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PJ.02-W2 AART

SAFETY SUPPORT TOOLS FOR AVOIDING RUNWAY EXCURSIONS

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

Abstract

Solution PJ.02-W2-25.1 "Enhanced runway condition awareness for runway excursion prevention" addresses a safety issue, which was initially covered in SESAR 2020 W1 in solution PJ.03b-06, i.e., the risk of runway excursions during take-off and landing. Runway excursions are the most frequent type of runway safety accident (25% of all accidents over the 2015-2019 period according to 2019 IATA Safety Report). The aim is to focus on how the risk of runway excursion can be mitigated by on-board and ground systems that help to determine and disseminate runway condition to pilots, air traffic controllers and airport operator when appropriate. In addition to safety, this solution can improve the runway capacity resilience in adverse weather situation through a better management of runway inspections and decontamination operations. This solution is targeting all airport operating environments.

Solution PJ.02-W2-25.1 is built of two cooperating systems that together aim to provide continuous awareness of the current and predicted runway condition:

- Runway Condition Awareness and Monitoring System (RCAMS) is a ground-based system operated by the Airport Operator. It performs a continuous assessment of current runway surface condition and provides a short-term forecast of runway conditions. Under Airport Operator control it disseminates this information to other stakeholders.

- On-board Braking Action Computation System (OBACS) is an airborne system generating reports of runway surface condition as sensed by the braking aircraft.

The V3 phase validation activities focused on the following operational issues:

- Precise RCAMS working method definition including in non-nominal or failure cases.

- Validation of the combined solution (RCAMS with OBACS) operational impact.

The results show that RCAMS and OBACS systems allow better Runway Condition awareness, which should help improving Airport Safety by better preventing runway excursions.

The prototype of the RCAMS system used for validation comprised also Duty Officer's HMI (covered by AO-0216) Duty Officer's HMI and system functionalities have been proved to be fully approved, operational and welcomed. It has been noticed that even greater benefits might be achieved when produced by RCAMS system Runway Condition Code would be a standardised service available to integrate with other systems, especially ATIS. RCR service integrated with other systems would not require separate monitor for ATCO; furthermore if ATIS would be an automatic consumer of RCR service the workload of tower controller would decrease. In current operating method in testes environment it's tower controllers' responsibility to update ATIS with current Runway Condition Code.

The following recommendations are expressed:

- When assessing the AOs trust in RCAMS functionalities it is important to remember that recent adoption of GRF made it difficult to accurately interpret the RC data. The validation period was at the same time the first winter season with new GRF implemented. There was still quite a lot of questions and doubts regarding which RWYCC should be the correct one. Duty Officers were learning new rules together with RCAMS system. If on deployment level better quantified benefits are required it is recommended to collect more input data from reference scenario (during longer period with degraded weather conditions) to allow reliable measurements and improvement of confidence level of gathered results.
- As a local implementation decision a reassessment of involving winter services should be made
- RCAMs Admin role and procedures should be operational at local level
- Solution is introducing a new service – Runway Condition Report, so while planning industrialisation activities it is recommended to review Service Description Document (Appendix A to Technical Specification).

Additionally solution identified following possibilities for further R&D works:

- Provide additional work on RCAMS - ATIS and RCAMS – NOTAM system integration. Bridge the automation gap between RCAMS information generation and RCAMS information dissemination, using ATIS messages, while preserving the supervisory role of Tower ATCOs. The same could apply to the integration of RCAMS with the NOTAM system. SNOWTAMs generated with the RCAMS system could be more easily used by NOTAM services to issue SNOWTAMs more effectively. This leads to the conclusion that the best solution would be to make the current and predicted RWYCC service a standardised service. RCAMS provides a service that can be used by all appropriate stakeholders (e.g., ATIS, NOTAM),
- Improve the global usability of the Predicted RWYCC and Current RWYCC for all concerned roles. Provide additional work to clearly present and distinguish the predicted runway condition from the current runway condition. Prediction of runway surface condition (Predicted RWYCC) and its dissemination currently lack any regulatory framework; a standardisation would be needed to enable operational use of Predicted Runway Condition Code offered complementarily to current Runway Condition Code by SVC-061

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1 Purpose

This contextual note introduces a SESAR Solution PJ.02-W2-25.1 (which targets a V3 maturity level in 2023 as foreseen in the H2020 Grant Agreement No 874477). It provides to any interested reader (external and internal to the SESAR programme) an introduction to the Solution PJ.02-W2-25.1 in terms of scope, main operational and performance benefits, relevant system impacts.

