International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Seventh Meeting of the GREPECAS Aerodromes and Ground Aids/Aerodrome Operational Planning Subgroup (AGA/AOP/SG/7)
Buenos Aires, Argentina, 9 to 13 November 2009

Agenda Item 4 **Review of Task Forces Activities, CARSAMPAF and ALACPA**
4.1 Report of the Runway Strips and Runway End Safety Areas (RESA) Task Force

REPORT BY THE RUNWAY STRIPS AND RUNWAY END SAFETY AREAS [RESA] TASK FORCE ON THE OUTCOMES BY THE AERODROME DESIGN WORKING GROUP RELATIVE TO RUNWAY STRIPS, RESA, EMAS, AND PANS-AGA

(Presented by the Rapporteur)

SUMMARY

The 7th meeting of the Aerodrome Design Working Group, under the Aerodromes Panel, was held in Montreal, Canada from 14 to 16 July 2009. The agenda covered various subjects that included (1) the definition and specifications for Runway End Safety Areas [RESA], (2) acceptability of Engineered Materials Arresting Systems [EMAS], (3) development of a *Procedures for Air Navigation Services-Aerodromes* [PANS-AGA] document, and (4) tasks associated with the continued review of Annex 14, Volume 1, *Chapter 3, Physical Characteristics*.

This Working Paper provides members of AGA/AOP/7 with the more significant proposed changes by ADWG to Annex 14, Volume I that may affect runway strips and RESAs

References:

- Annex 14, Vol. I *Aerodrome Design and Operations.*

Strategic Objectives	*This working paper is related to Strategic Objectives A and D.*

1. Introduction

1.1 The Aerodrome Design Working Group [ADWG] under the Aerodromes Panel [AP] is tasked with reviewing Chapters 1, 2, and 3 of Annex 14, Volume I for possible changes to existing standards and recommended practices [SARP], the introduction of new SARPs, and other necessary changes to the Annex. The two major tasks assigned by AP to ADWG are (1) a comprehensive review of Chapter 3 SARPs and (2) the development of a new document, namely a PANS-Aerodromes [PANS-AGA] document which will offer aeronautical solutions for aerodrome operators at existing aerodromes that are unable to meet a SARP.

1.2 The topics of runway end safety areas [RESA], runway strips, and alternative mitigation measures to achieve RESA have been discussed virtually in all ADWG meetings. This DP provides the latest efforts by ADWG relative to these topics.

1.3 Since the U.S. representative to ADWG additionally serves as the U.S. representative to GREPECAS and the AGA/AOP/SG, any design questions by AGA/AOP/SG and conclusions adopted by GREPECAS have been presented to ADWG. This has helped ADWG to better understand the needs GREPECAS Member States during their review.

2. **Outcomes relative to RESA**

2.1 **DP/14/ADWG/4 in Sept 2007** alerted the members that paragraph 3.5.1 of Annex 14, Volume I did not have any SARP for a RESA off code numbers 1 and 2 non-instrumented runways. Table 1 shows this omission. Regarding runway strips, Table 2 shows that only precision runways must have a runway strip, i.e., a standard.

Table 1. Incomplete coverage of RESA safety enhancements under paragraph 3.5.1

	International Runway By Types X = Standard		
Code Number	***Precision***	***Non-Precision***	***Visual***
1	***x***	***x***	***NA***
2	***x***	***x***	***NA***
3	***x***	***x***	***x***
4	***x***	***x***	***x***

Table 2. Inconsistent runway strip safety enhancements under paragraphs 3.4.3, 3.4.4 and 3.4.5

	International Runway By Types		
Code Number	***Precision***	***Non-Precision***	***Visual***
1	***Standard***	***recommended practice***	***recommended practice***
2	***Standard***	***recommended practice***	***recommended practice***
3	***Standard***	***recommended practice***	***recommended practice***
4	***Standard***	***recommended practice***	***recommended practice***

2.2 To eliminate the RESA inadequacy, ADWG agreed to propose a recommended practice that such runways have a 30 meter RESA beyond the edge of the runway strip. The value of 30 meters, which was considered as a starting point, was derived in part from the current practices in The Netherlands and the United States. Both of these Member States use larger values; USA uses at least 42m and the Netherlands uses 60m. ***Appendix A*** *of thisWP* provides the proposed change (at this time) and necessary modifications to paragraphs 3.5.1 – 3.5.5. The subject of table 2 for runway strips was not discussed.

