*Contextual note – SESAR Solution description form for deployment planning*

*Purpose:*

*This contextual note introduces a SESAR Solution (for which maturity has been assessed as sufficient to support a decision for industrialization) with a summary of the results stemming from R&D activities contributing to deliver it. It provides to any interested reader (external and internal to the SESAR programme) an introduction to the SESAR Solution in terms of scope, main operational and performance benefits, relevant system impacts as well as additional activities to be conducted during the industrialization phase or as part of deployment. This contextual note complements the technical data pack comprising the SESAR deliverables required for further industrialization/deployment.*

## Improvements in Air Traffic Management (ATM)

The **SESAR Solution "Runway status lights" (RWSL)** provides a fully automatic system that uses A-SMGCS surveillance data to dynamically switch on and off some new airfield lights to directly inform the flight crews and the vehicle drivers about the current runway usage. This runway status indication informs the flight crews and the vehicle drivers when the runway is unsafe for entering, crossing or taking-off.

The benefits of this SESAR Solution are expected in terms of **safety** as the proposed improvements will lead to a **reduction in the number and severity of runway incursions**.

The SESAR Solution RWSL consists of the following new airfield lights:

1. **Runway Entrance Lights (REL)**: Sets of red lights illuminating runway entrances when it is not safe to enter or cross the runway.
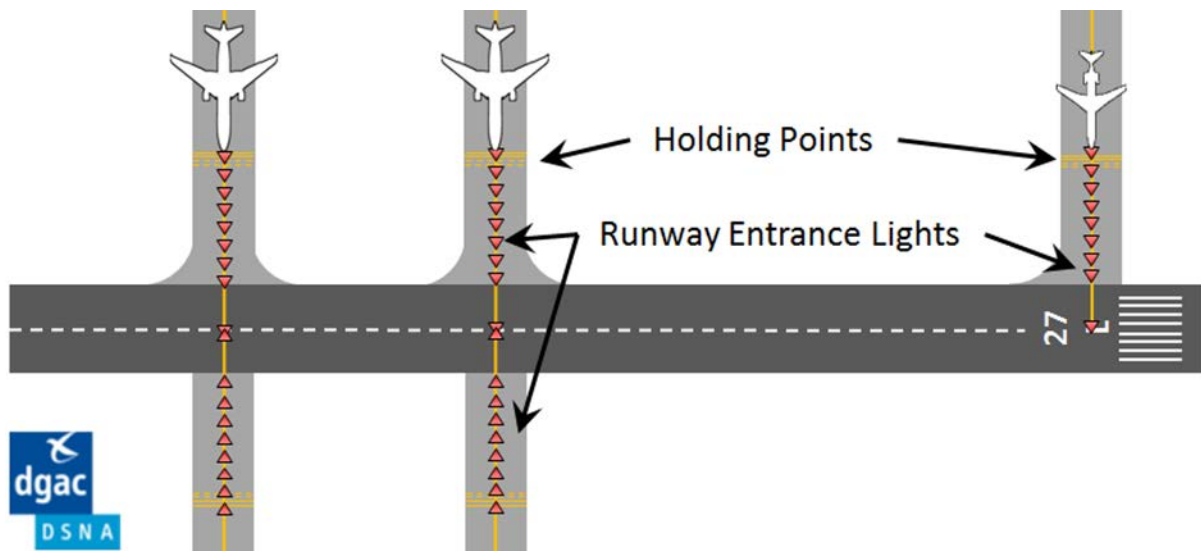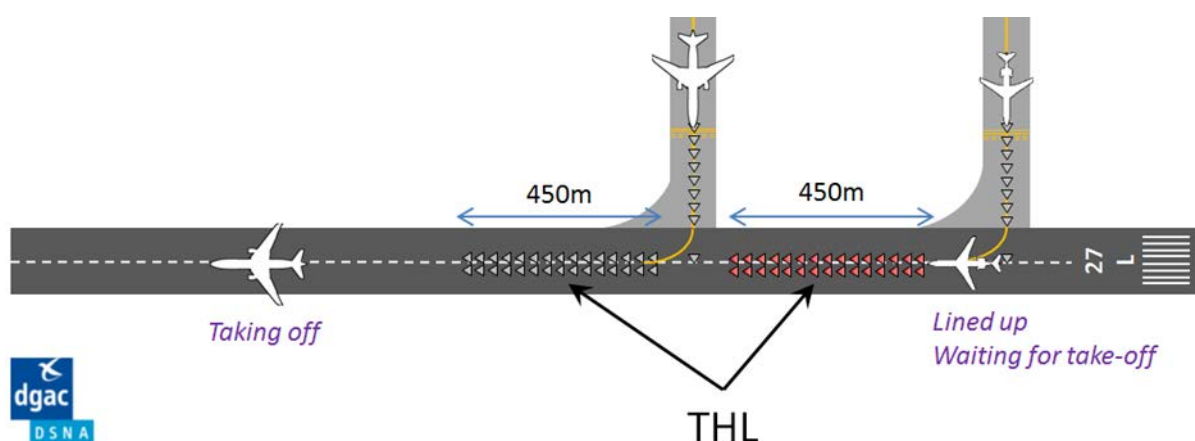


2. **Take-off Hold Lights (THL)**: Sets of red lights illuminating along the axis of a runway in front of a departing aircraft when it is unsafe to take-off from that runway due to an obstacle (vehicle or aircraft) already occupying the runway ahead.