It introduces the technical data pack comprising the SESAR JU deliverables.

2 Improvements in Air Traffic Management (ATM)

Runway excursions are the most frequent type of runway safety accident (22% of all accidents over the 2010-2014 period according to IATA Safety Report). A runway excursion is defined as “an event in which an aircraft veers off or overruns the runway surface during either take-off or landing”. The risk of a runway excursion is increased by wet and contaminated runways, in combination with gusts or strong cross or tailwinds.

The most straightforward way to prevent such events is to give to Flight Crews clear and objective information for them to make informed decisions in the preparation and execution of take-off, approach, and landing phases. While the focus of services provided by solution PJ.02-W2-25.1 is to prevent overruns caused by the wrong estimation of runway surface condition it may also contribute to the prevention of other types of excursions by increasing the awareness of all involved actors.

The aim of solution PJ.02-W2-25.1 is to focus on how the risk of runway excursion can be mitigated by on-board and ground systems that could warn pilots, air traffic controllers, and airport operator when appropriate. Solution PJ.02-W2-25.1 is based on ground and on-board capabilities using data provided by the following ground and airborne functions:

- Runway Condition Awareness and Monitoring System (RCAMS) is a ground-based system operated by the Airport Operator. It performs a continuous assessment of current runway surface condition and provides a short-term forecast of runway conditions. Under Airport Operator control it disseminates this information to other stakeholders (especially Tower Controller).
- On-board Braking Action Computation System (OBACS) is an airborne system generating reports of runway surface condition as sensed by the braking aircraft.

Solution PJ.02-W2-25.1 provides a support service to the air traffic controllers in case of risk of runway excursion during landing operations. Runway safety and resilience to adverse weather events are improved thanks to awareness on current runway and possibly forecast conditions:

- Validation of the accurate runway surface condition information for Air Traffic Controllers and Airport Operators. The primary means of sharing runway condition knowledge should be the runway condition code (RWYCC) calculated from the following sources:
    - runway surface sensors,
    - weather sensors,
    - braking actions reported by pilots, and
    - on-board friction analysis calculated on equipped aircraft.

  The RWYCC prediction further extends situational awareness and should improve the immediate planning phase of flights with estimated landing times from current time+60’ to current time+10’. Other information (type of contaminant, depth and coverage, temperature) complement the knowledge of the runway surface condition for users.

  Advanced systems (e.g., runway sensors, runway condition models, weather observations and forecasts, braking action calculated by landing aircraft) and tools should provide the airport with a continuous assessment of runway surface condition and alert Airport Operator in case of significant change of runway conditions in comparison with the last runway condition report (RCR). The system enables Airport Operator promptly create new RCR and disseminate it to other stakeholders (especially Tower Controller).

- Validation of the ability to send a braking action from the on-board sensor to the ground system to report the runway friction condition after landing. This feedback is used to consolidate the current RWYCC which is broadcasted to the crews on arrival to establish the Runway Overrun Awareness and Alerting System (ROAAS) configuration.

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3 Operational Improvement Steps (OIs) & Enablers

Solution PJ.02-W2-25.1 covers OI Step AO-0216 — Enhanced Runway Condition Awareness with enablers defined as:

- AIRPORT-57 (required)— Runway condition awareness management system based on manual assessment, weather information and runway sensors + PIREP + machine-learning based RWY condition model and predictions
- AIRPORT - 59 (optional) — RCAMS system function to integrate aircraft observed runway braking action into runway condition information
- SVC - 061 (optional)— Runway condition report service
- SVC - 071 (optional)— Runway Braking Action service
- A/C-64 (optional)— Data transmission means supporting downlinked observed runway surface condition (aircraft side)
- A/C-84a (optional)— Braking action computation function in on-board braking action computation system (OBACS) for airliners
- A/C-84b (optional)— Braking action computation function in on-board braking action computation system (OBACS) for business jet

Optional enablers listed above: AIRPORT-59, SVC-071, A/C-64, A/C-84a and A/C-84b are needed for OBACS implementation and integration with RCAMS. They all have to be treated as a set of enablers and implemented together.

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4 Background and validation process

The subject of Improved Safety with Better Prevention of Runway Excursions for Pilots has been studied by EUROCONTROL and the FAA, and is supported by the following initiatives:

- European Action Plan for the Prevention of Runway Excursions (EAPPRE) - Edition 2.0 - EUROCONTROL,
- A Study of Runway Excursions from an European Perspective, EUROCONTROL – March 2010
- Take Off and Landing Performance Assessment (TALPA) Initiative by the FAA.

