International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Third Meeting of the Programmes and Projects Review Committee (PPRC/3)
(Mexico City, Mexico, 21 to 23 July 2015)

Agenda Item 3: Review of the GREPECAS Programmes and Projects

3.5 Projects of the Aerodromes Programme (B0-SURF and B0-ACDM)

RUNWAY EXCURSION MITIGATION

(Presented by United States)

SUMMARY

The 2014-2016 Global Aviation Safety Plan (GASP) states that improvement in runway safety performance is one of three global safety priorities. Within this priority, ICAO determined that the mitigation of runway excursions is one essential element necessary for the achievement of this global safety priority.

Noting the importance of the runway safety, GREPECAS has also emphasized projects throughout the region to improve runway safety through such activities as runway safety teams and workshops on best practices to prevent runway incursions and excursions.

This Working Paper provides various aerodrome-specific technical solutions for implementation within the CAR/SAM Regions. All aerodrome-specific technical solutions relate to either aerodrome designs or aerodrome maintenance, most covered by Annex 14, Volume I.

Regarding their implementation, the Working Paper promotes the GASP objective that: *"As an integral part of the GASP, Regional Aviation Safety Groups (RASGs), together with Regional Safety Oversight Organizations (RSOOs) will harmonize all activities undertaken to address aviation safety issues specific to each ICAO region."*

Hence, this Working Paper proposes the expansion in the scope of existing runway excursion programs to implement aerodrome-specific technical solutions as part of the work programs for GREPECAS and for all RASGs within the CAR/SAM Regions.

Additionally, the United States Federal Aviation Administration (FAA) Office of Airports will lend its technical support to the ICAO CAR/SAM Regional Offices for their effective implementation.

References:	
• ICAO 2014-2016 Global Aviation Safety Plan • ICAO Annex 14, Volume I, Aerodromes Design and Operations • ICAO PASG/1-DP/8 dated 1 November 2009 • FAA Advisory Circular (AC) 150/5300-13A, Airport Design • FAA AC 150/5320-12, Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces • FAA AC 150/5220-22, Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns • FAA AC 150/5340-18, Standards for Airport Sign Systems	
Strategic Objective:	• Safety

1. Introduction

1.1 Runway excursions are a common problem associated with aviation accidents; therefore it is important for aerodrome operators to create a safe environment within the airfield for the operation of aircraft while minimizing their risks to runway excursions and their consequences. Annex 14, Volume I identifies various safety practices that include both the design of airfield infrastructures and operational maintenance programs. Paragraph 2 of this Working Paper provides these common aerodrome-specific technical solutions.

1.2 In accordance with ICAO's iSTARs, GREPECAS States have an effective implementation rate of 60.46% of aerodrome standards and recommended practices. Many of these deficiencies fall under Critical Element 4 - *Technical personnel qualification and training* and Critical Element 7 *Surveillance Obligations*.

2. Discussion

Aerodrome-Specific Technical Solutions

2.1 *Rubber Removal:* Landing and braking aircraft will typically leave tire rubber embedded in any available surface voids (please see figure 1). It is well documented that rubber build-up will negatively impact aircraft braking action. Wet runway conditions furthermore, reduce aircraft braking actions due to loss of the pavement/tire friction interphase. Because monitoring runway surface friction is an important safety function for aerodrome operators, the CAR/SAM Regions should implement programs for the timely removal of rubber-buildup (please see *FAA AC 150/5320-12*). The four most popular methods of removing rubber build-up consist of water blasting, chemical removal, shot blasting and mechanical removal.

Figure 1: Excessive rubber buildup on the runway

2.2 *Longitudinal Grading of Final ¼ of Runways:* Overshoot and undershoot are critical safety events to be mitigated. The first and last ¼ of longitudinal runway grade for code 3 and code 4 runways play an important safety role in mitigating such incidents. The grades maintained within these runway segments enhance the pilot's visibility, performance of instrument approach systems, and the performance of aircraft braking action. For example, excessive downward slopes at the stop end of a runway only lengthen the stoppage distance of an aircraft, while an excessive upward slope at the approach end of a runway causes pilots (human factor) to over shoot the touchdown zone. Physical characteristics, such as runway lights and aiming points are better acquired when the first and last ¼ of the runway grades are constructed within the standard parameters. Airport Design Advisory Circular *AC 150/5300-13* clearly prescribes the appropriate runway longitudinal grade profile.

