xw concept wake separation minima |
| Requirement | The Tower Runway Controller shall be informed of the WDS-D Xw concept wake separation minima to apply. |
| Status | <validated> |
| Rationale | Currently controllers are responsible for judging which separation minima should be the primary determinant of the take-off time of the next succeeding aircraft. With the addition of PWS-D and the WDS-D Xw concept this task will need to be reallocated to a technical system component and controllers informed.<br><br>When WDS-D Xw concept reduced separations are being applied in the context of PWS-D or local static wake separation rules the Tower Runway Controller will need to be informed of when the WDS-D Xw reduced separation can be applied between departure aircraft and the associated reduced wake separation that can be applied.<br><br>The Enhanced OSD tool only applies the WDS-D Xw reduced wake separation to eligible pairs when there is a Controller Go indication. The eligibility of pairs includes ensuring the SID route of the follower departure aircraft is upwind of the SID route of the preceding departure aircraft after the first SID route turn for to avoid encountering the wake turbulence generated by the preceding departure aircraft.<br><br>When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the |

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| | application of the reduced wake separation. For all other pairs the PWS-D wake separations or the locally deployed static wake separation scheme is applied.<br><br>Validated in NATS RTS5 for WDS-D Xw reduced wake separations in the context of PWS-D wake separations for the "airborne time" procedures. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0019 |
| Title | WDS-D Xw concept runway controller failure to see the advisory trigger line is not displayed |
| Requirement | For the WDS-D Xw concept the probability that the runway controller fails to see that the advisory trigger line is not displayed shall be no greater than 1×10-2 per take-off. |
| Status | <in progress> |
| Rationale | The runway controller failure to see that an advisory trigger line is not displayed may result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-08.<br><br>This applies to the application of distance-based separation for departures where the trigger line is the Dynamic Departure Indicator - Distance (DDI-D).<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.1019 |
| Title | WDS-D Xw concept runway controller failure to see the time separation is not displayed |
| Requirement | For the WDS-D Xw concept the probability that the runway controller fails to see that the advisory time separation is not displayed shall be no greater than 1×10-2 per take-off. |
| Status | <in progress> |
| Rationale | The runway controller failure to see that an advisory time separation is not displayed may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is the time-based equivalent to the CREDOS Safety Requirement SR-05 on the failure to see the advisory trigger line is not displayed for distance-based separation.<br><br>This is failure to see that the NBAT/NBTOT is not displayed (i.e. nothing displayed in the NBAT/NBTOT field of the FDE), or failure to see that there is no displayed countdown time for the follower aircraft (no follower callsign and associated countdown in the Countdown timer).<br><br>Error has to be mitigated, however HP cannot commit to the probability numbers given.<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation and earliest Time to each preceding aircraft<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Determine the most restrictive Wake Separation or SID Separation Distance |

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|---|---|---|
| | | Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0020 |
| Title | WDS-D Xw concept provision of crosswind information |
| Requirement | The Tower ATC Roles may be provided with the WDS-D Xw concept crosswind information to inform their situation awareness. |
| Status | <deleted> |
| Rationale | To safely and effectively apply the WDS-D Xw concept, there has to be adequately strong crosswinds for a suitable period of time. To minimise the risk that controllers incorrectly apply this reduction in separation time, it is important that they are given crosswind information.<br><br>Provision of crosswind information is already addressed in REQ-02.01-SPRINTEROP-DEP2.0004. This is a duplicate requirement, so delete requirement. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0021 |
| Title | WDS-D Xw concept runway controller failure to inspect the Go/No-Go indication |

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| Requirement | For the WDS-D Xw concept the probability that that the runway controller fails to inspect the Go/No-Go indication shall be no greater than 1×10-9 per take-off. |
| Status | <deleted> |
| Rationale | The runway controller failure to inspect the Go/No-Go indication can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>The basic HMI in CREDOS just had a Go/No-Go indication for each departure pair, no advisory trigger line or countdown timer. This was seen as an important engagement issue in this context with respect to reducing the potential for Controller error of wrongly suspending the application of the wake separation minimum between the departure pair.<br><br>The SESAR 2020 WDS-D Xw concept now has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation.<br><br>The SESAR 2020 WDS-D Xw concept does not have an explicit Go/No-Go indication for each departure pair. The requirement is out-of-date, so the requirement has been deleted. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed |

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|---|---|---|
| | | Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0022 |
| Title | Informing controllers of WDS-D Xw concept reduced wake separation application |
| Requirement | The Tower Runway Controller shall be informed of when WDS-D Xw concept reduced wake separation is being applied. |
| Status | <validated> |
| Rationale | Part II SAR SR#D43 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br><br>Controllers need a clear visual indicator of when the WDS-D Xw concept reduced wake separation is being applied, first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the reduced wake separation and secondly to help ensure overall compliance with the associated procedures.<br><br>When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation.<br><br>Validated in NATS RTS5 for the "airborne time" procedures. |
| Category | <Human Performance>, <Safety>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br>Inform operational actors that WDS-D is no longer to be applied<br>Determine whether and how the application of WDS-D is to be changed<br>Apply WDS-D to Departures<br>Stop Applying WDS-D to Departures<br>Determine Wake Separation Distance to preceding aircraft<br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| Identifier | REQ-02.01-SPRINTEROP-DEP2.0023 |
|---|---|
| Title | Applying WDS-D Xw concept to an unsuitable aircraft pair |
| Requirement | For the WDS-D Xw concept the probability that the runway controller applies WDS-D Xw concept reduced wake separation to an unsuitable aircraft pair shall be no greater than 1×10-9 per take-off. |
| Status | <in progress> |
| Rationale | The runway controller application of the WDS-D Xw concept to an unsuitable aircraft pair, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br>When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation.<br>Note that this is CREDOS Safety Requirement SR-10.<br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| Identifier | REQ-02.01-SPRINTEROP-DEP2.0024 |
|---|---|
| Title | WDS-D Xw concept runway controller applying insufficient wake turbulence separation |
| Requirement | For the WDS-D Xw concept the probability that the runway controller applies insufficient wake turbulence separation shall be no greater than 1×10-9 per take-off. |
| Status | <deleted> |
| Rationale | The runway controller applying insufficient wake turbulence separation, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-11.<br><br>This requirement applies to both the application of distance-based wake separations and wake separation times.<br><br>For a HP perspective this is to be addressed through applying the User Centred Design (UCD) process and as such does not mitigate anything and so is just a form of argument. This is addressed through practical HMI or procedural requirements and so is not needed and so is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Monitor separation on initial departure path<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0025 |
| Title | Provision to controllers of the WDS-D Xw concept reduction factors |
| Requirement | The Tower Runway Controller shall be provided with the specific WDS-D Xw concept wake separation minima reduction factors such as the crosswind speed, each aircraft line-up position and each aircraft planned SID. |
| Status | <validated> |
| Rationale | Trust in a system can be facilitated if controllers are given the opportunity to check that the system is functioning as expected. To this end, a request to make available to controllers the specific details of the WDS-D Xw concept reduction factors such as the crosswind speed, each aircraft line-up position and each aircraft planned SID.<br><br>The aircraft SID information that is already provided to the Tower Runway Controller in the local Heathrow environment. Each aircraft planned SID is already available on the FDEs. Each aircraft line-up entry taxiway is added on to the FDE. The runway surface wind speed and wind direction are displayed on the ADIS display. The runway surface crosswind speed was added when WDS-D Xw reduced wake separations were being applied. This was validated in NATS RTS5 for the "airborne time" separation procedures.<br><br>The provision of this information may need to be supplemented in other local environments. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0026 |
| Title | WDS-D Xw concept runway controller confusing a non-WDS-D runway with a WDS-D runway |
| Requirement | For the WDS-D Xw concept the probability that the runway controller confuses a non-WDS-D runway with a WDS-D runway shall be no greater than 1×10-9 per take-off. |
| Status | <deleted> |
| Rationale | The runway controller confusing a non-WDS-D runway with a WDS-D runway can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-12.<br><br>This may be applicable in multiple runway environments where more than one runway is being used to support departure operations at the same time. This is not a runway mode being validated in SESAR 2020 Wave 1, and is not foreseen to be validated, so this requirement has been deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0027 |
| Title | WDS-Xw concept wind forecast input |
| Requirement | The wind forecast provided to the users shall include standard meteorological information and WDS-D Xw concept specific information with respect to wind nowcast and forecast, wind speed, direction and trends, in particular the crosswind component with respect to each runway direction. |
| Status | <deleted> |

| | |
|---|---|
| Rationale | Controllers need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the procedure.<br><br>Provision of meteorological information is already addressed in REQ-02.01-SPRINTEROP-DEP2.0004. This is a duplicate requirement, so delete requirement. |
| Category | <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0028 |
| Title | Using WDS-D Xw concept differently than specified |
| Requirement | For the WDS-D Xw concept the probability that the runway controller uses WDS-D Xw concept differently than specified in the operational concept shall be no greater than 1×10-9 per take-off. |
| Status | <deleted> |

| | |
|---|---|
| Rationale | The runway controller using WDS-D Xw concept differently than specified can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-13.<br><br>It is considered that "differently than specified" is equivalent to ignoring the tool. Preventative mitigation is the training on the use of the advice from the tool. Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0029 |
| Title | WDS-D Xw concept departure planning system support |
| Requirement | Departure planning system support shall be provided to the users to plan or execute WDS-D Xw concept operations. |
| Status | <validated> |

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|---|---|
| Rationale | The system support is envisaged to include standard departure information and WDS-D Xw concept specific information:<br><br>1. The departing flights, their allocated runway, SIDs and first cleared flight level<br><br>2. The aircraft types and wake turbulence categories and changes to these categories depending on WDS-D Xw concept reduced wake separation application or suspension<br><br>3. The set of available SIDs and advise on their use for WDS-D Xw concept reduced wake separations (upwind, downwind).<br><br>The level of support which is currently given would need to be enhanced in the new operating environment (i.e. the allocation of the task between human actors and technical systems would shift to placing the onus on the technical system). This should help to mitigate any risks associated with reduced or lost information processing capacity.<br><br>In SESAR 2020 WDS-D Xw concept the departure planning system support includes the A-CDM/DMAN support to formulate and optimise a departure sequence order and departure rate for coordinating the TOBTs and TSATs and for managing the taxi-out flow of the departure aircraft to the runway holding points (see REQ-02.01-SPRINTEROP-DEP0.001). This system support may also be extended to formulating an optimised sequence plan for line-up and take-off, taking into account departure aircraft readiness constraints at the runway holding points (see REQ-02.01-SPRINTEROP-DEP0.002).<br><br>In the local Heathrow environment the specific information on each departure flight is provided on the Flight Data Entry (FDE) of the EFPS. There are no dynamic changes to wake turbulence categories or need for advice on the available SIDs or on their use. This has been validated in NATS RTS5 for the "airborne time" separation procedures.<br><br>The provision of this system support may need to be supplemented in other local environments.<br><br>This is a system requirement and so there should be associated requirements in the TS/IRS. |
| Category | <Operational>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0030 |
| Title | WDS-D Xw concept runway controller issuing distance-based take-off clearance early |
| Requirement | For the WDS-D Xw concept the probability that the runway controller issues a take-off clearance before the predecessor has crossed the advisory trigger line shall be no greater than 3×10-5 per take-off. |
| Status | <deleted> |
| Rationale | The runway controller issuing the take-off clearance early, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-14.<br><br>This applies to the application of distance-based separation for departures where the advisory trigger line is the Dynamic Departure Indicator - Distance (DDI) in the SESAR 2020 OSD concept.<br><br>Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft |

| | | |
|---|---|---|
| | | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Issue take-off clearance and Monitor and Record Roll Time<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.1030 |
| Title | WDS-D Xw concept runway controller issuing time-based take-off clearance early |
| Requirement | For the WDS-D Xw concept the probability that the runway controller issues a take-off clearance too early with respect to the NBAT/NBTOT or displayed countdown time for the required wake separation shall be no greater than 3×10-5 per take-off. |
| Status | <deleted> |
| Rationale | The runway controller issuing the take-off clearance early, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-14 in the context of time separation procedures.<br><br>Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0031 |
| Title | WDS-Xw concept wake turbulence advisory system support |
| Requirement | Wake turbulence advisory system support shall be provided to the users to plan or execute WDS-D Xw concept operations. The system support shall include an indication of whether wind conditions allow the application of WDS-D Xw concept reduced wake separation or require its suspension. |
| Status | <validated> |
| Rationale | Controllers need a clear visual indicator of the WDS-D Xw concept Go/No Go status; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the procedure.<br><br>The SESAR 2020 WDS-D Xw concept has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation.<br><br>The above was validated in NATS RTS5 for the "airborne time" separation procedures.<br><br>This is a system requirement and so there should be associated requirements in the TS/IRS. |
| Category | <Operational>, <System>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |



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|---|---|---|
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0032 |
| Title | WDS-D Xw concept Flight Crew misinterprets an instruction as a take-off clearance |
| Requirement | For the WDS-D Xw concept the probability that the Flight Crew misinterprets a communication as a take-off clearance for a WDS-D operation and subsequently starts the take-off roll shall be no greater than 1×10-8 per take-off. |
| Status | <deleted> |
| Rationale | The Flight Crew misinterpreting a communication as a take-off clearance for a WDS-D operation, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-15.<br><br>Flight Crew and Airline Operator representatives need to be consulted on this requirement.<br><br>Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Issue take-off clearance and Monitor and Record Roll Time<br><br>Commence take-off roll |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0033 |
| Title | WDS-D Xw concept wake turbulence advisory system support |
| Requirement | Wake turbulence advisory system support shall be provided to the users to plan or execute WDS-D Xw concept operations. The system support shall include an indication of whether wind conditions allow the application of WDS-D Xw concept reduced wake separation or require its suspension. |
| Status | <deleted> |
| Rationale | Controllers need a clear visual indicator of the WDS-D Xw concept Go/No Go status; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the procedure.<br><br>The SESAR 2020 WDS-D Xw concept has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation.<br><br>Duplicate requirement with REQ-02.01-SPRINTEROP-DEP2.0031 so delete. |
| Category | <System>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
| --- | --- | --- |
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br>Inform operational actors that WDS-D is no longer to be applied<br>Determine whether and how the application of WDS-D is to be changed<br>Apply WDS-D to Departures<br>Stop Applying WDS-D to Departures<br>Determine Wake Separation Distance to preceding aircraft<br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
| --- | --- |
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0034 |
| Title | WDS-D Xw concept Flight Crew selects wrong SID |
| Requirement | For the WDS-D Xw concept the probability that the flight crew selects the wrong SID shall be no greater than 3×10-5 per take-off. |
| Status | <deleted> |
| Rationale | The Flight crew selecting the wrong SID may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br>Note that this is CREDOS Safety Requirement SR-16.<br>Flight Crew and Airline Operator representatives need to be consulted on this requirement.<br>Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0035 |
| Title | WDS-D Xw concept system support users |
| Requirement | The users of the wind information, departure planning and wake turbulence advisory system support shall be the Tower Runway Controller, the Tower Supervisor, the Tower Clearance Delivery Manager and the Tower Ground Controller. |
| Status | <validated> |
| Rationale | The users of the system support for the WDS-D Xw concept are the Tower ATC Roles responsible for the application of the WDS-D Xw concept reduced wake separations.<br><br>The wind information system support is used by the Tower Supervisor and the Tower Runway Controller (see REQ-02.01-SPRINTEROP-DEP2.0004).<br><br>The departure planning system support for pushback and taxi-out is used by the Tower Clearance Delivery Manager and the Tower Ground Movement Controllers (see REQ-02.01-SPRINTEROP-DEP0.0001).<br><br>The departure planning system support for line-up and take-off is used by the Tower Runway Controller (see REQ-02.01-SPRINTEROP-DEP0.0002).<br><br>The wake turbulence advisory system support is used by the Tower Supervisor and Tower Runway Controller (see REQ-02.01-SPRINTEROP-DEP2.0031).<br><br>Validated in NATS RTS5 for the "airborne time" separation procedures. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0036 |
| Title | WDS-D Xw concept Flight Crew deviating from SID due to engine failure |
| Requirement | For the WDS-D Xw concept the probability of the crew deviating from the SID due to engine failure shall be no greater than 1×10-6 per take-off. |
| Status | <deleted> |
| Rationale | The flight crew deviating from the SID due to engine failure may result in an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-17.<br><br>There is a need to clarify this requirement as the Flight Crew will not necessarily have control over the deviation from the SID when there is an engine failure. Flight Crew and Airline Operator representatives need to be consulted on this requirement.<br><br>Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0037 |
| Title | Authorisation of the application of WDS-D Xw concept reduced separations |
| Requirement | The responsibility to authorise the application of WDS-D Xw concept reduced wake separations for a significant period of time or on a case by case basis shall be clearly defined as part of Tower ATC operational procedures. |
| Status | <in progress> |
| Rationale | Part II SAR SR#D44 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br><br>There is a need for clearly defined Tower ATC Roles who are responsible for authorising the application of the WDS-D Xw concept reduced wake separations.<br><br>The approval process is subject to local considerations.<br><br>As a result of NATS RTS5 it is suggested that for Heathrow the authorisation process is based on pre-authorisation by the Tower Supervisor, who takes all operational factors into consideration, and then supported automatically on a departure pair case by case basis with respect to the sufficiency of the crosswind conditions when the follower aircraft is given clearance to line-up.<br><br>The Tower Supervisor requirements have still to be addressed taking into account the Supervisor workload and other task commitments with the recommendation that as much as possible should be automated. This is to be further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety>, <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied |

| | | |
|---|---|---|
| | | Determine whether and how the application of WDS-D is to be changed<br>Apply WDS-D to Departures<br>Stop Applying WDS-D to Departures<br>Determine Wake Separation Distance to preceding aircraft<br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0038 |
| Title | WDS-D Xw concept Flight Crew deviating from SID in nominal operations |
| Requirement | For the WDS-D Xw concept the probability of the crew deviating from the SID to avoid clouds (Cb), other traffic, or expected wake turbulence shall be no greater than 4×10-6 per take-off. |
| Status | <in progress> |
| Rationale | The flight crew deviating from the SID may result in an unacceptable increase in the probability of a severe wake turbulence encounter.<br>Note that this is CREDOS Safety Requirement SR-18.<br>Questions have been raised about the scenario examples for deviating from the SID and whether these constitute nominal operations.<br>Weather avoidance conditions constitutes non-nominal operations and it would be expected that the employment of the WDS-D Xw concept reduced separations would be suspended.<br>Similarly deviating from the SID due to conflict scenarios with other traffic is a non-nominal scenario and deviating from the SID due to expected wake turbulence encounter is a non-nominal scenario.<br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0039 |
| Title | Responsibility for applying the WDS-D Xw concept reduced separations |
| Requirement | The Tower Runway Controller shall be responsible for applying the WDS-D Xw concept reduced wake separation to any applicable departure aircraft pair. |
| Status | <validated> |
| Rationale | The Tower Runway Controller is responsible for applying the WDS-D Xw concept reduced wake separations to any applicable departure aircraft pair as advised by the wake turbulence advisory system support of the Enhanced OSD tool.<br><br>Validated in NATS RTS5 for the "airborne time" separation procedures. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

| | | |
|---|---|---|
| | | Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0040 |
| Title | WDS-D Xw concept unjust Go/No-Go indication |
| Requirement | For the WDS-D Xw concept the probability of an unjust Go/No-Go indication due to an unreliable wind forecast shall be no greater than 2×10-9 per take-off. |
| Status | <deleted> |
| Rationale | An unjust Go indication may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-19.<br><br>The basic HMI in CREDOS just had a Go/No-Go indication for each departure pair, no advisory trigger line or countdown timer. In CREDOS an unjust Go indication could result in wrongly suspending the application of the standard wake separation minimum between the departure pair.<br><br>In the SESAR 2020 WDS-D Xw concept the equivalent is an unjust reduced separation being reflected in the NBAT/NBTOT and/or countdown time for the take-off clearance when applying a time separation or being reflected in the Dynamic Departure Indicator - Distance (DDI-D) when applying a distance-based separation.<br><br>This requirement is deleted as it is not relevant to the SESAR 2020 WDS-D Xw concept. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0041 |
| Title | WDS-D Xw concept monitoring of reduced separation for distance-based separation |
| Requirement | When a WDS-D Xw concept reduced wake separation is applied, the Runway Controller shall monitor the aircraft during the initial climb phase. |
| Status | <validated> |
| Rationale | Part II SAR SR#D52 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path.<br><br>The Tower Runway Controller is responsible for ensuring the continued correct application of a WDS-D Xw concept reduced wake separation when applying distance-based separation.<br><br>This is so as to ensure that the WDS-D Xw concept reduced wake separation remains applicable, based on the information provided by the wind information and wake turbulence advisory system support.<br><br>This is also to ensure the effective application of WDS-D Xw concept reduced wake separation through verifying departing aircraft progress, through the provision of a traffic situation picture.<br><br>When the follower aircraft is not yet airborne, if the first SID turn takes place fairly quickly after take-off the ATCO may be able to stop the follower aircraft on the ground when the lead aircraft is monitored as turning the wrong way.<br><br>When the follower aircraft is rolling and cannot be stopped from becoming airborne, or is airborne, the opportunity for intervention action is reduced to an extent that all the controller may be able to do is issue a cautionary wake advisory. |

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| Category | <Human Performance>, <Operational>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0042 |
| Title | WDS-D Xw concept aircraft catches up due to speed differences |
| Requirement | For the WDS-D Xw concept the probability that an aircraft catches up on its predecessor due to speed differences shall be no greater than 3×10-5 per take-off. |
| Status | <in progress> |
| Rationale | A follower aircraft catching up to the preceding aircraft due to speed differences, when WDS-D Xw concept reduced wake separation is being applied, may result in insufficient time for the wake vortices to be transported out of the path of the follower aircraft, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-20.<br><br>This requirement is not relevant to the application of time separation for departures where departure pairs applying a wake separation diverge onto wake independent SIDs after the first SID turn when the straight-out initial common departure paths are short with limited opportunity for time separation catch-up before the first SID turn.<br><br>This requirement possibly applies when the straight-out initial common departure paths are sufficiently long for there to be significant opportunity for time separation catch-up before the first SID turn for departure pairs that diverge onto wake independent SIDs after the first SID turn. |



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| | This requirement possibly applies when the leader and follower are employing the same SID or employing wake dependent SID paths after the first SID turn.<br><br>There is a need to consider whether there are any cases where the wake separation is larger than the SID separation when the leader and follower are employing the same SID or are employing non wake independent SID paths after the first SID turn, and where the follower aircraft type has a significantly faster airspeed profile than the lead aircraft type. Normally the follower aircraft types of wake pairs employ a similar or slower airspeed profile compared to the larger leader aircraft types.<br><br>This requirement is also relevant to the application of distance-based separation for departures.<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0043 |
| Title | WDS-D Xw concept notification to Flight Crews |
| Requirement | The Flight Crew shall be notified of the application of WDS-D Xw concept reduced wake separations:<br>1. In terms of operational rules and procedures (through the Aeronautical Information Publication)<br>2. During tactical phase, when WDS-D Xw concept reduced wake separation is applied or likely to be applied during the day of operation (maybe part of the local air traffic information service such as ATIS)<br>3. When their own flight is subject to reduced wake separation from the preceding departure and when reduced wake separation is suspended, in a timely manner |

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|---|---|
| Status | <deleted> |
| Rationale | The Flight Crew are required to be informed of the application of the WDS-D Xw reduced wake separations so that they are fully aware of the reduced wake separations so that they can consistently apply the associated procedures.<br><br>It has been established through Airspace User and ATCO discussions that the Flight Crew should be prepared for the WDS-D Xw reduced separation to be applied at all times without the need for specific notification of when it is being applied. To support this the notification can be through the AIP and through the Flight Crew briefing material for the aerodrome.<br><br>Specific notification of when the WDS-D Xw reduced wake separation is being applied is not seen as necessary and so is optional. In NATS RTS5 the NBAT was highlighted when a WDS-D Xw reduced wake separation was being applied. The runway surface crosswind speed was also provided on the ATIS display so as to support the Tower Runway Controller in providing the runway surface crosswind speed to the Flight Crew in the take-off clearance instruction.<br><br>This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so delete requirement. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0044 |
| Title | WDS-D Xw concept aircraft deviates laterally on SID |

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|---|---|
| Requirement | For the WDS-D Xw concept the probability that the aircraft deviates laterally outside the boundaries of the Wake Turbulence Separations Suspension Airspace Volume (WTSSAV) shall be no greater than 1×10-6 per take-off. |
| Status | <in progress> |
| Rationale | The preceding or the follower aircraft deviating laterally on the straight-out initial SID, beyond the normally contained lateral navigation performance, may result in insufficient time for the wake vortices to be transported out of the path of the follower aircraft, causing an unacceptable increase in the probability of a severe wake turbulence encounter with the WDS-D Xw concept.<br><br>Note that this is CREDOS Safety Requirement SR-21.<br><br>In SESAR 2020 we have not retained the concept of a WTSSAV as the WDS-D Xw concept reduced wake separations is only proposed to be applied to departure pairs applying wake independent SIDs after the first SID turn where the follower SID is upwind of the lead SID.<br><br>It should be noted that CREDOS was also proposing to apply the WDS-D Xw concept reduced separations to departure pairs employing the same SID provided the standard radar wake separation is achieved before the follower aircraft exits the WTSSAV.<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0045 |
| Title | WDS-D Xw concept delegation of responsibility |
| Requirement | The Runway Controller shall have a delegated responsibility for issuing radar vectoring instructions to aircraft subject to WDS-D Xw concept reduced wake separation up to the agreed flight level for the handover to the TMA Departure Controller. |
| Status | <validated> |
| Rationale | Part II SAR SR#D53 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path.<br><br>The Tower Runway Controller is responsible for applying the WDS-D Xw concept reduced wake separations.<br><br>When the follower aircraft is not yet airborne, if the first SID turn takes place fairly quickly after take-off the ATCO may be able to stop the follower aircraft on the ground when the lead aircraft is monitored as turning the wrong way.<br><br>When the follower aircraft rolling and cannot be stopped from becoming airborne or is airborne the opportunity for intervention action is reduced to an extent that all the controller may be able to do is issue a cautionary wake advisory.<br><br>This will be dependent on local factors such as the extent of the straight-out initial common departure path, when the follower aircraft will attain a stable flight profile such that the Flight Crew are able to respond to intervention action, and when separation responsibility is transferred to the TMA Departure Controller. |
| Category | <Operational>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine Wake Separation Distance to preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0046 |
| Title | WDS-D Xw concept aircraft employs different SID to WDS-D planning |
| Requirement | For the WDS-D Xw concept the probability that the SID used by an aircraft is not the SID used in WDS-D planning shall be no greater than 4×10-6 per take-off. |
| Status | <in progress> |
| Rationale | The preceding or the follower aircraft employing a different SID than WDS-D may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter.<br><br>Note that this is CREDOS Safety Requirement SR-22.<br><br>The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0047 |
| Title | WDS-D Xw concept Tower to TMA coordination |
| Requirement | When the application of WDS-D Xw concept reduced wake separations are likely to have an impact on the work of the TMA Departure Controller, the Tower Supervisor or Tower Runway Controller shall coordinate with the TMA Departure Controller prior to employing the WDS-D Xw concept reduced wake separations. |
| Status | <validated> |
| Rationale | There is a need to ensure the TMA Departure Controller is aware of and able to support the WDS-D Xw concept reduced wake separations.<br><br>Validated in NATS RTS5 where the TMA Departure Controller indicated that there was no need for any coordination for the "airborne time" separation procedures. |
| Category | <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0048 |
| Title | WDS-D Xw concept deviation alert |
| Requirement | The Tower Runway Controller shall be alerted, through audio and / or visual signal, when an aircraft deviates from its planned SID trajectory when applying a WDS-D Xw concept reduced wake separation. |
| Status | <validated> |

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|---|---|
| Rationale | Part II SAR SR#D54 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path.<br><br>The Controller should need to know when an aircraft is deviating from the planned SID, for any reason, since when applying the WDS-D Xw concept reduced wake separation the conditions to ensure the crosswind transport of the wake vortices out of the path of the follower may no longer be guaranteed and as a consequence this could lead to a risk of a wake encounter with significantly stronger wake vortices compared with standard separation (RECAT-EU or RECAT-EU-PWS) in reasonable worst case conditions.<br><br>In the Heathrow local case where the first SID turn is less than 1.5NM from the end of the runway the Tower Runway Controller have indicated that there is no opportunity for any intervention action and so question the necessity of a deviation alert.<br><br>This is a local issue to be investigated in the local V4 maturity development and validation activities. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0049 |
| Title | WDS-D Xw concept wind forecast |
| Requirement | The users shall be provided with the wind forecast in order to plan or execute the departure operations. |
| Status | <deleted> |
| Rationale | To allow the Controller to have the needed information to execute the departure plan with or without WT separation.<br><br>The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement. |

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|---|---|
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0050 |
| Title | WDS-D Xw concept activation HMI |
| Requirement | The Tower Supervisor shall be able to activate and monitor the application of the WDS-D Xw concept reduced wake separation procedure through the HMI. |
| Status | <deleted> |
| Rationale | Tower Supervisor shall have on the HMI the possibility to activate the application of the WDS-D Xw concept reduced wake separations.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied |

| | | |
|---|---|---|
| | | Stop Applying WDS-D to Departures<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0051 |
| Title | WDS-D Xw concept meteorological information |
| Requirement | Standard meteorological information and specific information with respect to wind nowcast and forecast, wind speed and direction shall be provided to support the WDS-D Xw concept. |
| Status | <deleted> |
| Rationale | To allow Tower ATC to have all information to take the decision about WT separation reduction (w.r.t WDS-D Xw concept).<br><br>Additional information (crosswind component at the runway surface at the rotation positions) is required beyond that currently provided.<br><br>The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0052 |
| Title | WDS-D Xw concept de-activation HMI |
| Requirement | The Tower Supervisor shall be able to de-activate the application of the WDS-D Xw concept reduced wake separation procedure through the HMI. |
| Status | <deleted> |
| Rationale | Tower Supervisor shall have on the HMI the possibility to de-activate the application of the WDS-D Xw concept reduced wake separations.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0053 |
| Title | WDS-D Xw concept wind condition changes notification |
| Requirement | The Tower Runway Controller shall be notified when the WDS-D Xw concept wind conditions changes. |
| Status | <deleted> |
| Rationale | The Controller shall be aware of wind conditions changes, because this could imply that WDS Xw concept applicability conditions are met/not met.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0054 |
| Title | WDS-D Xw concept wind conditions suitability indication |
| Requirement | An indication shall be provided to Tower ATC of whether the wind conditions allow the application of WDS-D Xw concept wake separation reduction. |
| Status | <deleted> |
| Rationale | To allow Tower ATC to be sure of when the WDS-D Xw concept wake separation reduction can be applied.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0055 |
| Title | WDS-D Xw concept status monitoring |

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|---|---|
| Requirement | The Tower Runway Controller shall be able to check the WDS-D Xw concept activation status. |
| Status | <deleted> |
| Rationale | The Controller needs to have a clear indication of whether WDS-D Xw concept wake separation reduction is active or not.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |



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[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0056 |
| Title | WDS-D Xw concept wind forecast for runway |
| Requirement | Tower ATC shall be provided with current and forecast wind speed and direction for each runway when applying the WDS-D Xw concept. |
| Status | <deleted> |
| Rationale | To allow Tower ATC to be able to determine whether the WDS-D Xw concept reduced wake separation can be applied to each of the runways supporting departure operations.<br><br>From the NATS controller workshop discussions the feedback has been that the wind profile provided to the Tower Runway Controller should be just the current runway surface crosswind speed and only when the WDS-D Xw concept reduced wake separation is authorised to be applied. This was validated in NATS RTS5.<br><br>The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0057 |
| Title | WDS-D Xw concept authorisation notification to controller |
| Requirement | The Tower Runway Controller should be notified when WDS Xw concept wake separation reduction is authorised to be applied. |
| Status | <deleted> |
| Rationale | The Controller should have a clear indication of whether the WDS-D Xw concept wake separation reduction is authorised to be applied or not.<br><br>As a result of the Heathrow RTS5 it is proposed that it should optional as whether the Tower Runway Controller is proactively notified of when the WDS-D Xw concept status changes from No-Go to Go or from Go to No-Go. As a result this is changed to "should" rather than "shall".<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0058 |
| Title | WDS-D Xw concept wind on different altitudes |
| Requirement | Tower ATC shall be provided with the current and forecast wind speed and direction on different altitudes encompassing the initial climb phase on the straight-out initial common departure path when applying the WDS-D Xw concept. |
| Status | <deleted> |
| Rationale | To allow Tower ATC and the associated Enhanced OSD tool support to be able to determine whether the WDS-D Xw concept reduced wake separation can be authorised to be applied.<br><br>From the NATS controller workshop discussions the feedback has been that the wind profile provided to the Tower Runway Controller should be just the current runway surface crosswind speed and only when the WDS-D Xw concept reduced wake separation is authorised to be applied. This was validated in NATS RTS5.<br><br>The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0059 |
| Title | WDS-D Xw concept de-activation notification to Controller |