As part of the SESAR program, solution PJ.02-W2-25.1 “Enhanced runway condition awareness for runway excursion prevention” was preceded by SESAR Wave 1 PJ.03b-06 solution, which addressed the same safety issue, i.e., the risk of runway excursions during take-off and landing. Although the concept was validated at V2 level with a promising outlook, some remaining operational issues were still to be addressed in the V3 phase activities:

- Precise RCAMS working method definition especially in non-nominal situations or failures,
- Validation of the operational impact of the combined solution (RCAMS with OBACS).

To assess the maturity level of Solution PJ.02-W2-25.1, the following validation activities were conducted at V3 phase with the objective to validate the working methods and to verify safety performance gain:

- A shadow mode exercise that took place at Gdańsk Airport integrating the ground part of the solution and airborne data supply. Some aspects of the operating method were tested with the use of a DASSAULT test aircraft equipped with an OBACS system in Live Trials for the communication and information flow aspects,
- A Real-Time Simulation to address Air Traffic Controllers’ related issues (operational, human performance, safety, etc.).

5 Results and performance achievements

The main findings from the overall validation exercises are summarised next.

The Shadow-mode Trials taking place over a 5-month period during the winter season at Gdansk with a number of adverse weather conditions during which the conceptual usability of the RCAMS and OBACS systems could be evaluated. However, as with any weather-dependent evaluation, more data would have been preferred either through a longer data collection period, or through multiple-site evaluations to better generalise the results and their associated confidence levels to other airports. These considerations should apply to the next phase of evaluation.

Based on the Shadow-mode Trials as well as the real-time simulation, AO-0216 (Enhanced Runway Condition Awareness) is readily applicable as a standalone solution for Airport Operators. The operational improvement includes an increased situational awareness and safety especially for Airport Operators, by providing calculated Current and Predicted RWYCC and also reducing some of the workload dedicated to RCR/SNOWTAM formulation and its publication.

Airport Operator Role

The RWYCCs supplied by Airport Operators during flight tests appeared consistent with the deceleration experienced by the participating landing crews, following their debriefs. It is to be noted that the integration of the Predicted RWYCCs within flight crews' workspace, was lacking in the current evaluation due to lack of technical and regulatory means to share prediction with flight crew and have been recognised as a future R&D need to be covered

The RCR editor was positively evaluated as improving Airport Operators' reporting performances on the move, following runway inspections. The editor's usability allowed effective updates of the RCR/SNOWTAM information, as well as an improved access and readability of RWYCCs. Predicted condition codes were effectively calculated and pushed to Air Traffic Controllers (ATCOs), thereby reducing the delays between runway condition updates and the availability of that information to stakeholders. It was noted however, that ATCOs primarily consume the RWYCC information through ATIS publications to Flight Crews. Thus, manually copying that information to ATIS proved to be an added task, negatively impacting the workload for ATCOs. This presents an opportunity for bridging the automation gap between RWYCC generation and dissemination, which should be addressed by subsequent evaluation phases.

Airport Operators indicated that the RCAMS system was used to complement their usual working methods (phone calls and scheduled inspections), instead of replacing it, due to the limited time spent trialling the system. As such, scheduled and recurrent runway inspections were still performed, regardless of RCAMS indications. Further trust in the RCAMS calculations and predictions would also benefit from an effective integration of OBACS reports (braking action data) from landed aircraft, into the algorithm for runway surface condition calculation.

Concerning non-nominal operations, including failover and recovery procedures as well as their impact on workload and situational awareness, Airport Operators indicated being aware of the steps to follow in case such a situation arises. However, procedure execution was limitedly evaluated due to the unavailability of a dedicated Admin role. It was proved that Airport Operators with their usual methods can effectively fall-back to phone-based operations and scheduling runway inspections.

Tower ATCO Role

Due to operational safety considerations, Tower ATCOs were out of the scope of the Shadow-Mode Trials. Results relate to data collection performed during the Real-Time Simulation. ATCOs considered that they benefited from the completeness, accuracy, immediate availability of the provided RCAMS data, namely Current RWYCC, Predicted RWYCC and update notifications.

However, insofar as effective ATIS information is to be provided to airspace users, the added step of copying and pasting incoming RCAMS data (RCR) to ATIS is regarded with a negative impact on the availability of data as well as an increased workload. This is hot it’s organised now but can be eliminated with ATIS becoming an automatic consumer of RCAMS data (RCR).