2.3 **Brazilian delegation presented DP/3/ADWG/7** to describe how the USFAA methodology for evaluating EMAS was applied at ***Sao Paulo Congonhas Airport.*** The importance of the Brazilian application is that Brazil selected a different design exit speed lower than 70 knots for their EMAS installations. Furthermore, the Brazilian evaluation process involved simulators tests with the Boeing Company. As previously reported to AGA/AOP/SG, the USFAA design standard assumes a 70 knot entry speed by the errant airplane into the EMAS with no reverse thrust capability, poor runway friction [mu = 0.25], and poor airplane braking (consistent with aircraft certification standards) Reference: USFAA *Advisory Circular 150/5220-22, Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns.* http://www.faa.gov/airports/resources/advisory_circulars/

2.4 **Subsequent discussion within ADWG/7 resulted in the following key points:**

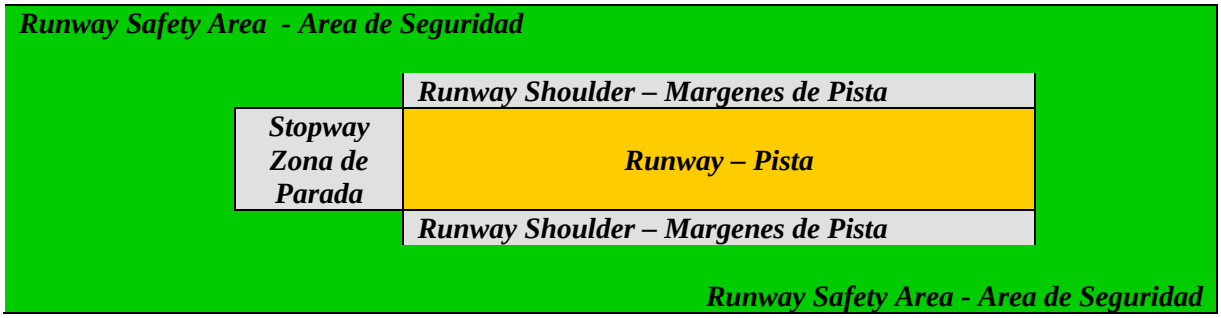
a) There was broad agreement for inclusion of some reference supporting the concept of *"equivalence"* for achieving RESA SARPs by alternative means, like EMAS, when it was not physically possible. Some indicated a preference to do so but it was agreed that the equivalence concept should be included but without specifying a particular system or methodology. For example do not only mention EMAS.

b) Noting the difference between the ICAO and FAA safety areas concepts, the purpose of RESA needed to be clarified, which could then help determine characteristics and specifications more closely related to the purpose for having the RESA.

c) ADWG members agreed that for short RESAs (less than 90m), EMAS would provide suitable equivalence.

d) Additional discussion covered the specifications for the length of RESAs. There was great support for the Recommended Practice length of 240 m. However, there was insufficient support to elevate this Recommended Practice to a Standard.

2.5 **Merging RESA with the Graded Portion of the Runway Strip as a Single Design Element.** A separate discussion described the U.S. FAA design application that combines the RESA with the graded portion of the runway strip into a *single rectangular* design feature called by the US FAA as the "Runway Safety Area" [see figure]. It is important to notice that Figure 4.1 illustrates that the width of the US FAA RSA equals the ICAO recommended width of the RESA instead of the standard width. This is done in order to obtain a perfect rectangular shape. No conclusion or support for any change was agreed to. Instead, it was agreed that the French DGAC would develop a proposal to consolidate RESA and runway strip (into a runway safety area concept) for the Chapter 3 Review, with the Secretary providing data.