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|---|---|
| Requirement | The Tower Runway Controller may need to be notified of when the WDS-D Xw concept application of reduced wake separations is de-activated. |
| Status | <deleted> |
| Rationale | The Controller may need to have a clear notification of when the WDS-D Xw concept application of wake separation reduction has been de-activated.<br><br>As a result of the Heathrow RTS5 it is proposed that it should be optional as to whether the Tower Runway Controller is notified of when the WDS-D Xw concept status changes from No-Go to Go or from Go to No-Go. As a result this is changed to "may" rather than "shall".<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.1059 |
| Title | WDS-D Xw concept reduced separation notification to Controller |

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|---|---|
| Requirement | The Tower Runway Controller shall be notified when a WDS-D Xw concept reduced wake separation is being applied to a departure pair. |
| Status | <deleted> |
| Rationale | The Tower Runway Controller needs to be informed when a WDS-D Xw reduced wake separation is being applied to a departure pair.<br><br>As a result of the Heathrow RTS5 It is proposed that the Tower Runway Controller is informed of when a WDS-D Xw concept reduced wake separation is being applied through highlighting the NBAT and also possibly highlighting the countdown time.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0060 |
| Title | WDS-D Xw concept controller situation awareness |
| Requirement | The Controller situation awareness shall not be reduced when the WDS-D Xw concept reduced wake separation is applied. |
| Status | <deleted> |

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|---|---|
| Rationale | The WDS-D Xw concept operation shall improve and/or not change the Controller situation awareness.<br><br>This is an HP argument statement against which evidence needs to be provided, rather than a requirement. Deleted as a requirement. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0061 |
| Title | WDS-D Xw concept activation notification to the Flight Crew |
| Requirement | The Flight Crew shall be notified when the WDS-D Xw concept is activated. |
| Status | <deleted> |
| Rationale | The Flight Crew needs to be informed when the WDS-D Xw concept reduced wake separation may be applied.<br><br>From the feedback from the Heathrow Tower Controllers involved in the preparation and execution of the RTS5 validation exercise and from feedback from the Airspace User representatives at the RTS5 visitor day there is no requirement for notification from the Tower ATC to the Flight Crew. There is just a need for the Flight Crew to be aware that the WDS-D Xw reduced wake separation may be applied through the AIP and the Flight Crew briefing material for the Aerodrome.<br><br>This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so deleted requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.1061 |
| Title | WDS-D Xw concept briefing of the Flight Crew |
| Requirement | The Flight Crew shall be made aware of the potential application of the WDS-D Xw concept reduced separation at an aerodrome through the Flight Crew briefing material and the AIP for the aerodrome. |
| Status | <deleted> |
| Rationale | The Flight Crew shall be informed of when the WDS-D Xw concept reduced wake separations may be applied at an aerodrome.<br><br>From the feedback from the Heathrow Tower Controllers involved in the preparation and execution of the RTS5 validation exercise and from feedback from the Airspace User representatives at the RTS5 visitor day there is no requirement for notification from the Tower ATC to the Flight Crew. There is just a need for the Flight Crew to be aware that the WDS-D Xw reduced wake separation may be applied through the AIP and the Flight Crew briefing material for the Aerodrome.<br><br>This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so deleted requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0062 |
| Title | WDS-D Xw concept controller workload |
| Requirement | The workload changes caused by the WDS-D Xw concept operation shall not negatively impact Controllers' performances. |
| Status | <deleted> |
| Rationale | The WDS-D Xw concept operation shall improve and/or not change the Controller performance.<br><br>This is an HP argument statement against which evidence needs to be provided, rather than a requirement. Deleted as a requirement. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Monitor separation on initial departure path<br><br>Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0063 |
| Title | WDS-D Xw concept de-activation notification to the Flight Crew |
| Requirement | The Flight Crew shall be notified when the WDS-D Xw concept application of the wake separation reduction is de-activated. |
| Status | <deleted> |
| Rationale | The Flight Crew has to be informed by Tower ATC when the WDS-D Xw concept application of the wake separation reduction is de-activated.<br><br>From the feedback from the Heathrow Tower Controllers involved in the preparation and execution of the RTS5 validation exercise and from feedback from the Airspace User representatives at the RTS5 visitor day there is no requirement for notification from the Tower ATC to the Flight Crew. There is just a need for the Flight Crew to be aware that the WDS-D Xw reduced wake separation may be applied through the AIP and the Flight Crew briefing material for the Aerodrome.<br><br>This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so deleted this requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is no longer to be applied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0064 |
| Title | WDS-D Xw concept tower runway controller monitoring |
| Requirement | The Tower Runway Controller shall be able to monitor the lead aircraft speed and receive alerting messages in case of deviation of the lead aircraft from the anticipated initial climb airspeed profile. |
| Status | <deleted> |
| Rationale | To give the Controller awareness of any deviation of the lead aircraft airspeed profile when applying the distance-based WDS-D Xw concept.<br><br>More generally this also applies to the distance-based separation deliver for standard wake separation rules such as ICAO, RECAT-EU and RECAT-EU-PWS.<br><br>Controller feedback in the ECTL validation exercises indicated that from their perspective this requirement is not feasible. As a result this requirement is deleted. |
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0065 |
| Title | WDS-D Tw concept applicability |
| Requirement | The Tower Runway Controller shall have the possibility to apply WDS-D Tw concept wake separation reductions only if the total wind (wind speed no matter the direction) at the aerodrome runway surface is equal or greater than a defined wind speed threshold. |
| Status | <deleted> |
| Rationale | The Controller shall be presented with the possibility to apply WDS-D Tw concept wake separation reductions only when wind speed conditions are met.<br><br>No work has been conducted in PJ.02-01-06 to develop the WDS-Tw concept and to validate this requirement. As a consequence this requirement is deleted. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0066 |
| Title | WDS-D Xw concept wake separation reduction application |
| Requirement | The Tower Runway Controller shall be advised when to apply the WDS-D Xw concept reduced wake separation. |
| Status | <deleted> |
| Rationale | To give the Controller awareness of when to apply the WDS-D Xw reduced wake separation.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Delete this requirement. |

| | |
|---|---|
| Category | <Operational>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0067 |
| Title | WDS-D Xw concept wind threshold |
| Requirement | The WDS-D Xw concept wind threshold shall be based on locally considering specificities of local traffic aircraft performance in the local weather conditions over the local straight-out common initial departure paths. |
| Status | <validated> |

| | |
|---|---|
| Rationale | Part II SAR SR#D45 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met and SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path.<br><br>The wind threshold for the WDS-D Xw concept needs to be based on consideration of the local traffic aircraft performance in the local weather conditions over the local straight-out initial common departure paths.<br><br>Local variation on the extent of the straight-out common initial departure paths and the aircraft performance over the straight-out initial departure paths will be dependent on local procedures and the variations in the stability of the crosswind conditions due to the local influences on the wind conditions.<br><br>This is a local V4 maturity development and validation activity. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Apply WDS-D to Departures<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0068 |
| Title | WDS-D Xw concept runway controller responsibilities |
| Requirement | The Tower Runway Controller shall be able to:<br>- confirm the WT separation suspension remains applicable between the departure aircraft<br>- ensure the effective application of the WDS-D Xw concept reduced wake separation<br>- verify the departing aircraft sequence |
| Status | <deleted> |

| | |
|---|---|
| Rationale | To enable consistent and accurate delivery and monitoring of the WDS-D Xw concept reduced wake separation.<br><br>For the SESAR 2020 WDS-D Xw concept there is no longer a need to confirm the separation suspension remains applicable as this is automatically managed by the WDS-D tool support. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031.<br><br>The effective application of the WDS-D Xw concept reduced separation is achieved though the consistent use of the NBAT and Countdown Timer for the "airborne time" separation procedures. This is already addressed by the associated safety requirements.<br><br>The assurance of the integrity of the departure sequence order provided to the Enhanced OSD tool is addressed by requirement REQ-02.01-SPRINTEROP-DEP3.0008.<br><br>This requirement is covered by other requirements so deleted this requirement. |
| Category | <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| Identifier | REQ-02.01-SPRINTEROP-DEP2.0069 |
|---|---|
| Title | WDS-D Xw concept application of standard separation |
| Requirement | The Tower Runway Controller shall apply standard separation when WDS-D Xw concept wind conditions criteria are not satisfied. |
| Status | <deleted> |
| Rationale | When the wind conditions do not satisfy the WDS-D Xw concept wind conditions criteria threshold standard separation has to be applied. Standard separation is anticipated to be RECAT-EU-PWS but may be RECAT-EU or ICAO if RECAT-EU-PWS has not yet been deployed.<br><br>This requirement is already covered or implied by REQ-02.01-SPRINTEROP-DEP2.0018, so deleted this requirement. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Apply WDS-D to Departures<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| Identifier | REQ-02.01-SPRINTEROP-DEP2.0070 |
|---|---|
| Title | WDS-D Xw concept to standard separation transition |

| | |
|---|---|
| Requirement | The Tower Runway Controller shall have the possibility to invoke the transition from applying WDS-D Xw concept wake separation reductions to applying standard wake separations. |
| Status | <validated> |
| Rationale | Part II SAR SR#D46 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br><br>There are situations where the Tower Runway Controller may need to invoke the switch from applying WDS-D Xw concept wake separation reductions to applying standard wake separations, for example in periods of weather avoidance or intruder traffic which impact on the straight-out initial common departure path. In such situations the Tower Runway Controller requires the possibility to invoke the transition to applying standard wake separations either in coordination with the Tower Supervisor or directly without coordination depending on local procedures.<br><br>It is not envisaged that the Tower Runway Controller requires the possibility to independently invoke the transition from applying standard wake separations to applying WDS-D Xw concept wake separation reductions without coordination with the Tower Supervisor. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0071 |
| Title | WDS-D Xw concept system interface |



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|---|---|
| Requirement | The users of the WDS-D system shall access it through a human-machine interface integrated into their working environment. The interface will be developed on purpose for WDS-D or will result from an upgrade of the current interfaces. The WDS-D system interface shall display information about:<br>1. Wind forecast<br>2. Applicability of WDS-D Xw concept reduced wake separation<br>3. Departure planning<br>These items will be displayed together or separately. |
| Status | <deleted> |
| Rationale | To satisfy the associated operational requirements and user requirements.<br><br>From NATS RTS5 it appears that the Tower Runway Controller requires the display of the runway surface crosswind speed with the implied Controller Go authorisation status when the WDS-D Xw reduced wake separations have been authorised to be employed.<br><br>It is a local issue to determine the responsibilities for the Controller Go/No-Go status authorisation of the employment of the WDS-D Xw reduced separations and the associated system support with respect to the displaying of the current and possibly forecast crosswind conditions and the associated Supervisor Go/No-Go status of whether the wind conditions are suitable.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <System>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0072 |
| Title | WDS-D Xw concept wind forecast |
| Requirement | The WDS-D system shall display the following information:<br>1. Current and forecast wind speed and direction<br>2. Current and forecast crosswind conditions for each runway direction<br>3. At different positions and altitudes encompassing the initial climb phase area |
| Status | <deleted> |
| Rationale | To satisfy the associated operational requirements and user requirements.<br><br>It is a local issue to establish the current and forecast wind conditions display requirements.<br><br>The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement. |
| Category | <Operational>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0073 |
| Title | WTE risk for WDS-D Tw concept minima |
| Requirement | The probability per departure of wake turbulence encounter of a given severity for a given traffic pair spaced at WDS Total wind minima on Initial Common Departure path or any applicable total wind conditions shall not increase compared to the same traffic pair spaced at reference minima in reasonable worst case conditions. |

| | |
|---|---|
| Status | <deleted> |
| Rationale | There should be no increase in the risk of wake turbulence encounter on the Initial Common Departure path related to the correct application of the WT scheme under consideration.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements.<br><br>Note that the WDS-D Tw concept has not been developed and validated in PJ.02-01-06 so delete this requirement. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0074 |
| Title | WDS-D Xw concept wake turbulence advisory |
| Requirement | The WDS-D system shall indicate for each runway direction whether wind conditions allow the application of WDS-D Xw concept reduced wake separations, in the form of a Go/No-Go information, taking into account standard aircraft wake turbulence categories and pre-defined departure profiles. |
| Status | <deleted> |

| | |
|---|---|
| Rationale | To satisfy the associated operational requirements and user requirements.<br><br>It is a local issue to establish the Supervisor Go/No-Go status and Controller Go/No-Go status display requirements.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <System>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0075 |
| Title | WTE risk for WDS-D Xw concept minima |
| Requirement | The probability per departure of wake turbulence encounter of a given severity for a given traffic pair spaced at a WDS-D Xw reduced wake separation on the straight-out initial common departure path for any applicable cross wind conditions shall not increase compared to the same traffic pair spaced at reference minima in reasonable worst case conditions. |
| Status | <deleted> |



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|---|---|
| Rationale | There should be no increase in the risk of wake turbulence encounter on the Initial Common Departure path related to the correct application of the WT scheme under consideration.<br><br>This is a SAC and so is to be deleted and replaced by the associated safety requirements. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Monitor for aircraft becoming airborne and record Airborne Time<br><br>Monitor separation on initial departure path<br><br>Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Stop Applying WDS-D to Departures<br><br>Inform operational actors that WDS-D is to be applied or changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0076 |
| Title | WDS-D Xw concept definition |
| Requirement | The WDS-D Xw concept shall apply weather dependent wake turbulence separation rules for departures, over the straight-out initial common departure path until aircraft diverge on to wake independent paths after the first SID turn, defined as minimum crosswind condition with an associated time separation minimum and associated SID pair constraints to be defined locally. |



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|---|---|
| Status | <validated> |
| Rationale | Part II SAR SR#D47 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br><br>The WDS-D Xw concept shall apply weather dependent wake turbulence separation rules for departures, over the straight-out initial common departure path until aircraft diverge onto wake independent paths after the first SID turn, defined as minimum crosswind condition with an associated time separation minimum and associated SID pair constraints to be defined locally.<br><br>Validated in NATS RTS5 for the "airborne time" separation procedures. |
| Category | <Safety>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Monitor for aircraft becoming airborne and record Airborne Time<br><br>Monitor separation on initial departure path<br><br>Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0077 |

| | |
|---|---|
| Title | WDS-D Xw concept applicability |
| Requirement | The Tower Supervisor shall be notified when the WDS-D Xw concept wake separation reduction is applicable. |
| Status | <deleted> |
| Rationale | The Tower Supervisor shall be able to recognize when the WDS-D Xw concept wake separation reduction conditions are met.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0078 |
| Title | WDS-D Xw concept wake separation rules |
| Requirement | WDS-D Xw concept wake separation rules shall be provided to the Enhanced OSD tool. |
| Status | <validated> |

| | |
|---|---|
| Rationale | Part II SAR SR#D38 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D).<br><br>WDS-D Xw concept wake separation rules shall be provided to the Enhanced OSD tool. This was validated in NATS RTS5.<br><br>This is a system requirement and so an associated requirement should be in the TS/IRS. |
| Category | <Operational>, <System>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0079 |
| Title | WDS-D Xw concept not applicable |
| Requirement | The Tower Supervisor shall be notified when the WDS-D Xw concept wake separation reduction is not applicable. |
| Status | <deleted> |

| | |
|---|---|
| Rationale | The Tower Supervisor shall be able to recognize when the WDS-D Xw concept wake separation reduction conditions are not met.<br><br>De-authorisation responsibility supported by automatic transition when busy with other activities.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0080 |
| Title | WDS-D Xw concept wind condition monitoring |
| Requirement | Tower ATC shall be able to monitor the wind conditions applicable to the WDS-D Xw concept. |
| Status | <deleted> |
| Rationale | Tower ATC shall be provided with wind speed and direction information applicable to the WDS-D Xw concept.<br><br>The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]