Flight Crew Role

Flight Crews indicated that the accessibility of raw RWYCCs as well as the transmission delays were acceptable for providing a useful information source as a means of refining braking decisions. However, several limitations were met during the Shadow-Mode trials:

- Predicted RWYCCs were not available to Flight Crews (due to lack of any standard to disseminate predicted runway conditions), thereby not allowing the integration of such a data source into landing decisions for the target runway,

- OBACS data generated by the on-board equipment following landing, could not be technically and instantly pushed directly or in-directly to other aircrafts. Thus, the impact of up-to-date braking information for improving the decision-making of subsequent landing aircraft could not be evaluated,

6 Recommendations and Additional activities

The following recommendations and activities are relevant once transitioned to industrialisation (V4):

- When assessing the AOs trust in RCAMS functionalities it is important to remember that recent adoption of GRF made it difficult to accurately interpret the RC data. The validation period was at the same time the first winter season with new GRF implemented. There was still quite a lot of questions and doubts regarding which RWYCC should be the correct one. Duty Officers were learning new rules together with RCAMS system. If on deployment level better quantified benefits are required it is recommended to collect more input data from reference scenario (during longer period with degraded weather conditions) to allow reliable measurements and improvement of confidence level of gathered results.
- Airport Operator's training should formally integrate the RCAMS admin roles and responsibilities in both normal and degraded operations. It's also recommended to enable workload and situation awareness measures as a means of determining the impact of the concept on all concerned roles and end users' activities;
- Involvement of Winter Services should be re-assessed as a local implementation decision.
- Solution is introducing a new service – Runway Condition Report, so while planning industrialisation activities it is recommended to review Service Description Document (Appendix A to Technical Specification).

Further R&D works might be considered in relation to :

- Bridge the automation gap between RCAMS information generation and RCAMS information dissemination, using ATIS messages, while preserving the supervisory role of Tower ATCOs. The same could apply to the integration of RCAMS with the NOTAM system. SNOWTAMs generated with the RCAMS system could be more easily used by NOTAM services to issue SNOWTAMs more effectively. This leads to the conclusion that the best solution would be to make the current and predicted RWYCC service a standardised service. RCAMS provides a service that can be used by all appropriate stakeholders (e.g., ATIS, NOTAM)
- Improve the global usability of the Predicted RWYCC and Current RWYCC for all concerned roles.
- Re-evaluate the air traffic controller's performance with the RCAMS information integrated into the ATIS.

7 Actors impacted by the SESAR Solution

The actors impacted by Solution PJ.02-W2-25.1 are as follows:

Stakeholder	Why it matters to stakeholder
Airport Operator	Airport actors expect the solution to support them in performing their work under the new ICAO GRF regulations. The system is expected to be able to determine the condition of runway that is contaminated with various weather-related contaminants (e.g., water, snow). One new role is added in terms of RCAMS Admin with whom the Airport Operator must liaise in case of degraded mode operations.

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8 Impact on Aircraft System

Solution PJ.02-W2-25.1 introduces the following functions in the baseline architecture:

- Data transmission means supporting downlinked observed runway surface condition (aircraft side): Aircraft Computed Braking Action Dissemination.
- Braking action computation function in On-board Braking Action Computation System (OBACS):
    - Compute Braking Action: OBACS introduction to provide Airport with on-board computed friction measurement at landing (Braking Action which can be measured when friction was limited during braking - anti-skid activated).
    - Display Computed Braking Action: OBACS introduction to provide Airport with on-board computed friction measurement at landing (Braking Action which can be measured when friction was limited during braking - anti-skid activated)

Related to AO-0216 - Enhanced Runway Condition Awareness, OBACS is an airborne system generating reports of runway surface condition as sensed by the braking aircraft to directly feed RCAMS.

The OBACS is a new system initially developed by Airbus as CORSAIR project (now deployed as BACF: Braking Action Computation Function). For solution PJ.02-W2-25.1, OBACS benefit for bizjet aircraft was also assessed by evaluating dedicated OBACS prototype fitted on Dassault Flight test aircraft.

The solution permits using data measured by the aircraft during the landing rollout to identify the Braking Action the aircraft experienced on the runway. The new technology works by reversing the landing distance calculation process. Whereas before, the flight crew would enter a runway state and retrieve an estimated stopping distance, the new technology measures the actual length of runway used during the landing and estimates the most appropriate corresponding runway condition.