## Operational Improvement Steps (OIs) & Enablers

Operational Improvement Step under the scope of the SESAR Solution:

- AO-0209 "Enhanced Runway Usage Awareness"

This OI is partially covered by the SESAR Solution as no V3 validation could be performed on the operational requirements related to crossing runways (RIL) since the Validation Platform had parallel runways. Regarding other potential candidate airports for this solution (e.g. Hamburg or Zurich airports), there was no real interest to validate and then deploy RILs. It results that the SESAR Solution only covers the REL and THL aspects of this OI.

Enablers supporting the SESAR Solution:

- AERODROME-ATC-66 "Tower A-CWP interfaced to the Runway Status Lights management tool" (Required)

- AERODROME-ATC-XX "RWSL management tool fed with airport surveillance data to determine runway usage and to control the airfield Runway Status Lights" (Required)

- AIRPORT-YY "Airfield Ground Lighting system upgraded to provide the Runway Status Lights" (Required)

   *Note: In the Integrated Roadmap Dataset DS16, the above enablers are grouped into a single enabler (AERODROME-ATC-66) with a different wording. A Change Request (3160) has been created in the SESAR 1 backlog to implement this change in SESAR 2020.*

- AERODROME-ATC-23a "Enhanced A-SMGCS Core Surveillance function for new A-SMGCS Services" (Optional, depending on the local context)

   *Note: AERODROME-ATC-23a is defined in the Integrated Roadmap Dataset DS16 but it is not linked to the OI Step AO-0209. This link is proposed as the RWSL performance strongly relies on SMGCS Core Surveillance function performances. The Change Request (3114) will implement this change in SESAR 2020.*

- PRO-246 "Procedures for standardised response to Runway Status Lights" (Required)

Applicable Integrated Roadmap Dataset is DS16.

## Background and validation process

The validation process to demonstrate a V3 maturity level consisted in the performance of a series of trials which culminated in the conduct of live trials. The airport environment for this series of trials was Paris-Charles-de-Gaulle (CDG) airport.

This series of trials at Paris-CDG consisted in the following successive trials for the validation of both THLs and RELs using the runway 09R/27L:

- Long duration operational validation in test environment for the validation of settings in all operational conditions (without the actual switching on and off of the new airfield lights).

- Shadow mode in tower (without the actual switching on and off of the new airfield lights).

- Live trials with State aircraft, simulated aircraft and with vehicles and observers.

## Results and performance achievements

Two types of assessments were made: a technical assessment, which measured the system correctness and an operational feedback, which measured user opinions of the Solution.

The technical assessment of the switching On/Off logic of the REL and THL showed that the system performed as designed, i.e. no major anomaly was observed. Recorded data allowed the fine tuning of a few parameters.

The main findings from the operational feedback can be summarised as follows:

- From the vehicle drivers and flight crews' point of view:

  o Vehicle drivers and flight crews understood that illuminated lights indicate a hazard, but lights turning off never imply a clearance.

  o The status lights were visible under good weather conditions in daylight and at night-time.

  o The lights intensity levels used in daylight and at night in good weather conditions were deemed satisfactory.

  o The lights timing was considered overall consistent with Paris-CDG operating practices. However, few concerns were expressed about some REL setting off late regarding the approaching aircraft altitude.

  o The location of the lights was considered satisfactory for optimum usability and effectiveness.

  o No increase to drivers or pilots' workload was reported.

- From the controllers' point of view:

  o Controllers were satisfied with the RWSL display on their HMI, i.e. RWSL well integrated with the ground surveillance HMI.

  o No interference of the RWSL with ATC normal safe surface operations was reported.

The main potential benefit reported is less severe and less frequent runway incursions due to an increase of runway usage awareness through accurate and timely indication of runway occupancy. It was not possible to provide quantifiable safety benefits due to the nature of the Solution (i.e. a safety net). Moreover, it would have been not safe to provoke runway incursions in live trials.

Following the SESAR activities and as part of the deployment phases, operational long duration live trials were planned in order to confirm the benefits of the solution in all weather conditions.

## Recommendations and Additional activities

The following activities are relevant once transitioned to industrialization (V4) and deployment (V5):

- Ensure airport core surveillance system performances.

- Adapt the configuration of the RWSL illumination logic to local implementations.

- Develop appropriate drivers training and pilots information.

- Develop appropriate ATCOs information to remind that the RWSL information presented on the ATCO ground surveillance HMI is not to be used to control the traffic.

- Develop operational procedures for use when RWSL is in conflict with clearances.