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| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed |

[REQ]

| Identifier | REQ-02.01-SPRINTEROP-DEP2.0081 |
|---|---|
| Title | WDS-D Xw concept no negative impact on safety |
| Requirement | WDS-D Xw concept application shall not have a negative impact on safety. |
| Status | <deleted> |
| Rationale | WDS-D Xw concept application shall not have a negative impact on safety.<br><br>This is a performance requirement to facilitate traceability to the associated safety validation objectives. However this is a safety objective rather than a requirement, and there are several safety requirements to facilitate traceability to the safety validation objectives, so this requirement is deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures<br><br>Determine Wake Separation Distance to preceding aircraft<br><br>Determine Wake Separation Time to preceding aircraft and associated Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0082 |
| Title | WDS-D Xw concept wind forecast information to the end user |
| Requirement | Wind forecast information shall be provided to the users so as to support the planning and execution of the WDS-D Xw concept operations. |
| Status | <deleted> |
| Rationale | Wind forecast information shall be provided to the users so as to support the planning and execution of the WDS-D Xw concept operations.<br><br>The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement. |
| Category | <System>, <Human Performance>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0083 |
| Title | WDS-D Xw concept departure planning system support |
| Requirement | The WDS-D system shall maintain up-to-date and display to the users using an appropriate HMI:<br>- for each departing aircraft:<br>- aircraft type and wake turbulence category<br>- designated runway, SID and the initial cleared flight level<br>- ICAO Flight Plan information<br>- for each planned set of departing aircraft<br>- available upwind - downwind SIDs<br>- advisory on optimum take-off sequence |
| Status | <deleted> |
| Rationale | To satisfy the associated operational requirements and user requirements.<br><br>Departure planning is now supported by the A-CDM/D-MAN system support for managing optimising the departure sequence and managing the TOBT and TSAT for each departure aircraft.<br><br>Flight plan information is now displayed on the departure aircraft FDE (flight data entry) in the electronic environment of the controller.<br><br>WDS-D Xw concept planning system support is covered by REQ-02.01-SPRINTEROP-DEP2.0029 so deleted this requirement. |
| Category | <System>, <Operational> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine next aircraft to be given a line-up clearance<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0084 |

| | |
|---|---|
| Title | Flight Crew training on awareness for accurate track keeping after departure for WDS-D Xw concept |
| Requirement | Flight Crew shall be provided with adequate training to enable awareness for accurate track keeping after departure. |
| Status | <validated> |
| Rationale | Part II SAR SR#D06 in relation to the Hazard: Aircraft deviates from planned trajectory. This is in the context of the WDS-D Xw concept and SO#D11: Not to increase the possibility of wake encounter on departure due to lateral deviation from the common initial departure path. (Only applicable to WDS-D Xw).<br><br>Validated in HP-SAF workshop. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Aircraft rotates and becomes airborne<br><br>Monitor separation on initial departure path |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0085 |
| Title | Ensuring the application of the WDS-D pre-defined parameters |
| Requirement | Tower controllers shall only apply WDS-D reduced wake separations when the pre-defined weather parameters are met. |
| Status | <validated> |
| Rationale | Part II SAR SR#D39 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br><br>Validated in NATS RTS5. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br>Determine whether and how the application of WDS-D is to be changed<br>Inform operational actors that WDS-D is no longer to be applied<br>Inform operational actors that WDS-D is to be applied or changed<br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0086 |
| Title | Informing Tower ATC when WDS-D parameters are met |
| Requirement | The WDS-D Tool shall inform Tower ATC when the defined weather parameters are met. |
| Status | <validated> |
| Rationale | Part II SAR SR#D40 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br>Validated in NATS RTS5. |
| Category | <Safety>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br>Determine whether and how the application of WDS-D is to be changed<br>Inform operational actors that WDS-D is no longer to be applied<br>Inform operational actors that WDS-D is to be applied or changed<br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0087 |
| Title | Supporting authorisation of the application of WDS-D reduced wake separations |
| Requirement | The WDS-D Tool shall support the procedures for authorising the application of the WDS-D reduced wake separations. |
| Status | <validated> |
| Rationale | Part II SAR SR#D41 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br><br>Validated in NATS RTS5. |
| Category | <Safety>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures<br><br>Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is no longer to be applied<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Stop Applying WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0088 |
| Title | Supporting automatic de-authorisation of the application of WDS-D reduced wake separations |
| Requirement | The WDS-D Tool shall support automatic de-authorisation of the application of the WDS-D reduced wake separation when the wind conditions change such that the pre-defined weather parameters are no longer met. |
| Status | <validated> |
| Rationale | Part II SAR SR#D42 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met.<br><br>Validated in NATS RTS5. |
| Category | <Safety>. , <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0089 |
| Title | Applying SID constraints for WDS-D Xw concept |
| Requirement | ATCOs shall only apply WDS-D Xw reduced wake separation when the follower aircraft departure SID is upwind of all applicable preceding aircraft departure SIDs (e.g. this may be also to the second preceding departure aircraft in the case of an A380 – Light – Light departure sequence). |
| Status | <validated> |
| Rationale | Part II SAR SR#D50 in relation to the SO#D04: Ensure the application of WDS-D only when pre-defined SID/Route combinations are met.<br><br>Validated in NATS RTS5. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0090 |
| Title | Monitoring the conformance of the flight path of the departure aircraft when applying a WDS-D reduced wake separation |
| Requirement | ATCOs shall monitor the conformance of the flight path of the departing aircraft along the initial common departure path (when WDS-D Xw reduced separation is being applied). |
| Status | <validated> |
| Rationale | Part II SAR SR#D51 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path and SO#D011: Not to increase the possibility of wake encounter on departure due to lateral deviation from the common initial departure path. (Only applicable to WDS-D Xw) and SO#D15: Provision of wake vortex warning(s) when crosswind transport is not assured due to divergence of either the preceding, or follower, aircraft from the straight-out initial common departure path.<br><br>Validated in SAF & HP workshop. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0091 |
| Title | ATCO training on safe intervention instructions to the departure aircraft with WDS-D Xw concept |
| Requirement | ATCOs shall be trained to issue safe intervention instructions to departure aircraft that will minimise the possibility of the follower departure aircraft encountering the wake generated by the preceding departure aircraft when a WDS-D Xw reduced wake separation is being applied. |
| Status | <validated> |
| Rationale | Part II SAR SR#D71 in relation to the SO#D12: Ensure wake turbulence separation between departing aircraft and an aircraft executing a go-around/missed approach.<br><br>Validated in SAF & HP workshop. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Apply WDS-D to Departures |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0092 |
| Title | System support for monitoring for departure aircraft lateral navigation divergence with WDS-D Xw concept |
| Requirement | System support shall be provided to monitor and provide a warning when there is divergence of either the preceding, or follower, aircraft from the straight-out initial common departure path when a WDS-D Xw reduced separation is being applied. |
| Status | <validated> |
| Rationale | Part II SAR SR#D72 in relation to the SO#D15: Provision of wake vortex warning(s) when crosswind transport is not assured due to divergence of either the preceding, or follower, aircraft from the straight-out initial common departure path.<br><br>Validated in SAF & HP workshop. |
| Category | <System>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0093 |
| Title | Positioning of the displayed crosswind speed |
| Requirement | The crosswind speed shall be positioned in the centre of/within the regular scanning pattern of the controller. |
| Status | <validated> |
| Rationale | In RTS5, the runway surface crosswind speed was displayed on the ADIS screen and perceived as on the periphery of controller scanning.<br><br>It was recommended that the displayed crosswind speed should be positioned closer to the centre of controller view and closer to the countdown timer. |

| | |
|---|---|
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine whether and how the application of WDS-D is to be changed<br><br>Inform operational actors that WDS-D is to be applied or changed<br><br>Inform operational actors that WDS-D is no longer to be applied |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP2.0094 |
| Title | Phraseology for WDS-D |
| Requirement | Phraseology that accommodates the use of WDS-D shall be designed. |
| Status | <validated> |
| Rationale | RTS5 employed phraseology in the WDS-D validation exercise for informing the flight crew of when a WDS-D Xw reduced wake separation was being applied to the preceding departure aircraft.<br><br>The take-off clearance phraseology incorporated the addition of the runway surface cross wind speed so as to inform the flight crew.<br><br>The feedback from the controllers is that they would expect the flight crew to be prepared and aware of when a WDS-D Xw reduced wake separation could be applied without the need for informing of the runway surface crosswind speed. |
| Category | <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0001 |
| Title | OSD capacity requirements |
| Requirement | The use of OSD shall increase runway throughput with respect to RECAT-EU or locally deployed static wake separation scheme without tool support. |
| Status | <deleted> |
| Rationale | The use of OSD shall increase runway throughput with respect to RECAT-EU or locally deployed static wake separation scheme without tool support.<br><br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br><br>Validated in NATS RTS5 with respect to RECAT-EU and the time-based "airborne time" separation procedures.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD capacity requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0002 |
| Title | Integrity assurance of the input data provided to the OSD (aircraft type and wake category) |
| Requirement | ATCOs shall be trained to ensure the integrity of the aircraft type and wake category information. |
| Status | <validated> |
| Rationale | Part II SAR SR#D10 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This is with respect to the procedures for checking and if needed correcting the aircraft type of the aircraft in the flight plan data (on the FDE) at the start-up of the flight. The aircraft type and wake category may be checked and amended by any of the Tower ATC roles.<br><br>This will need to be supported by the associated system propagation of any corrections to the OSD tool. This is to ensure that high integrity aircraft type and wake category information is provided to the OSD tool. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0003 |
| Title | Provision of Aircraft Type and RECAT-EU Wake Turbulence Category to the OSD tool. |
| Requirement | The tool shall be provided with the Aircraft Type and RECAT-EU Wake Turbulence Category of each departure aircraft. |

| | |
|---|---|
| Status | <validated> |
| Rationale | Part II SAR SR#D09 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This includes subsequent updates to this information for new aircraft types. This is with respect to the maintenance of the tool to accommodate new aircraft types.<br><br>This is a system requirement and so should be in the TS/IRS.<br><br>Validated in NATS RTS5 with respect to inputs to the industry prototype OSD tool provided by Indra for the "airborne time" separation procedures. |
| Category | <Operational>, <Safety>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0004 |
| Title | OSD predictability requirements |
| Requirement | The use of OSD shall decrease departure ground delay with respect to RECAT-EU or locally deployed static wake separation scheme without tool support. |
| Status | <deleted> |

| | |
|---|---|
| Rationale | The use of OSD shall decrease departure ground delay with respect to RECAT-EU or locally deployed static wake separation scheme without tool support.<br><br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br><br>Validated in NATS RTS5 with respect to RECAT-EU and the "airborne time" separation procedures.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD predictability requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Distance to preceding aircraft<br><br>Determine next aircraft to be given a line-up clearance<br><br>Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine the most restrictive Time satisfying Wake Separation or SID Separation<br><br>Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine earliest take-off clearance time taking into account any other separation<br><br>Formulate optimised sequence order for departing aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0005 |
| Title | Integrity assurance of the input data to OSD (aircraft SID) |



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|---|---|
| Requirement | The Tower ATCOs shall be trained to ensure the integrity of the aircraft SID information. |
| Status | <validated> |
| Rationale | Part II SAR SR#D14 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This is with respect to the procedures for changing the aircraft SID of the aircraft in the flight plan data (on the FDE). The SID information may be updated by any of the Tower ATC roles.<br><br>A study of STAR reports for individual airfields is recommended to inform whether there are any gaps in the robustness of the SID information within transmissions. I.e. whether Human error or any other type of error is leading to pilots misunderstanding the SID or to an incorrect SID being issued by ATC. Frequency of these errors will likely not increase in WDS-D, however consequences might be more serious due to reduced separation.<br><br>This will need to be supported by the associated system propagation of any corrections to the OSD tool. This is to ensure that high integrity aircraft SID information is provided to the OSD tool. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0006 |
| Title | OSD fuel efficiency requirements |
| Requirement | The use of OSD shall decrease ground departure fuel burn with respect to RECAT-EU or locally deployed static wake separation scheme without tool support. |

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|---|---|
| Status | <deleted> |
| Rationale | The use of OSD shall decrease ground departure fuel burn with respect to RECAT-EU or locally deployed static wake separation scheme without tool support.<br>This is a performance requirement to facilitate traceability to the associated validation objectives.<br>Validated in NATS RTS5 with respect to RECAT-EU and the "airborne time" separation procedures.<br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD fuel efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0007 |
| Title | Integrity assurance of the input data to OSD (entry taxiway line-up position) |
| Requirement | The Tower Runway Controller shall be trained to ensure the integrity of the entry taxiway line-up position information of each departure aircraft. |
| Status | <validated> |

| | |
|---|---|
| Rationale | Part II SAR SR#D12 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircrafts and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This is with respect to ensuring that the ATCO adds the entry taxiway position to the FDE by the time they give the line-up clearance and the FDE is moved to the runway bay.<br><br>This will need to be supported by the associated system propagation to the OSD tool. This is to ensure that high integrity entry taxiway line-up position information is provided to the OSD tool. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0008 |
| Title | Integrity & stability assurance of departure sequence provided to the OSD |
| Requirement | The Tower Runway Controller shall be trained to ensure the integrity and stability of the departure sequence information. |
| Status | <validated> |

| | |
|---|---|
| Rationale | Part II SAR SR#D08 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This is with respect to ensuring that the ATCO always reflects the intended departure sequence take-off order in the electronic environment. With EFPS this is the order of the FDEs in the runway bay.<br><br>This will need to be supported by the associated system propagation to the OSD tool. This is to ensure that high integrity intended departure sequence take-off order information is provided to the OSD tool.<br><br>In NATS RTS5 there were limitations in the EFPS support which exposed the safety consequences of not providing the intended departure sequence take-off order to the OSD tool. The EFPS support was not able to inform the OSD tool of when an FDE was moved to the runway bay ahead of a departure aircraft already in the runway bay or to inform the OSD tool when the FDE order in the runway bay was changed. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0009 |
| Title | Consistency assurance of airborne time provided to OSD |
| Requirement | The Tower Runway Controller shall be trained to ensure the consistency of the airborne time information. |
| Status | <validated> |