As the new technology has on-board access to all the parameters affecting the aircraft performance and which are recorded during the landing, a simulation of the conditions at landing is made. Using the recorded parameters, and accessing dedicated aircraft models, the aerodynamic and thrust forces acting on the aircraft can be reconstructed to determine the contribution of the aircraft wheels and brakes to the aircraft’s deceleration during a particular landing, and thus the contribution of the runway state.

The function aims at determining the braking action encountered during landing.

The most accurate Braking Action analysis can be performed when the anti-skid system is regulating the brake pressure. Indeed, when the anti-skid system regulates the pressure, the aircraft braking capability is limited by the runway friction.

As such, the impacts of the concepts in this document on the Aircraft Systems are limited to an integration of the RCAMS HMI within the decision-making equipment in the cockpit.

9 Impact on Ground Systems

Solution PJ.02-W2-25.1 introduces a new system (the Runway Condition Awareness and Monitoring System – RCAMS) including the following functions and services:

- RCAMS updated to integrate aircraft observed runway braking action into runway condition information:
    - Display Alert on Aircraft Braking Action Reception.
    - Parse OBACS Data.
- Runway Condition Report service.
- Runway Braking Action service.

Related to AO-0216 - Enhanced Runway Condition Awareness, RCAMS is a system that provides continuous monitoring of runway surface condition utilizing runway surface sensors, weather sensors, on-board computed braking action when available, as well as short term forecast computed by model, which is presented to the Airport Operator or, indirectly, to any interested stakeholder (dispatcher, MET office, etc.). The Airport Operator receives reliable and objective information on the runway condition automatically and seamlessly. The runway condition model integrates available data to calculate type of contaminant, depth, coverage and corresponding RWYCC to alert Airport Operator in case of significant change of runway conditions in comparison with the last runway condition report (RCR). The system enables Airport Operator promptly create new RCR and disseminate it to other stakeholders (especially ATCO).

RCAMS raises awareness of runway conditions among various stakeholders, such as the Airport Operator, ATCO, pilots, and the AOC, by sharing seamlessly up-to-date information. This service is particularly valuable in situations where adverse weather conditions and runway surface conditions have changed and/or deteriorated rapidly. However, even when weather conditions are stable or do not result in a significant degradation of runway condition (e.g., drizzle on a dry runway, which can reduce the RWYCC from 6 to 5), the continuous and non-disruptive monitoring of runway condition by RCAMS, fed by information from the integrated surface condition sensors, can reduce the number of runway inspections.

10 Regulatory Framework Considerations

RCAMS developed in current SESAR Solution is expected to be a support for the airport authority to comply with the new requirements of the Global Reporting Format, transcript in EASA Notice of Proposed Amendment (NPA) 2018-14.

The standards and regulations that are applicable to the SESAR Solution PJ.02-W2-25.1 are listed below:

EASA

- EASA NPA 2016-11 (Review of aeroplane performance requirements for commercial air transport operations) proposes standards for runway surface condition reporting, airworthiness standards for landing performance computation at time of arrival, an in-flight assessment of landing performance at time of arrival as well as a reduced required landing distance for business aviation operations with performance class A aeroplanes and for performance class B aeroplanes operations.
- EASA NPA 2018-14 (Runway Safety). The objective of this NPA is to mitigate the safety risks associated with runway safety, from an aerodrome's perspective, focusing mainly on the prevention of runway incursions and on runway surface condition assessment and reporting, but also addressing issues such as ground collisions, runway confusion, foreign object debris (FOD)- related occurrences as well as runway pavements' maintenance.
- GRF implementation in EU:
    - EU 2019/1387 209 amending Commission Regulation N° 965/2012 AIR OPERATIONS.
    - EU 2020/469 amending Commission Regulation N° 923/2012 SERA.
    - EU 2020/767 amending Commission Regulations N° 2019/1387 and 2020/469: 6 months shift from 5 November 2020.
    - EU 2020/1176 amending Commission Regulation N° 2019/1387: applicability set to 12 August 2021.
- EASA Notice of Proposed Amendment (NPA) 2018-12 - The objective of this NPA is to address the safety issue of runway excursions that occur during landings. This NPA proposes to require the installation of a runway overrun awareness and alerting system on new large aeroplane designs (CS-25), and on certain new large aeroplanes operated in commercial air transportation (CAT) and manufactured after a predetermined date (Part-26/CS-26). The proposed regulatory changes are expected to increase safety by supporting the flight crew during the landing phase in identifying and managing the risk of a runway excursion. This should reduce the number of runway excursions that occur during landings.