3. **Outcomes relative to EMAS**

3.1 There was broad agreement for the use of EMAS as a proven means to achieve some level of equivalence (alternative) for lengths of RESA. Members agreed that for short RESAs of less than 90m, EMAS would provide suitable equivalence. It was also agreed that guidance material should be developed by ADWG once the inclusion of the equivalence concept for the RESA had been agreed to by AP**.**

3.2 **The ADWG Rapporteur briefed the meeting** on his visit to the US EMAS manufacturer and an airport so as to provide additional subject material for the ADWG to consider. The paper and subsequent questions highlighted several assumptions behind EMAS**:**

a) An EMAS system is set back 75 feet [23 m] from the runway end to reduce blast and undershoot risks;

b) The design standard assumes a 70 knot entry speed by the errant airplane with no reverse thrust, poor runway friction [0.2 mu] and poor braking (consistent with aircraft certification standards);

c) The design length for EMAS can be modified by changing these standards;

d) Based on the 70 knot speed an aircraft will stop at the end of the bed.

e) Different assumptions (e.g. restricted aircraft weights or reduced target entry speeds) could influence system length.

3.3 As a result, ADWG supported these assumptions. The importance for their support is that any Member State using the above assumptions with a targeted critical airplane could provide a proven, measured performance to assess State practices. Thus, they offer the Member State the ability as a good baseline to conduct a RESA assessment and to develop and justify an alternative for ANNEX 14 RESA SARPs. This opportunity is exactly what Brazil practiced (see section 2.2.)

4. Other relative outcomes

4.1 **Open Drainage/Ditches within the Runway Strip.** From 30 July – 3 August, 2007 the AGA/AOP *Runway Strips and RESA Task Force* meet in Lima, Peru at the ICAO Regional Office to discuss alternative methods to achieve RESA and to identify ambiguities in ANNEX 14, Volume I. One important design question resulting from the meeting was the need for ICAO Montreal to clarify whether or not an open drainage ditch is permissible within the runway strip. This practice is important to countries known to receive frequent rains, e.g., many GREPECAS Member States. The primary question for Montreal, ICAO was the use of an open drainage/ditch located *outside the graded portion* of the runway strip.

4.2 During ADWG/7, Brazil and the U.S. sought a clarification to the question. A discussion followed on the purpose of the runway strip, notably whether an open or other such features could be sited within or beyond the graded portion of the runway strip. The Secretary pointed out that ICAO considers that ditches (open) would be obstacles, as obstacles need not just point upwards and suggested that accident data (runway excursions, veeroffs) might show the percentage of excursions that go beyond the dimensions of the graded portion of the runway strip. Further discussion did not result in a final statement by the Secretary or ADWG. It is expected that ICAO Montreal will obtain excursion data for their review prior to any final decision. The next ADWG/8 meeting is scheduled for February 2010.

5. O**utcomes relative to PANS-AGA development**

5.1 **ADWG, formerly the Aerodrome Design Study Group,** over the past decade has been unable to reach sufficient consensus on several airport design practices. Created in the early 1990s to develop Code F SARPs, the members are unable to agree on certain design features, such as, width of Code F runways, separation of parallel taxiways, and size of safety areas. In response the Air Navigation Commission recognized that it would not be possible to resolve all of the safety and efficiency challenges facing **existing** aerodromes worldwide in their day-to-day operations through an amendment of the aerodrome design provisions in Annex 14, Volume I. This was particularly evident where larger airplanes needed to be accommodated and/or the development of the aerodrome is constrained. For example, during ADWG/7 there was opposition from several ADWG members to issuing notes in ANNEX 14 to modify a standard. The best recourse would be addressing the difficulty by the forthcoming PANS-Aerodrome document. The ANC therefore determined to develop a PANS-Aerodrome document to address aerodrome operational issues.

5.2 The importance of the PANS-AGA is that it will provide individuals with proven methodologies, alternatives to commence aeronautical studies.

5.3 **The Secretary** informed the meeting that a State Letter had been issued inviting members from participating states to join the **Pans Aerodromes Study Group (PASG**), which had been set a target to complete the their task by December 2011, i.e., a PANS-AGA document. He expected that the PASG would meet a minimum of 3 times but that much of the work would be completed and managed by email correspondence between meetings.