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|---|---|
| Rationale | Part II SAR SR#D16 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This is with respect to ensuring the Tower Runway Controller consistently observes and invokes the actions to record the airborne time that is provided to the OSD tool when no automatic means of identifying and recording this time is supported (REQ-02.01-SPRINTEROP-DEP0.0009).<br><br>Consistency is recording the airborne time of when the back wheels lift from the ground (rather than when the aircraft starts to rotate when the front wheels begin to lift from the ground), or just after the back wheels have lifted from the ground, so as to ensure that the OSD tool calculates an NBAT for the next departure aircraft that will result in the required wake separation time being delivered.<br><br>It is accepted that the Tower Runway Controller may be busy with other tasks and may occasionally be late in invoking the actions to record the airborne time. In these instances the OSD tool will calculate a NBAT for the next departure aircraft with the additional time from being late in invoking the recording of the airborne time. If the Tower Runway Controller then takes this into account when using the NBAT and associated countdown timer by providing an earlier clearance to take-off to the next departure aircraft than would normally be the case against the countdown time this could then have an impact on the system support for monitoring the delivered time separation ((REQ-02.01-SPRINTEROP-DEP0.1002). This could also induce a risk of under-separation delivery if the controller over-estimates how late they were in invoking the actions to record the airborne time. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0010 |
| Title | OSD usage no negative impact on human performance |
| Requirement | OSD usage shall not have negative impact on human performance. |
| Status | <deleted> |
| Rationale | OSD usage shall not have negative impact on human performance<br><br>This is a performance requirement to facilitate traceability to the associated HP validation objectives. However this is an HP objective rather than a requirement, and there are several HP requirements to facilitate traceability to the HP validation objectives, so this requirement is deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0011 |
| Title | Integrity & consistency assurance of start of take-off roll time used by the OSD |
| Requirement | The Tower Runway Controller shall be trained to ensure the integrity and consistency of the start of take-off roll time information. |
| Status | <validated> |

| | |
|---|---|
| Rationale | Part II SAR SR#D25 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This is with respect to ensuring the Tower Runway Controller consistently observes and invokes the actions to record the start of take-off roll time that is provided to the OSD tool when no automatic means of identifying and recording this time is supported (REQ-02.01-SPRINTEROP-DEP0.1009).<br><br>Consistency is recording the start of take-off roll time when the departure aircraft is beyond the line-up position and just meets the minimum roll ground speed criteria so as to ensure that the OSD tool calculates an NBTOT for the next departure aircraft that will result in required wake separation time being delivered.<br><br>It is accepted that the Tower Runway Controller may be busy with other tasks and may occasionally be late in invoking the actions to record the start of take-off roll time. In these instances the OSD tool will calculate a NBTOT for the next departure aircraft with the additional time from being late in invoking the recording of the start of take-off roll time. If the Tower Runway Controller then takes this into account when using the NBTOT and associated countdown timer by providing an earlier clearance to take-off to the next departure aircraft than would normally be the case against the countdown time this could then have an impact on the system support for monitoring the delivered time separation ((REQ-02.01-SPRINTEROP-DEP0.1002). This could also induce a risk of under-separation delivery if the controller over-estimates how late they were in invoking the actions to record the start of take-off roll time. |
| Category | <Safety>, <Human Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Role> | Tower Runway Controller (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0012 |
| Title | OSD cost efficiency requirement |
| Requirement | OSD usage shall have a positive return on investments. |
| Status | <deleted> |
| Rationale | OSD usage shall have a positive return on investments.<br><br>To be validated in the CBA.<br><br>ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD cost efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted. |
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0013 |
| Title | Provision of wind profile information to the OSD tool for supporting distance-based separation |
| Requirement | When required to support distance-based separation the OSD tool shall be provided with wind profile information over the departure SID routes out to the maximum distance-based separation that is required to be supported. |
| Status | <validated> |

| | |
|---|---|
| Rationale | To calculate the position of the Dynamic Departure Indicator - Distance (DDI-D) the OSD tool needs to take into account the airspeed profile and climb profile and the associated ground speed impact of the prevailing wind profile over the departure SID route of the lead aircraft out to the required distance-based separation from the anticipated initial airborne position of the follower aircraft. This is so as to calculate the distance the lead aircraft is anticipated to fly over the time the follower aircraft is anticipated to take to become airborne after being given the clearance to take-off. This distance is subtracted from the required wake separation distance to establish the position of where to display the DDI-D. The DDI-D is the position the lead aircraft needs to reach before the Tower Runway Controller should issue the clearance to take-off in order to satisfy the required separation when the follower aircraft becomes airborne.<br><br>Validated in ECTL RTS4b. |
| Category | <Operational>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0014 |
| Title | OSD usage no negative impact on safety |
| Requirement | OSD usage shall not have a negative impact on safety. |
| Status | <deleted> |
| Rationale | OSD usage shall not have a negative impact on safety.<br><br>This is a performance requirement to facilitate traceability to the associated safety validation objectives. However this is a safety objective rather than a requirement, and there are several safety requirements to facilitate traceability to the safety validation objectives, so this requirement is deleted. |

| | |
|---|---|
| Category | <Performance> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0015 |
| Title | Provision of airspeed profile and climb profile information to the OSD tool for supporting distance-based separation |
| Requirement | The OSD Tool shall be configured with the accurate airspeed and climb profiles of each aircraft type over the SID routes from each departure runway out to the maximum wake separation distance from the rotation positions of the follower aircraft types (to determine the DDI-D position for distance-based separation procedures). |
| Status | <validated> |
| Rationale | Part II SAR SR#D26 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>To calculate the position of the Dynamic Departure Indicator - Distance (DDI-D) the OSD tool needs to take into account the airspeed profile and climb profile and associated ground speed impact of the prevailing wind profile over the departure SID route of the lead aircraft out to the required distance-based separation from the anticipated initial airborne position of the follower aircraft. This is so as to calculate the distance the lead aircraft is anticipated to fly over the time the follower aircraft is anticipated to take to become airborne after being given the clearance to take-off. This distance is subtracted from the required wake separation distance to establish the position of where to display the DDI-D. The DDI-D is the position the lead aircraft needs to reach before the Tower Runway Controller should issue the clearance to take-off in order to satisfy the required separation when the follower aircraft becomes airborne.<br><br>Validated in ECTL RTS4b. |
| Category | <Operational>, <Safety>, <System> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

| | | |
|---|---|---|
| <ALLOCATED_TO> | <Activity> | Determine SID Separation Distance to each relevant preceding aircraft<br><br>Determine the most restrictive Wake Separation or SID Separation Distance<br><br>Determine preceding aircraft earliest distance position taking into account any other separation |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0016 |
| Title | Provision of take-off roll time and rotation position information to the OSD tool for supporting distance-based separation |
| Requirement | The OSD Tool shall be configured with the accurate roll time and rotation position of each aircraft type for each departure runway and line-up position (to determine the DDI-D position for distance-based separation procedures). |
| Status | <validated> |
| Rationale | Part II SAR SR#D22 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>To calculate the position of the Dynamic Departure Indicator - Distance (DDI-D) the OSD tool needs to take into account the roll time and rotation position of the follower departure aircraft to be issued with the take-off clearance. This is so as to calculate the distance the lead aircraft is anticipated to fly over the time the follower aircraft is anticipated to take to become airborne after being given the clearance to take-off. This distance is subtracted from the required wake separation distance from the anticipated rotation position (initial airborne position) of the follower departure aircraft to establish the position of where to display the DDI-D. The DDI-D is the position the lead aircraft needs to reach before the Tower Runway Controller should issue the clearance to take-off in order to satisfy the required separation when the follower aircraft becomes airborne.<br><br>Validated in ECTL RTS4b. |
| Category | <Operational>, <Safety>, <System> |



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[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0017 |
| Title | OSD tool assurance/integrity |
| Requirement | OSD tool assurance/integrity shall be set to a level, as appropriate for total ATCO dependence, to ensure, all applicable separations on departure (e.g. as required for the assurance of radar equipment). |
| Status | <validated> |
| Rationale | Part II SAR SR#D01 in relation to the Hazard: ATCO issues premature take-off clearance regarding wake separation.<br><br>In the Post RTS5 workshop it was established that when the OSD tool is in use, controllers will rely on it to a high extent, therefore the safety assurance of the OSD tool is necessary.<br><br>Through stakeholder engagement airspace users can be informed of the assurance of the separation service provided with the OSD tool support. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0018 |
| Title | Provision of intended take-off order of the departure aircraft to the OSD tool |
| Requirement | The tool shall be provided with the intended take-off order of the departure aircraft. |
| Status | <validated> |
| Rationale | Part II SAR SR#D07 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>Validated in NATS RTS5. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0019 |
| Title | Provision of line-up position to the OSD tool |
| Requirement | The tool shall be provided with the accurate line-up position of each departure aircraft (to allow for automatically adding the 60s for intermediate position line-up). |
| Status | <validated> |
| Rationale | Part II SAR SR#D11 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>Validated in NATS RTS5. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0020 |
| Title | Provision of SID to the OSD tool |
| Requirement | The tool shall be provided with the SID for each departure aircraft (for WDS-D and distance-based). |
| Status | <validated> |
| Rationale | Part II SAR SR#D13 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>Validated in NATS RTS5. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |



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[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0021 |
| Title | Provision of airborne time to the OSD tool |
| Requirement | The tool shall be provided with the accurate airborne time of each departing aircraft (for airborne time procedures). |
| Status | <validated> |
| Rationale | Part II SAR SR#D15 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>Validated in NATS RTS5. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0022 |
| Title | Provision of wind profile information to the WDS-D tool |
| Requirement | The tool shall be provided with accurate and reliable wind measurements at the rotation positions on the runway surface and aloft along the common straight-out initial departure path (for WDS-D). |
| Status | <validated> |
| Rationale | Part II SAR SR#D17 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>Validated in NATS RTS5. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0023 |
| Title | Consideration of staleness criteria for the wind profile information by the WDS-D tool |
| Requirement | The tool shall take into account staleness criteria with respect to the wind information and the timely suspension of applying associated reduced wake separations (for WDS-D). |
| Status | <validated> |
| Rationale | Part II SAR SR#D18 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0024 |
| Title | Software assurance level for the OSD tool |
| Requirement | The software assurance level of the tool shall be such that ATCOs may justifiably be reliant on the wake separation information provided by the tool facilitating the provision of the wake turbulence separation between each successive departure. |
| Status | <validated> |
| Rationale | Part II SAR SR#D19 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>Airline representatives need to be included in the future assurance activities. Airline representative familiarity of the assurance level of the tool, that ATCOs will use to make wake separation delivery decisions, will improve trust and might also highlight further risks to be addressed. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0025 |
| Title | Accurate display of the wake separation time |
| Requirement | In the case of wake separation time procedures, the wake separation time shall be accurately displayed with respect to indicating the applicable wake separation time interval between each successive departures. |
| Status | <validated> |
| Rationale | Part II SAR SR#D20 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>Validated in NATS RTS5. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine Wake Separation Time to preceding aircraft and associated Time<br><br>Issue take-off clearance and Monitor and Record Roll Time |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0026 |
| Title | Accurate display of the wake separation distance |
| Requirement | In the case of wake separation distance-based procedures, the wake separation distance shall be accurately displayed with respect to indicating the applicable wake separation distance between each successive departure. |
| Status | <validated> |
| Rationale | Part II SAR SR#D21 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>The ECTL RTSs applied wake time based separation procedures (more common in European airports) however the OSD tool validated in RTS4a and RTS4b provided for distance-based separation procedures capability. |
| Category | <Human Performance>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Activity> | Determine preceding aircraft earliest distance position taking into account any other separation<br><br>Determine Wake Separation Distance to preceding aircraft |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0027 |
| Title | Provision of start of take-off roll time to the OSD tool |
| Requirement | The tool shall be provided with the accurate start of take-off roll time of each departing aircraft (for start of take-off roll time procedures). |
| Status | <validated> |



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| | |
|---|---|
| Rationale | Part II SAR SR#D24 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This requirement has been validated in RTS4a and RTS4b. |
| Category | <System>, <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0028 |
| Title | Provision of wind profile to the OSD tool |
| Requirement | The tool shall be provided with accurate and reliable wind measurements along the SID route of each departure runway out to the maximum wake separation distance from the rotation positions of the follower aircraft types (to determine the DDI-D position for distance-based separation procedures). |
| Status | <validated> |
| Rationale | Part II SAR SR#D27 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This requirement has been validated in RTS4a and RTS4b. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

| | | |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0029 |
| Title | Consideration of staleness criteria for the wind profile information by the OSD-D tool |
| Requirement | The tool shall take into account staleness criteria with respect to determining the DDI-D position for distance-based separation procedures. |
| Status | <validated> |
| Rationale | Part II SAR SR#D28 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.<br><br>This requirement has been validated in RTS4a and RTS4b. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0030 |
| Title | Informing the OSD tool of late/tactical changes to the departure sequence |
| Requirement | The OSD Tool shall be informed of late/tactical changes to the departure sequence. |
| Status | <validated> |
| Rationale | Part II SAR SR#D74 in relation to the SO#D16: Maintain the ability of ATCOs to tactically rearrange the departure sequence.<br><br>This requirement has been validated in RTS4a and RTS4b. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-DEP3.0031 |
| Title | OSD tool ensuring the correctness of the information presented to the controller |
| Requirement | The OSD Tool shall ensure the correctness of the wake turbulence separation information presented to the controller when there is a late/tactical change to the departure sequence. |
| Status | <validated> |
| Rationale | Part II SAR SR#D75 in relation to the SO#D16: Maintain the ability of ATCOs to tactically rearrange the departure sequence.<br><br>There is a need to ensure the removal of the stale wake separation information for the old sequence order that no longer applies and the generation and presentation of the wake separation information for the new sequence order. This requirement has been validated in RTS4a and RTS4b. |
| Category | <Safety> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |
| <ALLOCATED_TO> | <Functional Block> | Departure Separation Management (PJ.02-01-06) |

## 4.2 Security Requirements

High level security requirements have been provided by the security experts for PJ.02-01-06.

These have been mapped to the PJ.02-01-06 Solutions through the following application of the requirements identifier fields:

- XXXZ is
  - ALL4 when the security requirement applies to all Concepts Solutions

4.3 SYS3 when the security requirement applies to the three system/software based Concepts Solutions only

The latest consolidated list of high level security requirements has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0001 |
| Title | Security Policy (C2.1) |
| Requirement | The Responsible Organisation shall produce, approve, and adopt a security policy which complies with the Reference ATM Security Policy; this security policy shall be communicated to all relevant parties. Note: it is recommended that this be based upon the principles set out in ISO-270001:2013, or later. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0002 |
| Title | Reviewing Security Policy (C2.2) |

| | |
|---|---|
| Requirement | The Responsible Organisation shall regularly review the security policy and ensure that it remains effective. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0003 |
| Title | Resourcing & Assigning Security Policy Roles (C3.1) |
| Requirement | The Responsible Organisation shall provide the resources needed for information and ATM services security and assign roles and responsibilities for all security management functions. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |



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[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0004 |
| Title | Coordinating Security Controls (C3.2) |
| Requirement | The Responsible Organisation shall ensure that the implementation of information and ATM services security controls is co-ordinated across the organisation. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design.  This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0005 |
| Title | Information Storage and Exchange Means (C3.3) |
| Requirement | Information storage and exchange means shall be defined in accordance with the security value of such information. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0006 |
| Title | Background Security Verification Checks (C4.1) |
| Requirement | Background verification checks on all staff shall be carried out in accordance with relevant laws, regulation, and ethics. The checks shall be proportional to the roles and responsibilities, in particular in respect to the business requirements (e.g. safety-critical function, developments), the protective marking or classification of information to be accessed, and the perceived risks. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0007 |
| Title | Staff Application of Security (C4.2) |
| Requirement | Staff shall apply security in accordance with the established policies and procedures. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0008 |
| Title | Security Awareness Training (C4.3) |
| Requirement | Staff shall receive appropriate awareness training and regular updates in organisational policies and procedures, as relevant for their job function. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0009 |
| Title | Staff Security Procedures (C4.4) |
| Requirement | Staff shall undergo a formal rotation, change, and leaving procedure. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0010 |
| Title | Inventory of Assets (C5.1) |
| Requirement | All assets shall be clearly identified, and an inventory of all important assets drawn up and maintained. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0011 |
| Title | Designated Responsibility (C5.2) |
| Requirement | All information and ATM services associated with information processing facilities shall be 'owned' by a designated responsible individual or role. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0012 |
| Title | Acceptable Use of Asset Policy (C5.3) |
| Requirement | Rules for the acceptable use of assets shall be identified, documented, and implemented. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0013 |
| Title | Security Classification (C5.4) |
| Requirement | All Information and ATM services shall be classified in terms of its value, legal requirements, sensitivity and criticality to ATM, ATM organisations and stakeholders. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0014 |
| Title | Labelling and Handling Procedures (C5.5) |
| Requirement | An appropriate set of procedures for information and ATM services labelling and handling shall be developed and implemented in accordance with the protective marking or classification scheme adopted. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0001 |
| Title | Removable Media Procedures (C5.6) |
| Requirement | There shall be procedures in place for the management of removable media. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0002 |
| Title | Media Disposal Procedures (C5.7) |
| Requirement | Media shall be disposed of securely and safely when no longer required, using formal procedures. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0003 |
| Title | Procedures for Handling and Storage of ATM Information (C5.8) |
| Requirement | Procedures for the handling and storage of ATM information shall be established to protect ATM services and information from unauthorised disclosure or misuse. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0015 |
| Title | Protection of ATM System Documentation (C5.9) |
| Requirement | ATM system documentation shall be protected against unauthorised access. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design.  This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0016 |
| Title | Access Control Policy (C6.1) |
| Requirement | An access control policy shall be established, documented, and reviewed based on business and security requirements for access. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0017 |
| Title | Access Control Procedure (C6.2) |
| Requirement | There shall be an access control procedure in place for granting and revoking access to all information systems and services. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0018 |
| Title | Allocation of Access Privileges (C6.3) |
| Requirement | The allocation of access privileges shall be restricted to users who have been specifically authorised to use ATM facilities, and such privileges should be controlled by a formal management process. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0004 |
| Title | Access Control Policy for Shared ATM Networks (C6.4) |
| Requirement | For shared ATM networks, especially those extending across the Responsible Organisation's boundaries, the capability of users to connect to the network shall be restricted, in accordance with the access control policy and requirements of the operational applications. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design.  This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0005 |
| Title | Utility Programs Policy (C6.5) |
| Requirement | The use of utility programs that might be capable of overriding system and application controls shall be restricted and tightly controlled. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0006 |
| Title | Sensitive Systems Policy (C6.6) |
| Requirement | Sensitive systems shall have a dedicated (protected) computing environment. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0007 |
| Title | External Access Policy (C6.7) |
| Requirement | The Responsible Organisation shall review the security requirements and risks of every external access to information or ATM Services before granting access. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0008 |
| Title | User Security Practices (C6.8) |
| Requirement | User shall be required to follow good security practices in the protection of authentication information or devices. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0009 |
| Title | Unattended Equipment Procedure (C6.9) |
| Requirement | Users shall ensure that unattended equipment has appropriate protection. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0010 |
| Title | Papers, Media and Information Processing Facilities Policy (C6.10) |
| Requirement | A security policy for papers and removable storage media and information processing facilities shall be adopted. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0019 |
| Title | Security Perimeter Policy (C7.1) |
| Requirement | Security perimeters shall be used to protect ATM sensitive areas and ATM processing facilities. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design.  This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0020 |
| Title | Entry Control Policy (C7.2) |
| Requirement | ATM secure areas shall be protected by appropriate entry controls which allow access only to authorised personnel and which detect unauthorised access. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0011 |
| Title | Auxiliary Means Policy (C7.3) |
| Requirement | ATM equipment shall be provided with auxiliary means to compensate for deliberate compromising of power supply, overheating and fire. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0012 |
| Title | ATM Cabling Policy (C7.4) |
| Requirement | ATM cabling shall be protected from deliberate damage, eavesdropping or interference. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| Identifier | REQ-02.01-SPRINTEROP-ALL4.0021 |
| Title | Maintenance and Servicing Policy (C7.5) |
| Requirement | ATM equipment shall be maintained and serviced to ensure their availability and integrity. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0022 |
| Title | Operating ATM Procedures Policy (C8.1) |
| Requirement | Operating ATM procedures shall be documented, maintained, and made available to all users who need to know them. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0023 |
| Title | Change Control Procedures Policy (C8.2) |
| Requirement | Changes to ATM information processing facilities, ATM services and systems shall be controlled. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| Identifier | REQ-02.01-SPRINTEROP-SYS3.0013 |
|---|---|
| Title | ATM Software Controls Policy (C8.3) |
| Requirement | Detection, prevention, and recovery controls to protect ATM software against malicious code and appropriate user awareness procedures shall be implemented. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0014 |
| Title | Back-up Policy (C8.4) |
| Requirement | Backup copies of ATM information and software shall be taken and tested regularly in accordance with an agreed backup policy. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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| Identifier | REQ-02.01-SPRINTEROP-SYS3.0015 |
|---|---|
| Title | Monitoring Procedures (C8.5) |
| Requirement | Procedures for monitoring the use of ATM services and information processing facilities shall be established and the results of the monitoring activities reviewed regularly. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0024 |
| Title | ATM Logging Protection Procedures (C8.6) |
| Requirement | ATM logging facilities and log information shall be protected against tampering and unauthorised access. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0025 |
| Title | Fault Logging and Resolution Procedures (C8.7) |
| Requirement | Faults shall be logged, analysed, and appropriate action taken. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0016 |
| Title | ATM Networks Policy (C9.1) |
| Requirement | ATM Networks shall be adequately managed and controlled, in order to be protected from threats, and to maintain security for the ATM systems and applications using the network, including information in transit. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0017 |
| Title | Formal Exchange Policies (C9.2) |
| Requirement | Formal exchange policies, procedures, and controls shall be in place to protect the exchange of ATM services and information through the use of all types of communication facilities. Agreements shall be established for the exchange of ATM services and information and software between the Responsible Organisation and external parties. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0018 |
| Title | Electronic Messaging Protection Policy (C9.3) |
| Requirement | Information conveyed by electronic messaging shall be appropriately protected. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0026 |
| Title | Security Requirements Policy (C10.1) |
| Requirement | Every specification for new or updated facilities shall include security requirements. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0027 |
| Title | Change Control Approval Policy (C10.2) |
| Requirement | An operational process and plan which controls how system changes are approved and implemented, and how security considerations are incorporated in the change process shall be enacted. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0028 |
| Title | Security Testing Policy (C10.3) |
| Requirement | Security testing shall be performed whenever a system is updated. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0029 |
| Title | Security Acceptance Criteria Policy (C10.4) |
| Requirement | Security acceptance criteria for new ATM information systems or services, upgrades, and new versions shall be established, and suitable security tests of the ATM system(s) carried out during development and prior to acceptance. This shall include individual development activities such as specification, design, development and qualification which may have corresponding acceptance criteria. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

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| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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| Identifier | REQ-02.01-SPRINTEROP-ALL4.0030 |
| Title | Reporting of Security Events Policy (C11.1) |
| Requirement | ATM service and Information security events shall be reported through appropriate management channels as quickly as possible. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0031 |
| Title | Reporting of Suspected Security Weaknesses or Malfunctions Policy (C11.2) |
| Requirement | All employees, contractors and third party users of information systems and services shall be required to note and report any observed or suspected security weaknesses or malfunctions in ATM systems or services. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0032 |
| Title | Responding to Security Incidents Policy (C11.3) |
| Requirement | Management responsibilities and procedures shall be established to ensure an effective and orderly response to ATM service and information security incidents. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |



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[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0033 |
| Title | Security Incident Evidence Management Policy (C11.4) |
| Requirement | Where a follow-up action against a person or organisation after an ATM service or information security incident involves legal action (either civil or criminal), pieces of evidence shall be collected, retained, and presented to the relevant jurisdiction(s). |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0034 |
| Title | Security Incident External Authorities Involvement Policy (C11.5) |
| Requirement | The Responsible Organisation shall have procedures in place that specify when and by whom external authorities (e.g. law enforcement, fire department, supervisory authorities) shall be contacted in the event of a security incident. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0035 |
| Title | ATM Business Continuity Security Requirements Policy (C12.1) |
| Requirement | A managed process shall be developed and maintained that addresses the ATM service and information security requirements needed for ATM business continuity. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |



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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0036 |
| Title | Disruptive Events Identification and Risk Assessment Policy (C12.2) |
| Requirement | Events that can cause interruptions to ATM business processes shall be identified, along with the likelihood and impact of such interruptions and their consequences for ATM information security. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0037 |
| Title | Planning Policy for Restoration from Disruptive Events (C12.3) |
| Requirement | Plans shall be developed and implemented to maintain or restore operations and to ensure the availability, integrity and confidentiality of information at the required level and in the required time scales following interruption to critical ATM business processes. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0038 |
| Title | Policy for Testing and Updating Business Continuity Plans (C12.4) |
| Requirement | ATM business continuity plans shall be tested and updated regularly to ensure that they are up to date and effective. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0039 |
| Title | Compliance Policy (C13.1) |
| Requirement | Compliance to statutory, regulatory and contractual requirements shall be checked, and the correct and authorised use of facilities and assets shall be defined. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-ALL4.0040 |
| Title | Compliance to National and European Requirements (C13.2) |
| Requirement | Any personal or protectively classified information shall be protected in accordance with National and European requirements. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|

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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0019 |
| Title | Malicious Software Policy (C8.3 PR1) |
| Requirement | The software development and production process shall detect and remove malicious software. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0020 |
| Title | Malicious Software Removal on Detection Policy (C8.3 PR2) |
| Requirement | The software management process shall ensure that all detected malicious software is removed on detection. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0021 |
| Title | Malicious Software User Policy (C8.3 PR3) |
| Requirement | Once detected users shall be immediately informed of the event and as soon as possible provided with detailed of any effects. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0022 |
| Title | Software Installation Media Policy (C8.3 PR4) |
| Requirement | Software shall only be installed from verified media. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0023 |
| Title | Software Validation and Verification Testing Policy (C8.3 PR5) |
| Requirement | Only software which has been the subject of documented validation and verification testing shall be installed. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0024 |
| Title | Related Systems Malicious Software Policy (C8.3 PR6) |
| Requirement | The software management process shall ensure that related systems are informed of any infection or repulsed malicious software. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0025 |
| Title | Malicious Software Staff Training Policy (C8.3 PR7) |
| Requirement | Software development, operations, maintenance and management staff shall be proved with periodic training on type of malicious software. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
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| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0026 |
| Title | Malicious Software Operational System Fall-Back Policy (C8.3 PR8) |
| Requirement | The operational system shall retain the most recent (-1) version of software to provide an immediate fall-back if the detected malicious software requires cessation of operations. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0027 |
| Title | Scanning Policy (C8.3 TR1) |
| Requirement | The detection and removal system shall scan all software before installation, all data items that are input to the system, all data and software on access and scan all system software in every 7 day period. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |



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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0028 |
| Title | Operational Systems Malicious Software Protection Policy (C8.3 TR2) |
| Requirement | For operational systems, protection against detected malicious software shall be achieved within 10 minutes of detection. If cessation of operations is necessary, this shall be done as soon as operationally safe to do so. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0029 |
| Title | New Form of Malicious Software Protection Policy (C8.3 TR3) |
| Requirement | In response to information about a new form of malicious software development and operation software shall be reviewed for presence. The detection software shall utilise signature databases from a reputable security source; systems connected to the Internet shall update their detection databases within 12 hours of the availability of new signatures, or within 72 hours if the system has no Internet connection. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0030 |
| Title | Malicious Software User Notification Policy (C8.3 TR4) |
| Requirement | The system and its management processes must ensure that users are notified of the detection of malicious software or any other security event that may cause perceptible loss of performance or a safety risk; such notification shall be within 1 hour of the identification of the risk. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0031 |
| Title | Malicious Software Alerting Policy (C8.3 TR5) |
| Requirement | The System shall alert the Security and Software Management processes within 5 minutes of detecting malicious software. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

| | |
|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0032 |
| Title | Verified Media Definition Policy (C8.3 TR6) |
| Requirement | Verified media shall be defined within the Software Management process. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0033 |
| Title | Validation and Verification Processes Policy (C8.3 TR7) |
| Requirement | Validation and verification processes to be used shall be based on industry standards e.g. ISO or Def Standards and industry best practices. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0034 |
| Title | Malicious Software Staff Training Policy (C8.3 TR8) |
| Requirement | Training to staff shall ensure that all users understand and practice processes for handling media, are aware of the risks resulting from malicious software and the mechanisms by which such software may be inadvertently introduced into the system, and understand general security requirements and good practice for the protection of security tokens such as passwords and access controls. Users shall demonstrate current knowledge of these issues at intervals of no less than 1 year. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0035 |
| Title | Operational Software Access Restriction Policy (C8.3 TR9) |
| Requirement | The Security and Software management processes shall maintain an up to date listing of those who have been trained and shall restrict access to operational software to those who have been trained and are current. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |

[REQ]

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|---|---|
| Identifier | REQ-02.01-SPRINTEROP-SYS3.0036 |
| Title | Virus Protection Policy (C8.3 TR10) |
| Requirement | To achieve the highest protection against virus introduction White Listing (or an acceptable industry standard equivalent) shall be used. |
| Status | <in progress> |
| Rationale | The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases. |
| Category | <Security> |

[REQ Trace]

| Relationship | Linked Element Type | Identifier |
|---|---|---|
| <ALLOCATED_TO> | <SESAR Solution> | PJ.02-01-06 |



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# 5 References and Applicable Documents

## 5.1 Applicable Documents

### Content Integration


[1] B.04.01 D138 EATMA Guidance Material;
[2] EATMA Community pages;
[3] SESAR ATM Lexicon;


### Content Development


[4] B4.2 D106 Transition Concept of Operations SESAR 2020;


### System and Service Development


[5] 08.01.01 D52: SWIM Foundation v2;

[6] 08.01.01 D49: SWIM Compliance Criteria;

[7] 08.01.03 D47: AIRM v4.1.0;

[8] 08.03.10 D45: ISRM Foundation v00.08.00;

[9] B.04.03 D102 SESAR Working Method on Services;

[10]B.04.03 D128 ADD SESAR1;

[11]B.04.05 Common Service Foundation Method;


### Performance Management


[12]B.04.01 D108 SESAR 2020 Transition Performance Framework;

[13]B.04.01 D42 SESAR2020 Transition Validation;

[14]B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition;

[15]16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model;

[16]16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA;

[17]Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014);

[18]ATM Cost Breakdown Structure_ed02_2014;

[19]Standard Inputs for EUROCONTROL Cost Benefit Analyses;

[20]16.06.06_D26-08 ATM CBA Quality Checklist;

[21]16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms;

### Validation

[22] 03.00 D16 WP3 Engineering methodology;

[23]Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects;

[24]European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010];

### System Engineering

[25]SESAR 2020 Requirements and Validation Guidelines;

### Safety

[26] SESAR, Safety Reference Material, Edition 4.0, April 2016;

[27]SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016;

[28]SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015;

[29]SESAR, Resilience Engineering Guidance, May 2016;

### Human Performance

[30]SESAR Human Performance Assessment Process V1 to V3 - including VLD, Edition 03.01, January 2020;

[31]16.04.02 D04 e-HP Repository - Release note;

### Environment Assessment

[32]SESAR, Environment Reference Material, alias, “Environmental impact assessment as part of the global SESAR validation”, Project 16.06.03, Deliverable D26, 2014;

[33]ICAO CAEP – “Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes” document, Doc 10031;

## 5.2 Reference Documents

[34]ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.

[35]P06.08.01, Wake Turbulence Re-Categorisation and Pair-Wise Separation Minima on Approach and Departure (RECAT-PWS-EU) Safety Case, v1.2, D38, 4th February 2016.

[36]P06.08.01, OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED, D30, 00.00.01, 31st May 2016.

[37]ICAO Doc 8168, Aircraft Operations.

[38]ICAO Document 4444 - ICAO Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM), Doc 4444, Fifteenth Edition, 2007.



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[39]ICAO DOC 8643 – ICAO, Aircraft Type Designators

[40]ICAO State Letter on update guidance for wake turbulence aspects of Airbus A380-800 aircraft, July 2008.

[41]P08.03.10, D64, European ATM Service Description for AirportMETObservation Service, Edition 00.01.01

[42]P08.03.10, D64, European ATM Service Description for AirportMETForecast Service, Edition 00.01.01

[43]P06.08.01, Operational Service and Environment Definition (OSED) for Time Based Separation for Arrivals (TBS), 00.01.02, D05, 3rd June 2013.

[44]P06.08.01, TBS, ORD, S-PWS and WDS for Arrivals OSED, 00.00.04, 16th October 2015.

[45]F. Holzäpfel, A. Stephan, T. Heel, S. Körner, "Enhanced Wake Vortex Decay in Ground Proximity Triggered by Plate Lines", Aircraft Engineering and Aerospace Technology, Vol. 88, Issue 2, 2016, pp. 206-214, http://dx.doi.org/10.1108/AEAT-02-2015-0045

[46]A. Stephan, F. Holzäpfel, T. Misaka, Hybrid simulation of wake-vortex evolution during landing on flat terrain and with plate line, Int. J. Heat Fluid Flow, Vol. 49, 2014, pp. 18-27, http://dx.doi.org/10.1016/j.ijheatfluidflow.2014.05.004.

[47]A. Stephan, F. Holzäpfel, T. Misaka, R. Geisler, R. Konrath, Enhancement of aircraft wake vortex decay in ground proximity - Experiment versus Simulation, CEAS Aeron. J., Vol. 5, 2014, pp. 109-125, http://dx.doi.org/10.1007/s13272-013-0094-8.

[48]Anton Stephan, Jürgen Schrall, Frank Holzäpfel "Numerical Optimization of Plate-Line Design for Enhanced Wake-Vortex Decay", J. Aircraft, 2016, http://dx.doi.org/10.2514/1.C033973

[49]"Collection of information on wake vortex encounters", ICAO note AN 13/4-07/67, 26 Oct. 2007.