EUROCAE

- ED-250 – Minimum Operational Performance Standard for a Runway Overrun Awareness And Alerting System.
- ED-292 - Minimum Aviation System Performance Standards (MASPS) for Runway Weather Information Systems.

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ICAO

- Guidance: Circular 355 (detailed procedures for generating condition reports are available in the PANS-Aerodromes. This is revised Circular 329 with updated guidance material and the new Aeroplane Performance Manual).
- Procedures for Air Navigation Services — Aeronautical Information Management (PANS-AIM, Doc 10066): Harmonization of AIS/AIM procedures; and SNOWTAM format. From the Solution perspective, important part of the document is: Appendix 4. SNOWTAM format in ICAO Doc 10066.
- ICAO EUR NAT: Guidance on the Issuance of SNOWTAM.
- ICAO Doc 10064 Aeroplane Performance Manual. This manual was developed to combine guidelines on certification and operational requirements regarding aeroplane performance. It was developed in the context of the Friction Task Force of the Aerodrome Operations and Services Working Group on the basis of existing and proposed national regulations, Annex 6 Attachment C and the proposals of the FAA Take-off and Landing Performance Aviation Rulemaking Committee (TALPA ARC).
- International Civil Organization (ICAO) State Letters AN 10/1.1, AN 11/1.3.33, AN 11/6.3.32, AN 3/5.13, AN 4/1.2.29, AN 2/2.7, AN 13/2.1, AN 4/27 and AN 2/33-20/73 – Amendments 45 to Annex 6, Part I; 107 to Annex 8; 16 to Annex 14, Volume I; 42 to Annex 15; 10 to PANS-ATM (ICAO Doc 4444); 4 to PANS-Aerodromes (ICAO Doc 9981); and 2 to PANS-AIM (ICAO Doc 10066): applicability set to 4 November 2021.
- International Civil Aviation Organization (ICAO) State Letters 2016/12 and 2016/29.
- ICAO Vision on use of PIREP for Runway Surface Condition Reporting.

FAA

- AC91-79A: Mitigating the Risks of a Runway Overrun Upon Landing
- AC 150/5200-30D: Airport Field Condition Assessments and Winter Operations Safety
- Mention in AC 150/5200-28F - Notices to Airmen (NOTAMs) for Airport Operators
- AC25-32: Landing Performance Data for Time-of-Arrival Landing Performance Assessments.

TALPA ARC group submitted its proposals for changes to FAA regulation in May 2009. TALPA proposals have been integrated into a series of advisory documents. Safety Alert For Operators 16009 list the main sources relevant to airlines, while guidance for manufacturers and airports is the object of several Advisory Circulars (part 25 for certification, and part 150 for airports).

11 Standardization Framework Considerations

The solution is compatible with ICAO regulations related to the runway condition reporting (Global Reporting Format - RWYCC) according to the Runway Condition Assessment Matrix (RCAM).

Prediction of runway surface condition (Predicted RWYCC) and its dissemination currently lack any regulatory framework. A standardisation would be needed to enable operational use of Predicted Runway Condition Code offered complementarily to current Runway Condition Code by SVC-061.

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12 Solution Data pack

The Data Pack for this solution includes the following documents:

- SESAR Solution PJ.02-W2-25.1 SPR-INTEROP/OSED for V3 – Part I (D7.1.002) Ed. 00.03.03 from 02 May 2023.
- SESAR Solution PJ.02-W2-25.1 SPR-INTEROP/OSED for V3 – Part II (D7.1.002) Ed. 00.00.02 from 17 April 2023
- SESAR Solution PJ.02-W2-25.1 SPR-INTEROP/OSED for V3 – Part IV (D7.1.002) Ed. 00.02.01 from 28 December 2022
- SESAR Solution PJ.02-W2-25.1 SPR-INTEROP/OSED for V3 – Part V (D7.1.002) Ed. 00.02.01 from 10 March 2023SESAR 2020 Solution PJ.02-W2-25.1: Validation Report (D7.1.0011) Ed. 00.01.11 from 25 April 2023
- SESAR PJ02-W2-25 CBA Ed. 00.00.04 from May 2023,
- SESAR Solution PJ.0-W2-25.1 TS-IRS (Final) for V3 (D7.1.007) Ed. 00.02.05 from 28 April 2023

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