

SESAR SOLUTION PJ.02- W2-21.4 CONTEXTUAL NOTE V3

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AART

PJ.02 AIRPORT AIRSIDE AND RUNWAY THROUGHPUT

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Abstract

This V3 Contextual note provides SESAR Solution description for industrialisation consideration.

It illustrates all relevant aspects of SESAR Solution 21.4 within PJ.02-W2 Airport Airside and Runway Throughput. Solution 21.4 investigates the Full Guidance Assistance to mobiles using 'Follow the Greens' procedures based on Airfield Ground lighting (aprons/taxiways/runways). The Solution intends to automate the prioritisation of mobiles along their cleared route on the whole movement area and improves Controller productivity. The Solution has been validated and is documented in a solution data pack

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1 Purpose

This contextual note provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solution PJ.02-W2-21.4 “Full Guidance Assistance to mobiles using 'Follow the Greens' procedures on Airfield Ground Lighting (aprons/taxiways/runways)” in terms of scope, main operational and performance benefits, and relevant system impacts.

When Solution is at V3 level, it contains as well additional activities to be conducted during the industrialization phase or as part of deployment.

Besides, this contextual note introduces the data pack comprising the SESAR 3 Joint Undertaking deliverables (for V3 Solutions, the deliverables aim at supporting industrialization/deployment of the concept).

2 Improvements in Air Traffic Management (ATM)

The SESAR Solution “Full Guidance Assistance to mobiles using 'Follow the Greens' procedures on Airfield Ground Lighting (aprons/taxiways/runways)” intends to automate the prioritisation of mobiles (aircraft or vehicles) along their cleared route on the whole aerodrome movement area. The Guidance Service considers other traffic for spacing to guide the mobile as it progresses along its assigned route and at the holding points. It allocates priorities between mobiles based on local operating rules (e.g. runway exit versus parallel taxiways, aircraft versus vehicle, aircraft converging or crossing at intersections and taxiways passing close to push back routes or other taxiways where insufficient wingtip separation exists), as well as known constraints from the surface management system. Automatic Guidance will be provided using “Follow the Greens” concept on the Airfield Ground Lighting infrastructure.

Improvements compared to SESAR1 baseline “Guidance assistance through airfield ground lighting” are mainly in Air Traffic Controller workload, as the solution automates Controller tasks. Reduced workload will increase Controller productivity – the SESAR KPI CEF2 “Flights per ATCO-Hour on duty”.

The improvements of this SESAR solution are on top of the improvements of the SESAR1 baseline solution benefits, meaning that if A-SMGCS Guidance Service is introduced at an airport as “Full Guidance”, the improvements will be both the SESAR1 baseline improvements in addition to the SESAR 2020 Solution improvements.

3 Operational Improvement Steps (OIs) & Enablers

The Operational Improvements (OI Steps):

OI Step ID	Title	Description	Master Rationale	Plan
AO-0222-B	Full guidance assistance to mobiles using 'follow the greens' procedures based on airfield ground lighting (aprons/taxiways/runways)	By using Airfield Ground Lighting, mobiles will be guided along their cleared route, taking into account tactical decisions (made by the Apron Manager, Tower Ground Controller and Tower Runway Controller) and known constraints from the surface management system. The Airfield Ground Lighting infrastructure will switch automatically the taxiway centerline lights and stop bars accordingly for each mobile individually. The operational service is capable of automatically supporting a safe longitudinal and lateral spacing between mobiles and also managing priorities between mobiles on the aerodrome surface in all weather conditions. In the context of trajectory based operations, this 'follow the greens' concept does not prevent the ground routing to be made available in the cockpit, for both pilot and on-board systems, for safety purpose.	There is a need of an advanced functionality of Airfield Ground Lighting that would cover the management of priorities to ensure lateral separation between mobiles on the movement area in all weather conditions.	

Table 1: Solution relevant OI

The following Enablers support the deployment of AO-0222-B.