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EUROPEAN PARTNERSHIP

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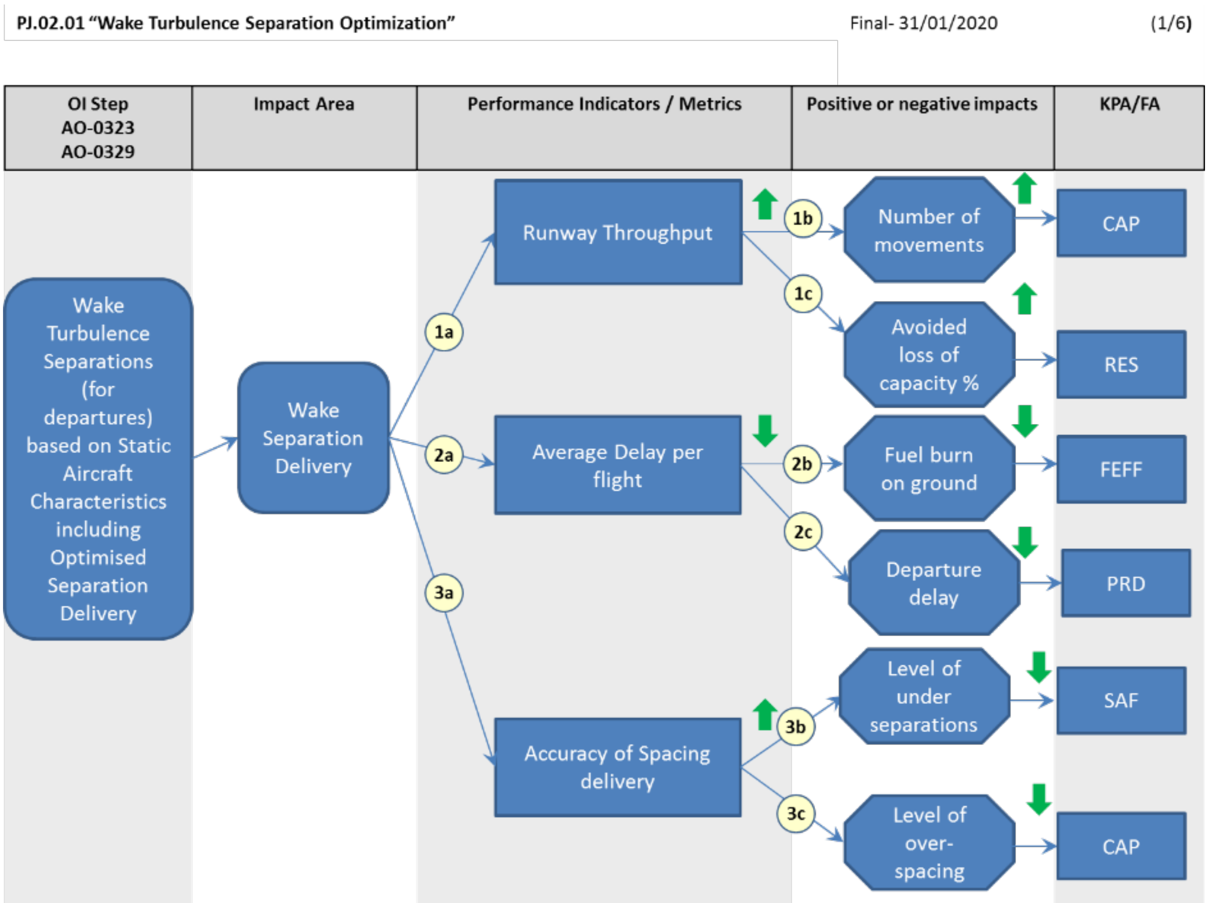
# Appendix A Cost and Benefit Mechanisms

## A.1 Stakeholders identification and Expectations

| Stakeholder | Involvement | Why it matters to stakeholder |
|---|---|---|
| Flight Crew | Are subjected to new wake turbulence separation rules applied by ATC. | Flight crews need to be aware of updated wake separation rules. Flight crews need to trust the safety of the applied rules. |
| Flight Crew | Are aware of concepts deployment and impact on reduced separations | They are responsible for the safety of aircrew and passengers on-board. It is important that they respond to the ATCO instructions promptly. |
| Airport Operator | They cope with the departures traffic pressure | Departures concepts deployment can provide capacity, resilience and predictability benefits to the departures traffic flow |
| ANSP | They deploy the departures concepts | They manage the air traffic control operations |
| Regulator | They need to approve the use of the concepts | They regulate the standards for air traffic control |
| ATCO | They provide ATC services and apply separations based on the concepts | The use of the tool and departures concepts shall not impact their workload such as to adversely impact safety of operations |
| Airline Operator | They schedule the flights | Improved capacity, predictability and resilience can reduce disruptions and provide financial benefits. |

**Table 17: Stakeholder’s expectations**

## A.2 Benefits mechanisms




(1a) The use of PWS-D is expected to reduce wake separation between departure aircraft. OSD is expected to optimise the accuracy of the spacing delivered between departure aircraft. The reduced wake separations and optimised spacing delivery increases the runway throughput.

(1b) PWS-D reduces wake separation and OSD Optimised spacing delivery accuracy between departure aircraft has a positive impact on the runway throughput. The higher the departure aircraft throughput, the higher the number of departure aircraft movements, leading to a positive impact on Capacity.

(1c) The use of PWS-D reducing the wake departure aircraft separations and the use of OSD improving the spacing delivery will result in higher Resilience and avoid loss of capacity.

(2a) The use of PWS-D Reducing the wake departure aircraft separations will reduce the average ground delay per flight.

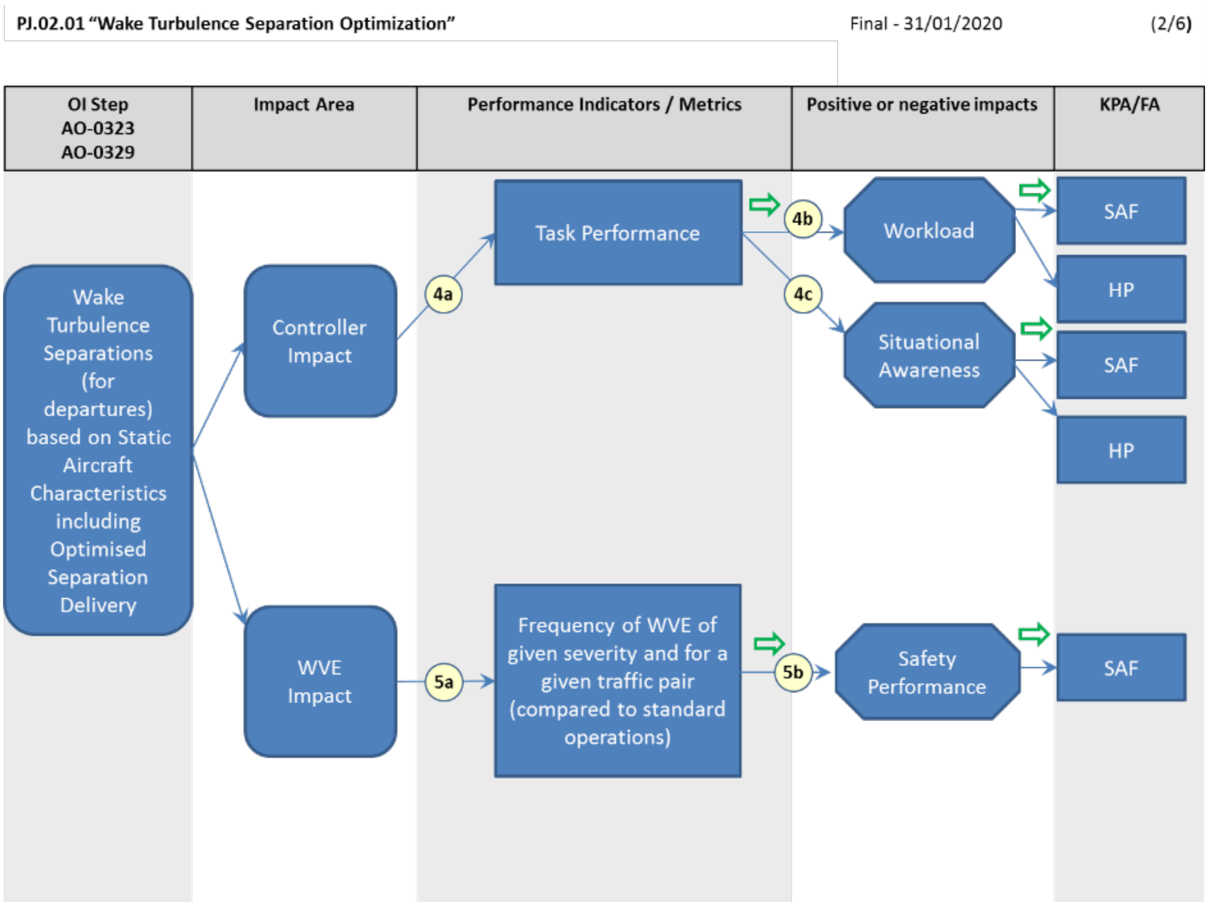
(2b) As ground delay uses more fuel (e.g. in case of ground holding), a reduction in this delay will result in reduced fuel burn on the ground. This has a positive impact on Fuel Efficiency.

(2c) A reduction in average delay per flight will result in less variability between the planned and actual departure time and departures flying closer to their planned time will improve on-time operations. This has a positive impact on Predictability.

(3a) With the OSD system support, the accuracy of the spacing delivered between departure aircraft can be improved compared to what is achieved today.

(3b) Improved spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the PWS-D rules, reducing the level of 'under separation delivery' compared to what is achieved today, thus enabling a safe reduction in the overall amount of wake separation that is required to be delivered, which links to Safety.

(3c) Improved spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the PWS-D rules, reducing the level of 'over spacing delivery' compared to what is achieved today, thus enabling the efficient reduction of the overall amount of wake separation that is required to be delivered, which links to Capacity.



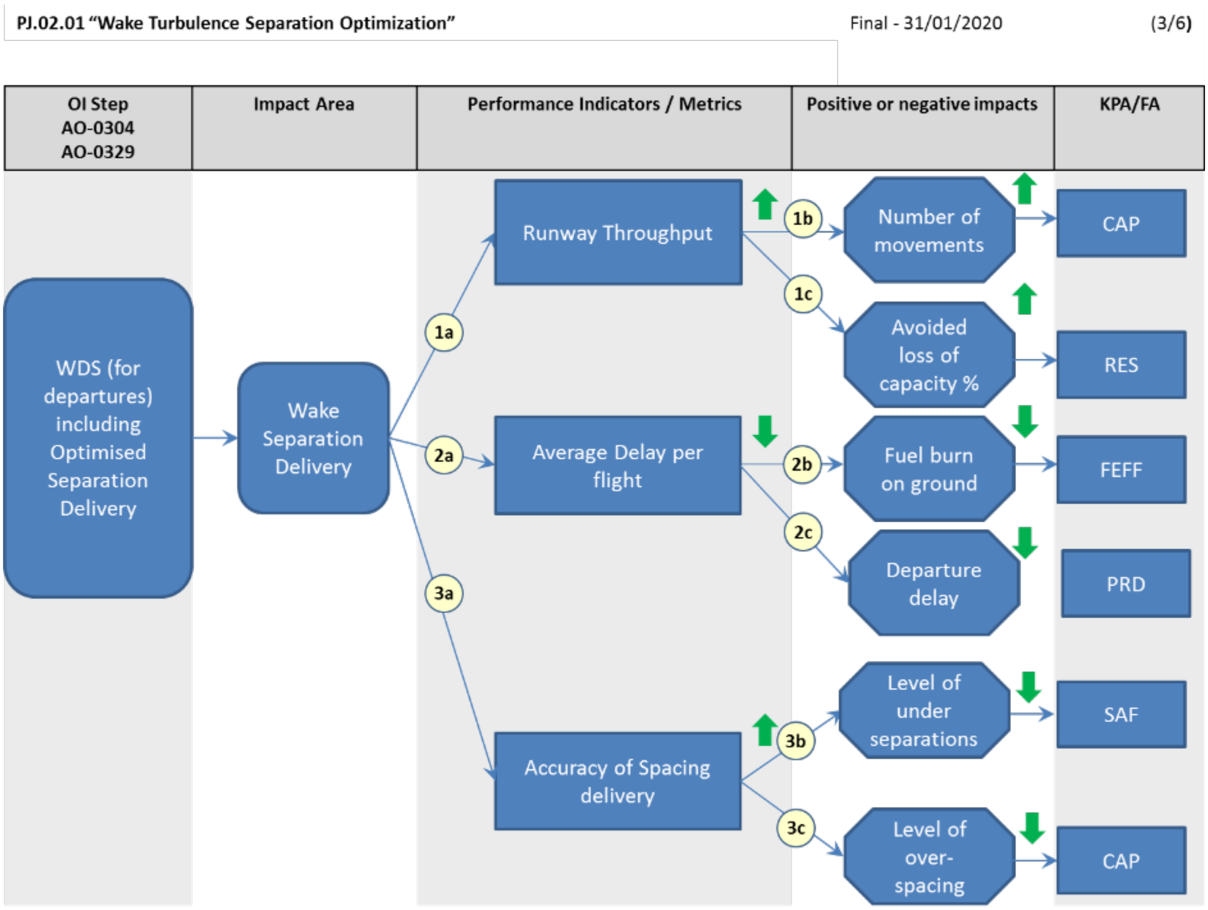

(4a) Controller reliance on the OSD system support should have no impact on Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

(4b) Overall workload should not increase. It is expected that any workload increase for some tasks will be offset as a result of the OSD system support and reduce workload in other areas, so no changes are anticipated to Safety and Human Performance.

(4c) Situational Awareness is not expected to be impacted and thus no changes are anticipated on Safety and Human Performance.

(5a) Using PWS-D will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(5b) No increase in the frequency of potential WVEs compared to reference traffic pair at current standard operations in reasonable worst case conditions, will not impact Safety Performance – links to Safety.




(1a) The use of WDS-D (e.g. for WDS based on crosswind when crosswind is above the activation threshold) is expected to reduce wake separation between departure aircraft. OSD is expected to optimise the accuracy of the spacing delivered between departure aircraft. The reduced wake separations and optimised spacing delivery increasing the runway throughput.

(1b) WDS-D reduced wake separation and OSD optimised spacing delivery accuracy between departure aircraft has a positive impact on the runway throughput. The higher the departure aircraft throughput, the higher the number of departure aircraft movements, leading to a positive impact on Capacity.

(1c) The use of WDS-D reducing the wake departure aircraft separations and the use of OSD improving the spacing delivery will result in higher Resilience and avoid loss of capacity.

(2a) The use of WDS-D reducing the wake departure aircraft separations will reduce the average ground delay per flight.