- Assess the impact of RWSL on communications between controllers, flight crews and vehicle drivers, to verify any impact on communication load.

- Confirm the local benefits of the Solution in non-nominal conditions (e.g. it was not possible to schedule SESAR live trials in non-nominal weather conditions).

## Actors impacted by the SESAR Solution

Airport operators, Flight crews, Airport vehicle drivers and Tower runway controllers.

## Impact on Aircraft System

There is no impact on aircraft systems.

## Impact on Ground Systems

On the Airport Operator side:

- The Airfield Ground Lighting system will need to be upgraded to provide the Runway Status Lights, i.e. the Take-off Hold Lights (THL) and Runway Entrance Lights (REL).

On the Airport Operator or ATC side (depending on the local context):

- An RWSL management processor will be needed to implement the RWSL safety logic, using the A-SMGCS surveillance data as input to switch on and off the Runway Status Lights accordingly.

On the ATC side:

- The A-SMGCS system will need to be upgraded to interface the RWSL management processor to display RWSL status information to the Tower runway controllers and to allow RWSL deactivation by the Tower supervisor.

- An enhanced A-SMGCS Core Surveillance function might be required to ensure that the Runway Status Lights are switched on/off at the right time, without downgrading the runway capacity. For instance, validation activities (cf. V3 Validation Report for the RWSL; 06.07.01-D09) highlighted that RWSL requires additional surveillance data, such as mobiles' accurate acceleration vector (even for static ones) or vertical climb rate to compute accurate vertical statuses for REL and THL. Moreover, false track reports have proven to be a nuisance for RWSL logic, and have to be filtered out at a system's level, for there is no "human in the loop" to detect and fix in real time detection problems that would lead to false REL and THL illuminations.

## Regulatory Framework Considerations

EASA, with NPA 2016-10, is proposing to include ARIWS as an AMC to ADR.OPS.B.030 Surface Movement Guidance and Control System. At this stage, the Agency is transposing the relevant ICAO provisions of Chapter 9 and Attachment A, while, at a later stage, the technical specifications of the lighting system will be incorporated into the aerodrome design Certification Specifications. It has to be highlighted that the technical specifications are based on the assumption that the runway does not have a displaced threshold. Especially for CAT II/III runways, when the threshold is displayed the Take-Off Hold Lights are interfering with the approach lights, therefore aerodrome operators should undertake specific studies on how to install the lights.

The inclusion of the ARIWS into the Agency's AMC does not however imply that this system is required, as, the Agency's objective is only to ensure that such systems have similar operational and technical characteristics and provide the same information to pilots and

vehicle drivers. Furthermore, it is considered that other measures to prevent runway incursions are available and thus this specific solution could be considered by the aerodrome operator, taking into account the efficiency of all other measures present at the aerodrome.

Further regulatory measures required from EASA:

- EASA  is going to include under ADR.OPS.B.030 in Regulation No 139/2014 the operational requirements of ARIWS, as described in ICAO Annex 14;
- EASA is going to include in the Certification Specifications for aerodrome design the technical specifications of RWSL;-
- Requirements for Flight Crews, ATCOs and vehicle drivers should also be established.-

At national level, the publication of applicable procedures for flight crews will be required for RWSL operations at the concerned airports. Additionally, the local airport regulation will need to be updated with the applicable procedures for airport vehicle drivers.

## Standardization Framework Considerations

Amendment 13 to ICAO Annex 14 introduced the Autonomous Runway Incursion Warning System (ARIWS), where RWSL is one type. The technical characteristics of the lighting system have been included in 5.3.30 in Annex 14, while 9.12 contains the operational requirements. Additional guidance is provided in Attachment A-21. Furthermore, in PANS-ATM 15.7.5 describes actions that should be taken by flight crews and vehicle drivers in relation to ARIWS warnings and the handling of conflicts between ARIWS warnings and ATC clearances.

The enabler AERODROME-ATC-16 is linked to a number of candidate standardisation activities. Some are covered by the above ICAO amendment of Annex 14, but others may require further development of the A-SMGCS standards (interface with RWSL).

## Considerations of Regulatory Oversight and Certification Activities

EASA, having analysed the submitted description of the RWSL considers that RWSL could be a mitigation measure to prevent runway incursions. The decision should be based on safety assessment, taking into account the efficiency of other measures.

## Solution Data pack

The Data pack for this SESAR Solution includes the following documents:

- Final OSED for the Runway Status Lights; 06.07.01-D10; 00.01.00; 12/09/2016. This document contains the operational requirements of the SESAR Solution.

- Final SPR for the Runway Status Lights; 06.07.01-D11; 00.01.00; 12/09/2016. This document contains the safety requirements of the SESAR Solution.

- "Operational Concept Description for the integration of the safety support tools"; 06.07.01-D05; 00.01.03; 07/11/2016. This document analyses the coexistence of the SESAR Solution with the other types of alerts, existing or forthcoming, ground based or on-board vehicles or aircraft, in the airport environment.

## Intellectual Property Rights (foreground)

The foreground is owned by the SJU.