Enabler	Title	Description	Coverage
AERODROM E-ATC-07c	A-SMGCS incorporating the function that provides No FtG CMAC Alert for Controllers	The A-SMGCS Safety Support Service incorporates the No FtG ('Follow-the-Greens' Guidance) CMAC Alert for the detection of non-conformance to Guidance provided in the taxiways. The No FtG CMAC Alert includes the situations where: - The clearance limit provided by means of AGL (Airfield Ground Lighting) is exceeded, and - No 'Follow-the-Greens' clearance has been	Full

		issued for stationary traffic and the mobile starts moving.	
AERODROM E-ATC-61b	Advanced surface guidance management services to process the automatic triggering of airport ground signs and lighting according to the route issued by ATC	Surface guidance management services enhanced to process the automatic triggering of airport ground signs and lighting according to the route (issued by Apron Manager, Tower Ground Controller and Tower Runway Controller), taking into account management of priorities between mobiles.	Full
REG-0541	Update of EASA Appendix 1 to AMC1 SERA.14001 General for possible update of phraseology	Update of EASA Appendix 1 to AMC1 SERA.14001 General for possible update of phraseology to introduce the possibility to instruct to use the Guidance Assistance through Airfield Ground Lighting at airports.	Full
STD-131	Update of ICAO Doc 4444 for possible update of phraseology	Update of ICAO Doc 4444 for possible update of phraseology to introduce the possibility to instruct to use the Guidance Assistance through Airfield Ground Lighting at airports.	Full

Table 2: Solution relevant OI

4 Background and validation process

In SESAR1 “Guidance assistance through airfield ground lighting” (Solution #47, AO-0222-A) was validated to V3 maturity. Dedicated validation exercise was conducted in order to validate guidance by airfield ground lighting and the corresponding procedure ‘Follow-the-Greens’ from a flight crew’s perspective

In SESAR 2020 Wave 1 “Full Guidance Assistance to mobiles using 'Follow the Greens' procedures based on Airfield Ground Lighting” (AO-0222-B) was validated by project PJ03a-01 to “V2 ongoing” maturity.

The validation of AO-0222-B continued in Wave 2 by PJ.02 WP6 as Solution PJ.02-W2-21.4

SESAR 2020 Solution 21.4 “Full Guidance” enhances SESAR1 Guidance by automating the detection of conflicts as well as the resolution of conflicts through the guidance by Follow the Greens procedure.

In Wave 2 the solution was validated using a validation platform consisting of a Tower Control automation system and a simulator system simulating air and ground traffic, view from the Tower, view from selected mobiles, and simulating the Airfield ground lighting system. The validation platform was what can be called a Real Time Simulator, or a Tower Control training simulator. This provided a realistic simulated operations for the Air Traffic Controllers to perform realistic simulated Aerodrome air traffic control using the Solution.

The validation exercise (TVAL.21.5) took place 21-25 March 2022 at Indra Navia facilities in Asker, using Budapest airport as operational environment and Air Traffic Controllers from HungaroControl familiar with that airport.

5 Results and performance achievements

As the Full Guidance Solution automates the taxiway traffic conflict detection and resolution, the Controllers can issue full taxi clearances (to RWY holding or parking stand), and the Solution will detect and resolve any taxi conflicts. Therefore, the Controllers' workload level and the time spent to detect conflicts and issue/update taxi instructions are reduced.

The Full Guidance by 'Follow the Greens' supported ATCOs in performing their tasks in a timely and efficient manner and was considered highly acceptable. At the same time, the Operating methods introduced by the automated switching of AGL function and A-SMGCS Routing Service could be followed accurately, efficiently and in a timely manner in all the operational conditions.

Improvements compared to SESAR1 baseline "Guidance assistance through airfield ground lighting" are mainly in Air Traffic Controller workload, as the solution automates Controller tasks. Reduced workload influences positively the Controller productivity – the KPI CEF2 "Flight per ATCO Hour on duty".

Performance Benefit at Network Level (ECAC Wide) for Controller productivity (CEF2) is assessed to be 1.4%. However, the improvement for a single airport introducing the Solution is larger. For the airport used in the validation exercise the increase in productivity was assessed to be 8,7% (in NORMAL weather condition).

