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**International Civil Aviation Organization
South American Regional Office**

**THIRD WORKSHOP/MEETING OF THE SAM IMPLEMENTATION GROUP (SAM/IG/3)
REGIONAL PROJECT RLA/06/901**

Lima, Peru, 20 to 24 April 2009

Agenda Item 4: Standards and procedures for performance-based navigation operations approval

REVIEW OF THE SURVEY FORM ABOUT AIRCRAFTS PBN CAPABILITY

(Presented by the Secretariat)

SUMMARY

This working paper presents a review proposal of the survey form about aircrafts PBN capability.

References:

- Regional Project RLA/99/901
- SAM/IG/2 Report
- PBN region CAR/SAM Route Map

1. Introduction

1.1 During the Second Workshop/Meeting of SAM Implementation (SAM/IG/2) (Lima, Peru, 3 to 7 November 2008), the Meeting was informed that the Regional Safety Oversight Cooperation System (SRVSOP) is providing support in the developing of the guidance material related to aircrafts and operators approvals for the implementation of PBN in the region and that the process for those approvals consider the capability evaluation of the aircrafts as well as of the Airlines.

1.2 In this respect, the Meeting approved the proposal to develop a survey addressed to all SAM Region States, to identify each aircraft by its registration number against its PBN capability. To carry on this survey, SRVSOP developed a survey form about PBN aircraft capabilities which was included in Appendix D to the Report about Item 2 of the Order of Business of SAM/IG/3.

2. Analysis

2.1 When analyzing the survey form about PBN capability of aircrafts, it may be observed that there exists just one box named APCH which means approach.

2.2 In accordance with Doc 9613 of the International Civil Aviation Organization (ICAO) – Performance Based Navigation Manual (PBN), exist two types of RNP navigation specifications for approach operations, RNP approach (RNP APCH) and RNP authorization required approach (RNP AR APCH).

2.3 Once the guidance documents have been developed for this two RNP navigation specifications, it can be noticed that both approaches are different and that they need different requirements, reason why the Survey form should include two boxes, one for RNP APCH operations and another for RNP AR APCH operations, based on the following detailed analysis:

RNP VALUES

According to the new Doc 9613 – PBN manual, procedures design is base on the following RNP values in nautical miles (NM):

	RNP APCH	RNP AR APCH
- Initial segment:	1	1 to 0.1
- Intermediate segment:	1	1 to 0.1
- Final segment:	0.3	0.3 to 0.1
- Missed approach segment:	1	1 to 0.1

PROCEDURES CHACARTERISTICS

The characteristics of the procedures are the following:

RNP APCH

- This procedure is designed only for approaches with straight segments.
- An RNP APCH approach may be designed with or without barometric vertical navigation (baro-VNAV).
- When is designed with baro-VNAV it is transformed in an approach procedure with vertical guidance (APV).
- When it is not designed with baro-VNAV is just a non-precision approach (NPA).

RNP AR APCH

This procedure is designed for the following characteristics (procedures subgroups or subtypes) which should be used only on the occasions where there is a specific operational need or benefit.

- *To fly a published arc, also known as a leg with a constant radius arc to a fix (RF leg);*
- *Reduced lateral obstacle evaluation area on the missed approach (also referred to as a missed approach requiring RNP less than 1.0).*
- *RNP AR APCH approach that uses a line of minima less than RNP 0.3 and/or a missed approach that requieres RNP less than 1.0.*

These approaches require to be designed with positive barometric vertical guidance. They must be approved for lateral navigation (LNAV) as well as for vertical navigation (VNAV), reason why it becomes an approach procedure with vertical guidance (APV).

EQUIPMENT REQUIREMENTS

Systems, equipment and functions needed for each type or subtype of approach are the following:

RNP APCH

- The GNSS (GPS) is the primary navigation system that supports RNP APCH procedures. The missed approach segment may be based upon the conventional NAVAIDS (e.g., VOR, DME, NDB).
- The GNSS (GPS) may be a stand-alone system or may be used as a sensor of a multi-sensor system (e.g., an FMS).
- The multi-sensor systems may use other sensor combinations such as DME/DME or DME/DME/IRU that provide the navigation performance acceptable for RNP AR APCH. However, such cases are limited due to increased complexity in the NAVAID infrastructure requirements and assessment, and are not practical or cost effective for widespread application.

RNP AR APCH

- The GNSS (GPS) is the primary navigation system that supports and sustains RNP AR APCH procedures too, although, the aircraft's RNP system automatically determines aircraft position in the horizontally plane using data inputs from the following types of positioning sensors (not listed in specific order of priority or combination):
 - ✓ Global Navigation Satellite System (GNSS).
 - ✓ Inertial Navigation System (INS) or Inertial Reference System (IRS), with automatic position updating from a suitable radio based navigation equipment.
 - ✓ Distance Measuring Equipment (DME) giving measurements from two or more ground stations (DME/DME)

Note.- Depending upon the infrastructure of DME, an operator may use DME/DME position updating as a reversionary means during an approach or missed approach. This function must be evaluated case by case and approved at the operational level.

RNP AR APCH with RF legs:

- ✓ The navigation system must have the capability to execute leg transitions and maintain tracks consistent with an RF leg between two fixes.
- ✓ The aircraft must have an electronic map display of the selected procedure.
- ✓ The FMC, the flight director system and the autopilot must be capable of commanding a bank angle up to 25 degrees above 400 feet AGL and up to 8 degrees below 400 feet AGL.