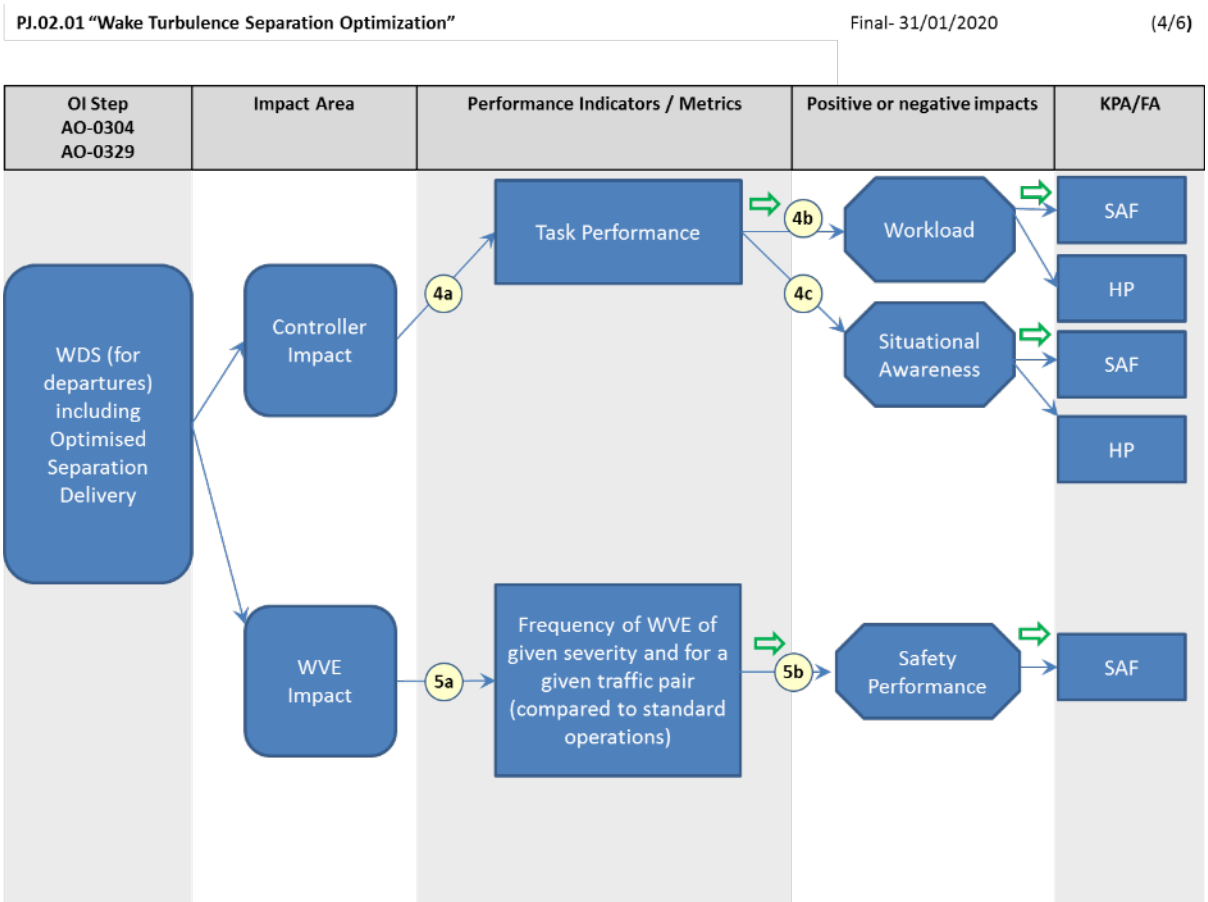
(2b) As ground delay uses more fuel (e.g. in case of ground holding), a reduction in this delay will result in reduced fuel burn on the ground. This has a positive impact on Fuel Efficiency.

(2c) A reduction in average delay per flight will result in less variability between the planned and actual departure time and departures flying closer to their planned time will improve on-time operations. This has a positive impact on Predictability.

(3a) With the OSD system support, the accuracy of the spacing delivered between departure aircraft can be improved compared to what is achieved today.

(3b) Improving spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the WDS-D rules, reducing the level of 'under separation delivery' compared to what is achieved today, thus enabling a safe reduction in the overall amount of wake separation that is required to be delivered, which links to Safety.

(3c) Improving spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the WDS-D rules, reducing the level of 'over spacing delivery' compared to what is achieved today, thus enabling the efficient reduction of the overall amount of wake separation that is required to be delivered, which links to Capacity.

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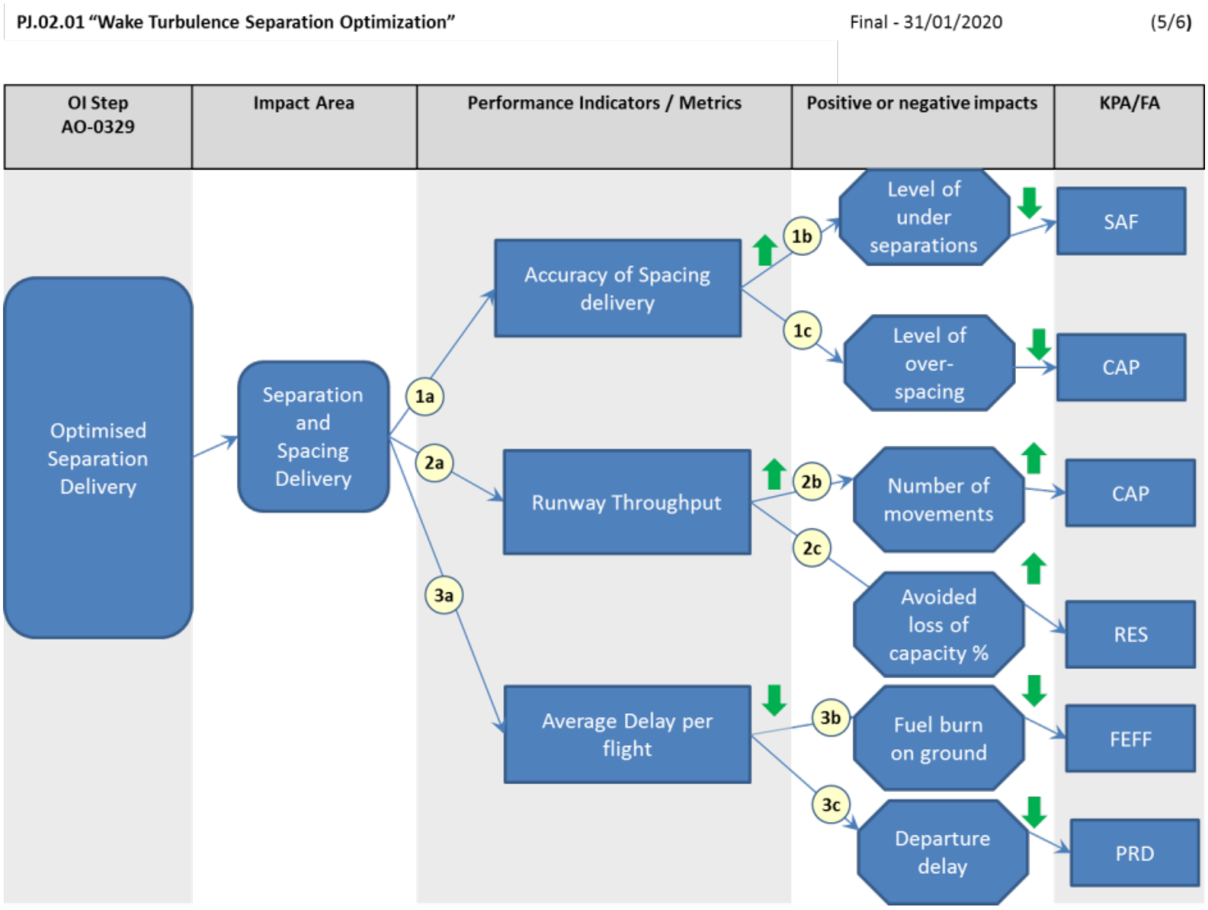
(4b) Overall workload should not increase. It is expected that any workload increase for some tasks will be offset as a result of the OSD system support and reduce workload in other areas, so no changes are anticipated to Safety and Human Performance.

(4c) Situational Awareness is not expected to be impacted and thus no changes are anticipated on Safety and Human Performance.

(5a) Using WDS-D will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(5b) No increase in the frequency of potential WVEs compared to reference traffic pair at current standard operations in reasonable worst case conditions, will not impact Safety Performance – links to Safety.




(1a) With the OSD system support, the accuracy of the spacing delivered between departure aircraft can be improved compared to what is achieved today.

(1b) Improving spacing delivery accuracy can enable the consistent separation delivery to the wake separation rules, with a reduced level of 'under separation delivery' compared to what is achieved today which links to Safety.

(1c) Improving spacing delivery accuracy can reduce the level of 'over spacing delivery' compared to what is achieved today, thus enabling the efficient reduction of the overall amount of wake separation that is required to be delivered, which links to Capacity.

(2a) The use of OSD is expected to optimise the delivery of departure aircraft separations and thus increasing runway throughput.

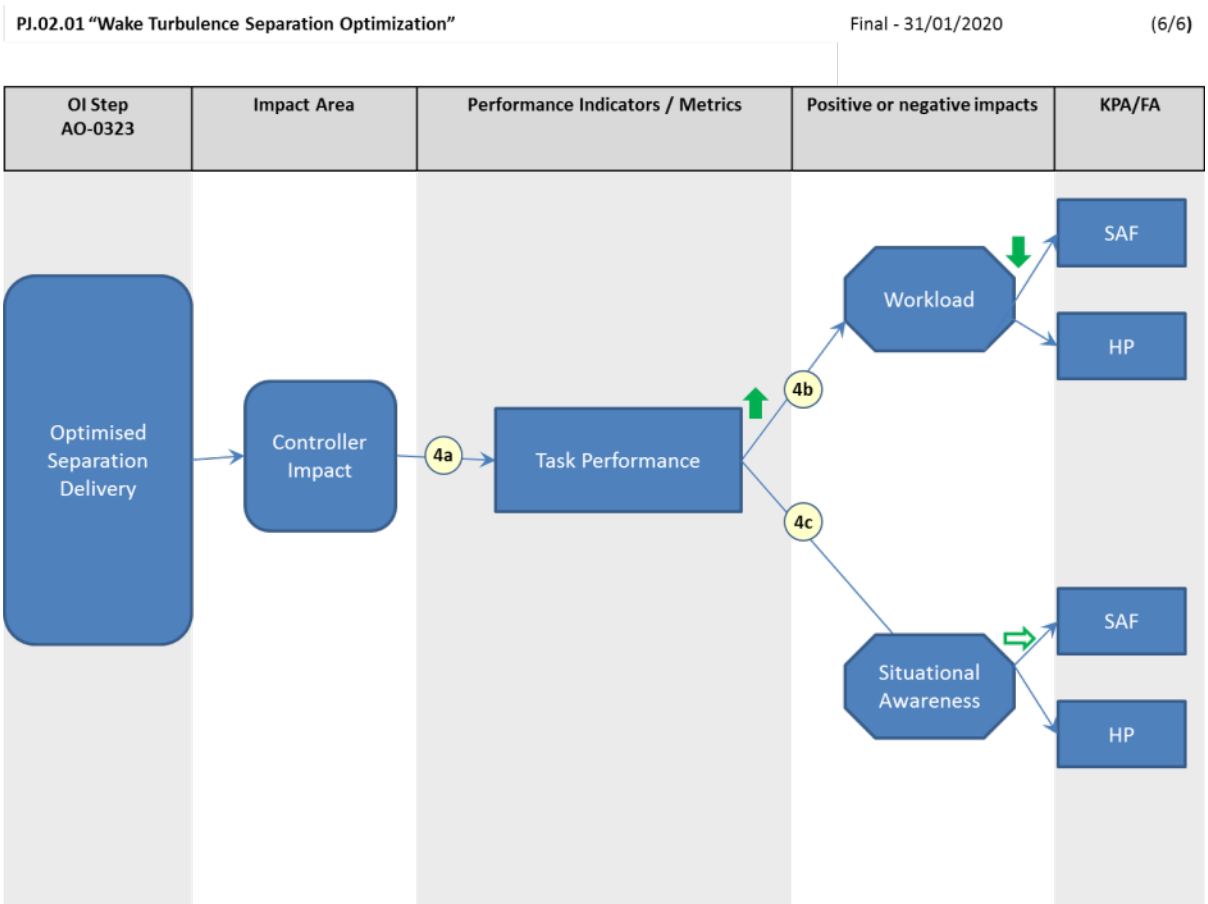
(2b) Optimised spacing delivery between departure aircraft has a positive impact on the runway throughput. The higher the departure aircraft throughput, the higher the number of departure aircraft movements, leading to a positive impact on Capacity.

(2c) Optimised delivery of departure aircraft separations can result in higher Resilience and avoid loss of capacity.

(3a) Optimised delivery of departure aircraft separations can reduce the average ground delay per flight.

(3b) As ground delay uses more fuel (e.g. in case of ground holding), a reduction in this delay will result in reduced fuel burn on the ground. This has a positive impact on Fuel Efficiency.

(3c) A reduction in average delay per flight will result in less variability between the planned and actual departure time and departures flying closer to their planned time will improve on-time operations. This has a positive impact on Predictability.

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(4b) Overall workload should not increase. It is expected that any workload increase for some tasks will be offset as a result of the OSD system support and reduce workload in other areas, so no changes are anticipated to Safety and Human Performance.

(4c) Situational Awareness is not expected to be impacted and thus no changes are anticipated on Safety and Human Performance.

## A.3 Costs mechanisms

The main cost drivers for the Departures Concepts Solutions are:

- The development and validation of the local method of operations covering all local nominal, non-nominal and failure scenarios.
- The training of the ATCOs and Supervisors and the development and provision of the supporting real-time simulation training facilities and briefing materials.
- The briefing of the Airline Operators and Airspace Users and the development and provision of the supporting briefing materials.
- The data mining and analysis of the local aircraft behaviour on the initial departure paths required to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support. This is required for distance-based wake separation procedures and may be required for time-based wake separation procedures if there is a need to actively manage airborne spacing evolution along the initial departure path.
- The data mining and analysis of the local initial departure path wind conditions aloft behaviour and runway surface wind conditions behaviour required to characterise the required performance of the runway surface and initial departure path wind profile modelling in the ATC tool support.
- The data mining and analysis of the local aircraft behaviour on each departure runway with respect to line-up position, take-off roll and initial airborne position to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support. This is required for distance-based wake separation procedures and may be required for time-based wake separation procedures if there is a need to actively manage airborne spacing evolution along the initial departure path.
- The development and provision of the local ATC tool support, the associated integration with the local ATC systems and services with respect to the provision of the required information and events, and the associated integration with the controller and supervisor workstation position facilities with respect to the provision of the required display and HMI interaction facilities support.
- The support of the required optimised wake turbulence separations by the local ATC tool support.
- The development and provision of the required local initial departure path wind conditions aloft service.
- The provision of the local runway surface wind conditions service including consideration of topological influences at the initial airborne positions of the departing aircraft.
- The preparing of the local case with the associated evidence, and the activities for obtaining the local regulatory approval.
- The development of the system support for post operational monitoring and the provision of the associated resources for carrying out, reporting and acting on the monitoring findings and associated recommendations.
- The ATC tool support maintenance costs with respect to accommodating new aircraft types and with respect to actioning required refinements to the characterisation of the aircraft type behaviour modelling and actioning required refinements to the initial departure path wind profile modelling.

The integration with local ATC systems includes consideration of:

- Surveillance tracking of the departure aircraft on the ground through line-up, take-off roll, and becoming airborne. This is required when there is a need for automated detection of the line-up and the associated line-up position, the start of take-off roll time, and the airborne time.
- Surveillance tracking of the departure aircraft in the air on the initial departure path. This may be required to support monitoring of aircraft behaviour and separation conformance.
- Provision of a high integrity runway take-off sequence order. This may be through the events generated for the departure runway controller electronic environment as the departure aircraft are issued with the line-up clearance and the electronic flight progress strips is moved to the runway bay, is issued with the take-off clearance and begins the take-off roll, and then rotates and is visually conformed as airborne. This may be through or supplemented by surveillance monitoring of the line-up position, the start of take-off roll, and becoming airborne.
- Provision of the flight data for the departure aircraft issued with line-up clearances and taking-off. This may be from the departure runway controller electronic environment or from the DMAN System or from the Flight Data Processing (FDP) System.
- Provision of runway surface wind conditions from the local runway anemometer service.
- Provision of the initial departure path wind conditions aloft profile through a suitable MET Service which may include local derivation from the downlinked Enhanced Mode S airborne parameters in the secondary surveillance data of the local initial departure path surveillance service.

The above are reflected in the enablers of each of the Departure Concepts Solutions listed below.

AO-0329: Optimised Separation Delivery for Departure

- AERODROME-ATC-69: ATC system to support optimised departure separation (Required)

AO-0323: Wake Turbulence Separations (for departures) based on Static Aircraft Characteristics

- AERODROME-ATC-42a: Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information (Required)
- REG-0523: Regulatory provisions for static pair-wise wake separation minima (S-PWS) (Required)
- STD-HNA-13: Non-ICAO Standards for 'Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information' (Required)

AO-0304: Weather-dependent reductions of Wake Turbulence Separations for Departure

- AERODROME-ATC-19: Runway Usage Management sub-system capable of processing initial departure path wind conditions information (Required)
- REG-0522: Regulatory provisions for weather-dependent separation minima (WDS)

# Annex A SESAR PJ.02-01 PWS Arrivals and Departures Methodology & Results

The following document presents the results of the study to update the RECAT pairwise wake turbulence separation matrix for arrival and departure (RECAT-PWS):

Annex A_SESAR W2
PJ02-01_PWS_metho

# Annex B Time Based Static Pairwise Wake Separations for Departures – Methodology & Results

Annex B_SESAR W2
PJ02-01_TB PWS-D_r

**-END OF DOCUMENT-**