The improvement of this SESAR Solution is on top of the improvements of the SESAR1 baseline Solution benefits, meaning that if A-SMGCS Guidance Service is introduced at an airport as "Full Guidance", the improvements will be both the SESAR1 baseline improvements and the SESAR 2020 Solution improvements.

6 Recommendations and Additional activities

This SESAR 2020 Solution should be regarded as replacing the SESAR1 “FOLLOW-THE-GREENS, Guidance assistance through airfield ground lighting” Solution (Release 5 SESAR1 Solution #47). The overall performance improvement of “[Full] Guidance assistance through airfield ground lighting” should be better assessed and understood (performance of Guidance assistance through airfield ground lighting compared to no guidance).

As the Solution involves many stakeholders:

- Airport operator,
- Air Navigation Service provider,
- Airspace User,
- Airfield ground lighting system manufacturer, and
- A-SMGCS/ATC system manufacturer,

it is strongly recommended to have all stakeholders involved simultaneously in further work.

Airports that have some sort of Follow-the-Greens in operation and AGL system capable of being controllable down to single lamp or short segments should be able to upgrade existing A-SMGCS guidance service to be compliant with the Full Guidance Solution with moderate investments.

As the validation simulated the airfield ground lighting system, the future phases need to confirm that the current standards for AGL systems are sufficient to support the solution.

As this validation focussed on Air Traffic Controllers acceptance and based the solution acceptance of pilots and vehicle drivers on SESAR 1 validations, further phases should demonstrate taxiing (and driving) using the Follow-the-greens procedures. Focus should be on how pilots and vehicle drivers may be instructed (by TCL) at taxiway intersections to give way to other traffic, as well as how pilots are instructed by TCL in low visibility conditions to maintain spacing to other traffic.

One particular topic that is introduced with Full Guidance is how the HMI with the ACTO should be designed for optimal HMI efficiency. The validation platform had an HMI where the required information could be found, and the required input could be performed (re-routing, priority swap). This configuration was regarded as appropriate to validate the concept/solution. In industrialization, further study and detailing of the HMI should be performed. At the same time, detailed HMI of any ATM system is never standardized or part of a standard (if exists). The ATCO HMI for the Guidance service is closely related to Routing HMI and alert HMI. HMI has to be efficient when integrated and used at the same time. The specific areas of HMI that should be studied and developed are:

- How the ATCO is informed about the conflicts that are detected, where the predicted conflict will occur, and who has been given priority in the conflicts. This information should preferably be presented to the ATCO without the need of any input to the system. This type of information is to be provided before any TCLs are being restricted and traffic is guided to give way/stop.

- At this early stage, when a conflict is detected, but not yet controlled, the ATCO may want to swap priority or re-route. There should be an effective HMI to change the priority or to change the route.
- At the stage where the mobile is actually being restricted by TCL, the ATCO should be clearly informed via the HMI that the solution is controlling a mobile, and what/where is the instructed limit (temporarily taxi clearance limit).

7 Actors impacted by the SESAR Solution

The Full Guidance Assistance to mobiles using 'Follow the Greens' procedures on Airfield Ground Lighting (aprons/taxiways/runways) have an impact on the following actors:

- TWR Controllers (that can be divided into:
 - TWR Ground Controller,
 - TWR Runway Controller,
- TWR Supervisor,
- Airspace users (Pilots),
- Vehicle drivers,
- Airport operators.

8 Impact on Aircraft System

There is no impact on aircraft systems as it is only the Flight Crew or Vehicle Driver who need to observe the AGL.

9 Impact on Ground Systems

A TWR ATC system with A-SMGCS surveillance service, Airport Safety support service, Routing, Guidance Services, and also with Electronic Controller Inputs (Clearances) is required.

In addition, Taxiway Centreline Lights (TCL) and lighted stop bars are required at the aerodrome, as well as an Airfield Ground Lighting (AGL) system with capabilities to switch TCL and stop bars on/off individually or in segments. The A-SMGCS Guidance Service need to interface with this AGL system to command the switching of TCL and stop bars and obtain the light status.