- ✓ Upon initiating a go-around or missed approach (through activation of TOGA or other means), the flight guidance mode should remain in LNAV to enable continuous track guidance during an RF leg.
- **Requirements for RNP AR APCH to less than RNP 0.3.**- Normally, the aircraft must have at least the following equipment:
 - ✓ Dual GNSS sensors;
 - ✓ Dual FMS;
 - ✓ Dual air data systems;
 - ✓ Dual AP; and
 - ✓ A single inertial reference unit (IRU).
- **Requirements for missed approach with RNP less than 1.0.**- Normally, the aircraft must have at least the following equipment:
 - ✓ Dual GNSS sensors;
 - ✓ Dual FMS;
 - ✓ Dual air data systems;
 - ✓ Dual AP; and
 - ✓ A single inertial reference unit (IRU).

3. **Recommendation**

3.1 Taking into consideration the differences identified between the RNP approaches, which require different approval criteria, it is recommended that the survey form on the PBN capacity shows both types of approaches, the RNP APCH and the RNP AR APCH.

4. **Suggested action**

4.1 The meeting is invited to:

- a) Take note of the information provided in this working paper;
- b) Consider the recommendation expressed in the Paragraph 3 of this working paper which is presented in Appendix A.

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Instrucciones para el llenado de la Tabla / Instructions for filling out the Table

- Explotador/Operator:** Complete el nombre del explotador, por ejemplo: CONDOR/Complete the name of the operator, for example: CONDOR.
- Aeronave/Aircraft:** En este punto se encuentran dos columnas que permiten identificar a la aeronave/At this point there are two columns which permit aircraft identification:
 - ▶ en la columna titulada "Matrícula", indique la matrícula de la aeronave/In column titled "License", please indicate aircraft license..
 - ▶ en la columna titulada "Modelo", indique el modelo de la aeronave, por ejemplo B767-300./In column titled "Model" indicate the aircraft model, for example B767/300.
 - Capacidad RNAV:** marque con una X, según corresponda, si la aeronave dispone de capacidades RNAV con los valores de confinamiento señalados en las columnas, de acuerdo a lo indicado en el Airplane Flight Manual (AFM) o en el Pilot Operating Handbook (POH). Esta solo debe reflejar la capacidad demostrada de la aeronave y no necesariamente el que tenga una autorización operacional de su Administración./Mark with an X, as required, if aircraft has RNAV capabilities with confinement values shown in columns, as per indicated in Airplane Flight Manual (AFM) or in the Pilot Operating Handbook (POH). This should reflect only the aircraft demonstrated capacity and not necessarily the one having operational clearance of its administration.
- RNAV Capacity:** Notas/Notes:
 - ▶ Si el AFM indica la capacidad RNP10, esta debe considerarse como válida en la opción RNAV 10./If AFM indicates RNP10 capacity, it should be considered as valid in option RNAV/10.
 - ▶ Si el AFM indica la capacidad B-NAV, esta debe considerarse como válida en la opción RNAV 5./If AFM indicates B-NAV capacity, it should be considered as valid in option RNAV 5.
- Capacidad RNP:** marque con una X, según corresponda, si la aeronave dispone de capacidades RNP con los valores señalados en las columnas, de acuerdo a lo indicado en el Airplane Flight Manual (AFM) o en el Pilot Operating Handbook (POH). Esta solo debe reflejar la capacidad demostrada de la aeronave y no necesariamente el que tenga una autorización operacional de su Administración.
 - Baro-VNAV:** marque con una X, según corresponda, si la aeronave dispone de capacidad Baro-VNAV, de acuerdo a lo indicado en el Airplane Flight Manual (AFM) o en el Pilot Operating Handbook (POH). Esta solo debe reflejar la capacidad demostrada de la aeronave y no necesariamente el que tenga una autorización operacional de su Administración. /Mark with an X if aircraft has BARO-VNAV capacity, as indicated in the Airplane Flight Manual (AFM) or in the Pilot Operating Handbook (POH). I should only reflect capacity demonstrated of the aircraft and not necessarily the one having an operational clearance by its administration.
 - Sensores de Navegación/ Navigation sensors:** marque con una X, según corresponda, los sensores de navegación con que dispone la aeronave./Mark with an X, as required, the navigation sensors of the aircraft.
 - GPS Primario/Primary GPS:** marque con una X, según corresponda, si la aeronave dispone de equipos DPS single o dual, certificados como equipos de navegación primarios y que cumplen con las TSO C129A; C145A o C146
 - Integridad/Integrity:** marque con una X, según corresponda, si el sistema GNSS de la aeronave dispone de medios para asegurar la integridad de los señales de navegación GPS (Vigilancia autónoma de la integridad en el receptor (RAIM) y de detección de fallas o exclusion (FDE). / Mark with an X, as required, if GNSS aircraft System has means to ensure integrity of GPS navigation signals. (Receptor Autonomous surveillance of receptor integrity (RAIM) and detection of failures or exclusion (FDE).
 - FMS:** marque con una X, según corresponda, en caso la aeronave disponga de FMS o No./Mark with an X as required, in case the aircraft has FMS or No.

A continuación se describe un ejemplo de cómo llenar la tabla/Here follows an example of how to fill in the table:

1. Explotador : CONDOR
Operator:

2. Aeronave Aircraft		3. Capacidad RNAV / RNAV Capacity (AFM)						4. Capacidad RNP/ RNP Capacity (AFM)				5. Baro-VNAV (AFM)	6. Sensores de Navegación / Navigation Sensors						8. Integridad Integrity		9. FMS		
													VOR/DME	DME/DME	INS o IRS	7. GPS Primario/Primary TSO C129A/C145A/C146A		RAIM o AAIM					
Matrícula Register	Modelo Model	10 (RNP 10)	5	2	1	P-RNAV	4	2	1	APRCH				Single	Dual								
BB-MEL	DHC-8-200	-	x	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	-	x		
AA-165	A321-232	x	x	x	x	x	x	x	x	x	x	x	x	-	x	x	x	x	-	-	x		