6. Action by the AGA/AOP/SG

6.1 Members take note of the reported outcomes by ADWG/7 under AP.

6.2 Members take note that the Air Navigation Commission [7th meeting of its 180th Session on 26 February 2009] agreed to the establishment of a study group to be named as the PANS-Aerodromes Study Group [PASG] to assist the Secretary to progress the task for developing a *Procedures for Air Navigation Services-Aerodromes* document to address procedures for aerodrome operational management.

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APPENDIX A

ADWG/7 PROPOSED RECOMMENDED PRACTICE FOR RESA FOR CODE NUMBERS 1 AND 2 NON-INSTRUMENTED RUNWAYS

This appendix provides you the proposed agreed to changes shaded by the ADWG. It is noted that the proposals may still be modified by ADWG. The proposals cover the definition of RESA, the recommended practices for code numbers 1 and 2 non-instrumented runways, and a Guidance Note informing the reader about the use of proven alternative, equivalent mitigating measures to achieve recommended RESA lengths. It is expected that the proposals will be presented to the Aerodromes Panel [AP] in 2010 for discussion and their endorsement. If endorsed by AP, the proposal will proceed to the Air Navigation Council for adoption.

1.0 Proposed Changes to RESA Definition

As a reminder, the existing definition for RESA is:

Runway end safety area (RESA). An area symmetrical about the extended runway centre line and adjacent to the end of the strip primarily intended to reduce the risk of damage to an aeroplane undershooting or overrunning the runway.

Proposal:

Runway end safety area (RESA). An area symmetrical about the extended runway centre line and adjacent to the end of the runway (strip) intended to reduce the risk of damage to an aeroplane overrunning the runway by helping it to stop on this area, or an aeroplane undershooting by helping it to continue landing, and, as required, by facilitating the movement of rescue and fire fighting vehicles.

Also, please see section 3.0

2.0 Proposed Changes to Paragraph 3.5, Runway end safety areas

3.5.1 A runway end safety area shall be provided at each end of a runway strip where:

- the code number is 3 or 4; and
- the code number is 1 or 2 and the runway is an instrument one.

3.5.2 **Recommendation**:- A runway end safety area should be provided at each end of a runway strip where the code number is 1 or 2 and the runway is a non-instrument one.

Dimensions of runway end safety areas

~~3.5.2~~ 3.5.3 A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m where.

- the code number is 3 or 4; and
- the code number is 1 or 2 and the runway is an instrument one.

3.5.4 **Recommendation**:-A runway end safety area should extend from the end of a runway strip to a distance of at least 30 m where the code number is 1 or 2 and the runway is a non-instrument one.

3.5.~~3~~ 5 **Recommendation**:- A runway end safety area should, as far as practicable, extend from the end of a runway strip to a distance of at least:

- 240 m where the code number is 3 or 4; and
- 120 m where the code number is 1 or 2 and the runway is an instrument one.

unless equivalent mitigating measures are in place.

Note: Guidance on equivalent mitigating measures is provided in ….(to be determined).

3.5.~~4~~ 6 The width of a runway end safety area shall be at least twice that of the associated runway.

3.5.~~5~~ 7 **Recommendation**:- The width of a runway end safety area should, wherever practicable, be equal to that of the graded portion of the associated runway strip.

Objects on runway end safety areas

3.5.~~6~~ 8 **Recommendation**:- An object situated on a runway end safety area which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.

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3.0 Guidance material for proven mitigation alternatives

The proposed guidance will be within paragraph 3.5.

At an existing airport, where it is not possible to comply with the ICAO Recommendation of 240 metres for code 3 and 4, an aeronautical study should be performed taking into account specific criteria for example runway length, type of aircraft operations, runway slope, to identify if additional mitigations measures are needed.. Alternative solutions may include but not limited to providing a proven arrestor system, other equivalent mitigating measures, or reducing declared distances.

(A decision was made by ADWG to leave the existing definition as is, but add a note under the Runway end safety area Section saying “the purpose of a runway end safety area is to help an aeroplane overrunning the runway to stop…..FRR” (using similar wording above….covering three elements: overrunning, undershooting and facilitating RFF.

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