2.3 *Runway Markings, Signage, and Lighting*: Compliance and maintenance of runway markings, signage, and lighting in accordance with Annex 14, Volume I support the mitigation of runway excursions. Hence, Runway Excursion Programs with a RASG work program should contain tasks that determine the level of satisfactory compliance by these runway features.

2.4 *Distance Remaining Signs (DRS):* DRS provide situational awareness for pilots to determine more quickly the distance remaining after touchdown or during take-off operations from both runway ends. Such signage along the runway offers pilots the ability to determine available runway length to: (1) execute safe deceleration during landing operations, (2) accelerate, rotate and lift-off during take-offs, and (3) safely abort a take-off. In accordance with FAA AC 150/5340-18, DRS are placed at 1000-foot intervals (300 meters) as shown in figure 2. Although the installation of DRS plays a helpful role in the United States, Annex 14, Volume I does not recognize this signage practice for runways. Hence this Working Paper proposes for the ICAO CAR/SAM Regions to requests ICAO Headquarters, Montreal, that Annex 14, Volume I contain Distance Remaining Signs.

Figure 2. Distance remaining signs along a runway; close-up view of an individual installation

2.5 *Runway Grooving and USOAP:* The CAR/SAM Regions are known for their high intensity short duration and frequent tropical storms. The use of transverse grooves or pavement channeling (6mm x 6mm spaced at 38mm apart) across the runway surface enables water runoff to flow with lesser depth beneath the tires footprint(please see figure 3). The presence of grooves does not increase the frictional characteristics of the pavement; it does however reduce the risk of hydroplaning. (Please see FAA AC 15/5320-12). This Working Paper further makes note of the result of the April 2005-December 2008 USOAP audit. That audit revealed the lack of reporting of wet runways (70%) as the second highest non-compliant Annex 14 provisions (Reference: PASG/1-DP/8 dated 1 November 2009).

Figure 3. Standard (Left) and Trapezoidal (Right) Grooves Side by Side

2.6 *Runway End Safety Areas (RESAs) and Arrestor Bed Systems*: Unfortunately, not all runway excursions can be avoided. In such cases, Annex 14 prescribes the design feature of a runway end safety area beyond the runway ends as a proven means to minimize personal injury and minimize aircraft damage during excursion events and undershoots. The Annex prescribes both a standard length and a longer recommended length for RESA. Although the Annex prefers that aerodromes comply with at least the standard length (availability of terrain), it still recognizes that many aerodromes are land-constraint. Under such a case, the Annex offers several design options to comply with the standard length or the recommended length. The principal design options are the use of declared distances and the installation of an arrestor bed system to achieve the equivalent of a desired RESA length. Arrestor bed systems are known in the United States as EMAS which states for "Engineered Materials Arresting System" (please see FAA AC 150/5220-22). Figure 4 shows the original arrestor bed systems installed in United States over the past couple of decades. Just recently, the FAA technically accepted a second type of EMAS that uses different materials as shown in figure 5.

Figure 4. Aerial photo showing the original, materially-designed arrestor bed system installed off Runway 26 at Burbank Airport, Burbank, California

Figure 5. Ground photo showing the newest, materially-designed arrestor bed system installed off Runway 22L at Midway Airport, Chicago, Illinois

2.7 EMAS is a critical aspect of the United States Runway Safety Area (RSA) Program for all runway ends to have a RSA. It is noted that the FAA RSA begins at the end of the runway (or stopway) as compared to the Annex, RESA which starts beyond the runway strip. For the United States, several RSA improvements were only possible by installing EMAS arrestor bed systems primarily to overcome the lack of sufficient terrain. Currently there are 83 EMAS installations at 53 airports in the United States with 15 planned installations at 12 more airports. In terms of return benefits, EMAS has played a role in 9 aircraft overruns that were safety arrested and resulting in a total 243 passengers and crew avoiding personal injury. There were no fatalities.

3. Recommended Actions

3.1 The Meeting is invited to take note of the:

a) Aerodrome-specific technical solutions to mitigate runway excursions and their aftermath.

b) Proposal to expand the scope of existing runway excursion mitigation programmes to implement aerodrome-specific technical solutions as part of the work programmes for GREPECAS and for all RASGs within the CAR/SAM Regions.

c) Proposal for ICAO CAR/SAM Regional Offices to requests ICAO Headquarters, Montreal, that Annex 14, Volume I contain Distance Remaining Signs.

d) Willingness by the FAA Office of Airports to lend its technical support to ICAO CAR/SAM Regional Offices for effective implementation of aerodrome-specific solutions; and

e) Note the referenced FAA Advisory Circulars (hyperlinked).

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