Concerning the prioritisation and control of mobiles, the Guidance Service needs to be upgraded so that the guidance is restricted when appropriate to one of the mobiles involved in a potential conflict, based on predefined rules. This system needs to consider as well different aspects such as the types of aircraft, weather conditions or the presence of vehicles when applying the spacing rules.

Moreover, the Controller's HMI need to be upgraded in order to display the relevant elements for successfully applying the Full Guidance. Information such as the status of the service, the conflicts detected and the assignation of priorities.

10 Regulatory Framework Considerations

The Guidance Assistance through Airfield Ground Lighting may require updating ICAO standards for phraseology, which is mainly defined in ICAO Doc 4444 (PANS-ATM). Doc 4444 12.3.4.7 specifies phraseology for Taxi procedures, and it is recommended to add new standard phraseology, where the following is proposed: “TAXI TO HOLDING POINT [number] [RUNWAY (number)] (or STAND [number]) FOLLOW THE GREENS”, associated to a “Circumstance” of “...where surface movement guidance by airfield ground lighting exist”.

In a similar way, EASA SERA (Standardised European Rules of the Air) (EU regulation 923/2012) specifies taxi phraseology in Appendix 1 to AMC1 SERA.14001 General with ATC PHRASEOLOGIES (1.4.7). The same standard phraseology it is proposed to be added here also.

Moreover, SERA contains an appendix (Appendix 1) as well for Signals. Using light signals for taxi guidance may need to be described here.

The European Telecommunications Standards Institute (ETSI) has published standards for “Advanced Surface Movement Guidance and Control System (A-SMGCS)” - EN 303 213 Part 1 to 7. Specific versions and parts of the ETSI EN 303 213 are Community Specifications in accordance with Article 4 of Regulation (EC) No 552/2004 of the European Parliament and of the Council on the interoperability of the European. The current Community Specifications for A-SMGCS does not cover Guidance service, thus should be considered to be extended with Guidance service.

11 Standardization Framework Considerations

EUROCONTROL Specification for Advanced-Surface Movement Guidance and Control System (A-SMGCS) Services (SPEC-171) exist and contain specification for A-SMGCS Guidance service. EUROCONTROL has established an A-SMGCS Task Force to update the standard. Solution PJ.02-W2-21.4 “Full Guidance Assistance to mobiles using 'Follow the Greens' procedures on Airfield Ground Lighting (aprons/taxiways/runways)” should be incorporated into the specification.

Also, EUCOAE ED-87E; MINIMUM AVIATION SYSTEM PERFORMANCE STANDARD (MASPS) FOR ADVANCED SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEMS (A-SMGCS) exist and the latest version (87E) contains guidance service in its scope. EUROCAE Working Group 41 “*is tasked to develop and update MASPS, MOPS and Guidelines for A-SMGCS in alignment with EUROCONTROL operational concepts and requirements, and to provide technical inputs in the areas of implementation of A-SMGCS related to EUROCONTROL developments, EC research projects and ICAO specific requirements*”. Solution PJ.02-W2-21.4 should also be incorporated into ED-87 if relevant.

12 Solution Data pack

D6.4 - Solution PJ.02-W2-21.4 V3 Data Pack, containing:

1. D6.4.001 - PJ.02-W2-21.4 SPR-INTEROP/OSED, containing:
 - a. SESAR Solution PJ.02-W2-21.4 SPR-INTEROP-OSED for V3 – Part I
 - b. SESAR Solution PJ.02-W2-21.4 SPR-INTEROP-OSED for V3 – Part II – Safety Assessment Report (SAR)
 - c. SESAR Solution PJ.02-W2-21.4 SPR-INTEROP-OSED for V3 – Part IV – Human Performance Assessment Report (HPAR)
 - d. SESAR Solution PJ.02-W2-21.4 SPR-INTEROP-OSED for V3 – Part V – Performance Assessment Report (PAR)
2. D6.4.003 - PJ.02-W2-21.4 Validation Report (VALR)
3. D6.4.004 - PJ.02-W2-21.4 TS/IRS
4. D6.4.005 - PJ.02-W2-21.4 Cost Benefit Analysis (CBA)



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